Mr. Walter F. Willcox

John H. Miller

June 1. 1888

# OUTLINES OF COSMIC PHILOSOPHY.

*VOLUME I.*

# OUTLINES OF COSMIC PHILOSOPHY
## BASED ON THE DOCTRINE OF EVOLUTION, WITH CRITICISMS ON THE POSITIVE PHILOSOPHY

BY

JOHN FISKE

*L'univers, pour qui saurait l'embrasser d'un seul point de vue, ne serait, s'il est permis de le dire, qu'un fait unique et une grande vérité.* — D'ALEMBERT

*Καὶ τὸ ὅλον τοῦτο διὰ ταῦτα Κόσμον καλοῦσιν, οὐκ ἀκοσμίαν.* — PLATO

IN TWO VOLUMES

VOLUME I.

NINTH EDITION

BOSTON AND NEW YORK
HOUGHTON, MIFFLIN AND COMPANY
The Riverside Press, Cambridge
1887

To

GEORGE LITCH ROBERTS,

IN REMEMBRANCE OF

THE GOLDEN DAYS WHEN, WITH GENEROUS AIMS IN COMMON,

WE STUDIED PHILOSOPHY TOGETHER,

AND IN CONSECRATION OF THE LIFELONG FRIENDSHIP

WHICH HAS BEEN

AN UNFAILING SOURCE OF JOY AND STRENGTH

TO US BOTH,

I Dedicate this Book.

# PREFACE.

The present work is based upon lectures given at Harvard University in the autumn of 1869 and spring of 1871, and afterwards repeated, wholly or in part, in Boston, New York, Milwaukee, and London.

At the outset these lectures were designed to include only a criticism of the Positive Philosophy, and I had no intention of publishing them in anything like the shape in which they were originally written. It was only when—at the suggestion of Dr. E. L. Youmans, and through the kindness of Mr. Marble — the lectures were reported in the New York *World*, and seemed to meet the wants of a large number of readers, that I decided upon publishing them, and upon so enlarging the course as to make it include a somewhat complete outline-sketch of the new philosophy based on the Doctrine of Evolution. In coming to this decision, I was at first but carrying out a project, formed several years earlier, of writing a series of essays illustrative of Mr. Spencer's philosophy. But the work has grown on my hands, and in its present shape is something more than it was originally intended to be. For while it does not, as a whole, lay any claim to the character of an original work, it has nevertheless come to contain so much new matter, both critical and constructive, that it can no longer be regarded as a mere reproduction of Mr. Spencer's thoughts. The new constructive matter begins with the eighteenth chapter of Part II., which (together with its predecessor) was written in 1866, and which leads to conclusions concerning the relations of a social community to its environment, such as will doubtless be much more thoroughly and satisfactorily presented by Mr. Spencer in his forthcoming work on Sociology. The following chapters on the Genesis of Man, along with considerable expository and critical matter, contain a theory as to the part taken by the prolongation of human infancy in originating social evolution, which is entirely new in all its features. With the exception of numerous minor suggestions scattered here and there throughout the work, these are the only parts of the constructive matter which I can claim as my own; though it may be interesting to observe that the chapter on the Evolution of Mind was mostly written, and the theory contained therein entirely worked out, before the publication of Part V. of the second edition of Mr. Spencer's "Principles of Psychology."

The new critical matter is mostly to be found in the chapters relating to religion, and in the discussion of the various points of antagonism between the philosophy here expounded and the Positive Philosophy. Though the real work of demolishing the undue pretensions of Positivism had already been well accomplished by Mr. Spencer, most of whose arguments are here reproduced, it seemed to me that much might still be done toward clearing up the dire confusion with which in the popular mind this subject is surrounded; and this I realized the more keenly as it was some time before I had succeeded in getting clear of the confusion myself. Accordingly on every proper occasion the opinions characteristic of the Positive Philosophy are cited and criticized; and on every occasion they are proved to be utterly irreconcilable with the opinions characteristic of Mr. Spencer's philosophy and adopted in this work. The extravagant claim of Positivism to stand for the whole of attainable scientific philosophy is, I trust, finally disposed of when it is shown that a system of philosophy has been constructed, out of purely scientific materials and by the employment of scientific methods, which opposes a direct negative to every one of the theorems of which Positivism is made up.

The phrase "Cosmic Philosophy,"[1] by which I have proposed to designate this system, has not found favour with Mr. Spencer, who urges the objection that all philosophies whatever may, in a certain sense, be termed "Cosmic," inasmuch as all philosophies have had for their subject-matter the explanation of the universe or Cosmos. In this objection there would no doubt be much weight if any alternative term could be proposed which should be ideally perfect. As it is, I cannot but think that the alternative term suggested by Mr. Spencer is open to a parallel objection of at least equal weight. To the phrase "Synthetic Philosophy," as a distinctive epithet, it is an obvious objection that the systems of Aquinas and Hegel, and other systems built up by the aid of metaphysical methods, might claim to be entitled "Synthetic" as well as the system of Mr. Spencer. So far as this goes, therefore, there would seem to be but little room for choice between the two terms. But when we look more carefully into the matter, the case is seen to be otherwise. For not only does the term "Cosmic," when regard is had to the implications of its primitive meaning, convey all that is conveyed by the term "Synthetic," but it further hits the precise point by which Mr. Spencer's philosophy is fundamentally distinguished alike from Positivism and from all ontological systems. For the

[1] This term was first suggested to me by Mr. Manton Marble, some four years ago, though at that time neither he nor I could have appreciated it at its full value.

term "Cosmos" *connotes* the orderly succession of phenomena quite as forcibly as it *denotes* the totality of phenomena; and with anything absolute or ontological, with anything save the "Mundus" or orderly world of phenomena, it has nothing whatever to do. So that, strictly speaking, no theological system of philosophy can be called "Cosmic" while admitting miracle, special-creation, or any other denial of the persistence of force, into its scheme of things; and no ontological system can be called "Cosmic" while professing to deal with existence not included within the phenomenal world. The term, therefore, forcibly distinguishes Mr. Spencer's philosophy from systems which have contained ontological or theological assumptions. And, on the other hand, as is shown below, in the ninth and tenth chapters of Part I., it distinguishes it from Positivism; since the latter philosophy consists of an Organon of scientific methods ancillary to the construction of a system of Sociology, and has always implicitly denied the practical possibility of such a unified doctrine of the Cosmos as Mr. Spencer has succeeded in making. In short, Mr. Spencer's philosophy is not merely a Synthesis, but it is a "Cosmic Synthesis;" that is, it is a system which, without making appeal to data that are ontological or to agencies that are extra-cosmic, brings all known truths concerning the coexistence and succession of phenomena into relation with one another as the corollaries of a single primordial truth, which is alleged of the omnipresent Existence (ignored by Positivism) whereof the phenomenal world is the multiform manifestation. To no other system yet devised can this definition be strictly applied; and of no other system can we strictly say that it is "Cosmic."

Along with these specific advantages, as characterizing Mr. Spencer's system of philosophy, the term "Cosmic" and its congeners possess sundry general advantages, as characterizing that entire method or habit of philosophizing of which Mr. Spencer's system is in our day the most conspicuous product. In this sense I have contrasted "Cosmism" with "Anthropomorphism" as two different fashions or habits of interpreting phenomena, the contrast being more specifically carried out, in the concluding chapters of this work, between "Cosmic Theism" and "Anthropomorphic Theism." For further justification and elucidation I must refer to the body of the work, where these terms are introduced and defended as occasion requires. In view of all that is thus from time to time brought forward, I think it will appear that a more strikingly characteristic terminology would be hard to find, or one in which so great a number of kindred distinctions are expressed by so small a group of terms.

But while it is incumbent on me to declare Mr. Spencer's disapproval of this terminology, it should be added that, so far as I know, the question at issue between us is purely a question of nomenclature, and is not implicated with any essential differences of opinion as to the character and position of the system of thought to which the nomenclature is applied. Without implying that Mr. Spencer should be held responsible for everything that is maintained in the following pages, I believe that the system here expounded is essentially his, and that such supplementary illustrations as I have added are quite in harmony with the fundamental principles which he has laid down.

Much of the new critical matter thus appears to be concerned with questions of nomenclature and other questions which hinge, directly or remotely, upon these. And considering how important are the "counters of thought," and how often they are made to do duty as its hard money, it will perhaps be felt that too much emphasis has not been laid upon these points. The rest of the new critical matter, as before hinted, occurs in Part III., where it is attempted to show that the hostility between Science and Religion, about which so much is talked and written, is purely a chimera of the imagination. Putting the case into other language, it may be said that to assert a radical hostility between our Knowledge and our Aspirations, is to postulate such a fundamental viciousness in the constitution of things as the evolutionist, at least, is in no wise bound to acknowledge. The real conflict, as I have sought to show, is not between Knowledge and Aspiration, but between the less-imperfect knowledge of any given age and the more-imperfect knowledge of the age which has gone before. For it lies in the nature of progress that the heresy or new-knowledge of yesterday is the orthodoxy or old-knowledge of to-day, and that to those who have learned to associate their aspirations with the old knowledge it may well seem impossible that like aspirations should be associated with the new. But the experience of many ages of speculative revolution has shown that while Knowledge grows and old beliefs fall away and creed succeeds to creed, nevertheless that Faith which makes the innermost essence of religion is indestructible. Were it not for the steadfast conviction that this is so, what could sustain us in dealing with questions so mighty and so awful that one is sometimes fain to shrink from facing their full import, lest the mind be overwhelmed and forever paralyzed by the sense of its nothingness?

VENICE, *April* 16, 1874.

# CONTENTS.

## PART I.

## *PROLEGOMENA.*

CHAPTER I.

PAGE

THE RELATIVITY OF KNOWLEDGE . . . . . . . . . . . . 3

CHAPTER II.

THE SCOPE OF PHILOSOPHY . . . . . . . . . . . . . . 22

CHAPTER III.

THE TEST OF TRUTH . . . . . . . . . . . . . . . . . 45

CHAPTER IV.

PHENOMENON AND NOUMENON . . . . . . . . . . . . . 72

CHAPTER V.

THE SUBJECTIVE AND OBJECTIVE METHODS . . . . . . . . . 97

CHAPTER VI.

CAUSATION . . . . . . . . . . . . . . . . . . . . 146

CHAPTER VII.

PAGE
ANTHROPOMORPHISM AND COSMISM . . . . . . . . . . . . . . 162

CHAPTER VIII.

ORGANIZATION OF THE SCIENCES . . . . . . . . . . . . . . 188

CHAPTER IX.

PHILOSOPHY AS AN ORGANON . . . . . . . . . . . . . . 234

CHAPTER X.

COSMISM AND POSITIVISM . . . . . . . . . . . . . . 255

CHAPTER XI.

THE QUESTION STATED . . . . . . . . . . . . . . 265

## PART II.

## *SYNTHESIS.*

CHAPTER I.

MATTER, MOTION, AND FORCE . . . . . . . . . . . . . . 279

CHAPTER II.

RHYTHM . . . . . . . . . . . . . . 297

CHAPTER III.

EVOLUTION AND DISSOLUTION . . . . . . . . . . . . . . 314

CHAPTER IV.

THE LAW OF EVOLUTION . . . . . . . . . . . . . . 326

## CONTENTS.

### CHAPTER V.

PAGE
PLANETARY EVOLUTION . . . . . . . . . . . . . . . . 356

### CHAPTER VI.

THE EVOLUTION OF THE EARTH . . . . . . . . . . . . . 398

### CHAPTER VII.

THE SOURCES OF TERRESTRIAL ENERGY . . . . . . . . . . 406

### CHAPTER VIII.

THE BEGINNINGS OF LIFE . . . . . . . . . . . . . . 418

### CHAPTER IX.

SPECIAL-CREATION *or* DERIVATION? . . . . . . . . . . . 438

# PART I.

## *PROLEGOMENA.*

"Quare speculatio illa Parmenidis et Platonis, quamvis in illis nuda fuerit speculatio, excelluit tamen : Omnia per scalam quandam ad unitatem ascendere."—BACON.

"Das schönste Gluck des denkenden Menschen ist das Erforschliche erforscht zu haben, und das Unerforschliche ruhig zu verehren."—GOETHE.

## CHAPTER I.

### THE RELATIVITY OF KNOWLEDGE.

When we contemplate any portion of matter, such as a cubical block of metal or wood, it appears to our senses to be perfectly solid. No breach of continuity appearing anywhere among the aggregate of visual and tactual perceptions which its presence awakens in us, we are unable to restrain ourselves from imagining that its parts are everywhere in actual contact with each other. Nevertheless, a brief analysis of this opinion will suffice to show that it cannot be maintained without landing us in manifest absurdity. We need only recollect that every portion of matter is compressible,—may be made to occupy less space than before,—and that compressibility, implying the closer approach of the constituent particles of the body, is utterly out of the question, unless empty space exists between these particles. We are therefore obliged to admit that the molecules of which perceptible matter is composed, are not in immediate contact, but are separated from each other by enveloping tracts of unoccupied space.

But no sooner do we seek refuge in this assumption than we are again met by difficulties no less insuperable than the one just noticed. The form of our experience of all objects compels us to postulate that cohesive or gravitative forces are continually urging the particles of matter toward closer union, while disruptive or thermal forces are continually urging them toward wider separation. In view of this, suppose we regard matter, with Newton, as consisting of solid atoms, never absolutely contiguous to each other, but always attracting or repelling each other with a force varying inversely as the squares of the distances between the atoms.

What then is the constitution of these hypothetical atoms? Are they divisible, or indivisible? And if divisible, what shall we say of the parts into which they are divided? Can these be again divided, and so on for ever? If we say yes, we are speedily brought face to face with a double inconceivability. For, on the one hand, by no effort of thought can we conceive the infinite divisibility of a particle of matter. Mentally to represent any such division would require infinite time. On the other hand, granting that the particles which we have postulated as the component units of matter are divisible, we have not escaped the difficulty which confronted us at the outset. For each of these particles, if divisible, is a piece of matter just like the block of metal or wood with which we set out,—only smaller in size. The particles of these particles cannot, as we have seen, be in direct contact; then they must each be composed of several particles not in contact, but exerting on each other attractive and repulsive forces that vary inversely with the squares of their distances apart; and again we have to ask of these particles, Are they divisible or indivisible? and so on, for ever.

Such are the difficulties into which we are led if we assume that the atoms of which matter is composed are divisible. Let us now assume that (as their name implies) they are indivisible. And this is, no doubt, the assumption which is most congruous with the experiences of the chemist. Yet we shall find that an absolutely indivisible atom is quite inconceivable by human intelligence. Every such atom, if it exists, must have an upper side and an under side, a right side and a left side, or if spherical, must have a periphery that is conceived as covering some assignable area. Now by no effort of our intelligence can we imagine sides so close together that no plane of cleavage can pass between them; nor can we imagine a sphere so minute that it cannot be conceived as divisible into hemispheres; nor can we imagine a cohesive tenacity so great that it might not be overcome by some still greater disruptive force such as we can equally well imagine.

When we contemplate the mode in which one particle of matter acts upon the adjacent particles by attractive and repulsive forces, we find ourselves equally puzzled. As Mr. Spencer well observes, "matter cannot be conceived except as manifesting forces of attraction and repulsion. Body is distinguished in our consciousness from space, by its opposition to our muscular energies; and this opposition we feel under the twofold form of a cohesion that hinders our efforts to rend, and a resistance that hinders our efforts to compress. Without resistance there can be merely empty extension. Without cohesion there can be no resistance. Thus we are obliged to think of all objects as made up of parts that attract and repel each other; since this is the form of our experience of all objects. Nevertheless, however verbally intelligible may be the proposition that pressure and tension everywhere co-exist, yet we cannot truly represent to ourselves one ultimate unit of matter as drawing another while resisting it."

Nor is this the last of the difficulties which encumber our hypothesis of mutually-attracting and repelling particles separated by tracts of unoccupied space. For this hypothesis requires us to conceive one particle acting upon another through a space that is utterly empty; and we can in no wise conceive any such action? How shall we escape this difficulty? Shall we assume that the intervals between the particles are filled by a fluid of excessive tenuity, like the so-called imponderable ether to which physicists are in the habit of appealing? We shall soon find that the problem is only shifted. As soon as we inquire into the constitution of this hypothetical intermolecular fluid, we are no better off than before. For we have no alternative but to regard this fluid as itself an extremely rarefied form of matter: since it does not perceptibly affect the weights of bodies, we must regard it as possessed of a density that is almost infinitesimal,—that is, its constituent particles must be separated from each other by regions of empty space that are even greater in proportion to the size of the particles than are the spaces that intervene between the molecules of that relatively dense form of matter which we call ponderable. With regard to the ether, as before with regard to the matter, we have to ask, How can its particles act upon each other through space that is utterly empty? How can a thing act where it is not? How can motion be transmitted, in the absence of any medium of transmission? and to this question no answer ever has been, or ever can be devised.

Thus, whichever horn of the dilemma we take hold of, we are sure to be gored by it. Whether we assume on the one hand that matter is absolutely solid, or on the other hand that it is absolutely porous, we are alike brought face to face with questions which we can neither solve nor elude.

If now we turn from the inquiry into the ultimate constitution of that matter out of which the universe is formed, and inquire what was the origin of this universe, we shall find ourselves plunged into still darker regions of incomprehensibility. Respecting the origin of the universe three verbally-intelligible hypotheses may be formed. We may say, with the Atheist, that the universe is self-existing; or, with the Pantheist, that it is self-created; or, with the Theist, that it is created by an external agency. Let us examine these three propositions severally, not with the view of determining which of them is true, but with the view of determining whether any one of them is comprehensible.

Philosophically speaking, then, we must admit that, whether or not the Atheistic hypothesis of a self-existent universe be assumed as true, it is at any rate incomprehensible. We can form no genuine conception answering to the phrase "self-existence." For by self-existence we clearly mean existence which is not dependent on any extraneous existence; which is not conditioned or determined by any cause. The assertion of self-existence is the denial of causation; and when we deny causation we also deny commencement, inasmuch as to suppose that there was a time when the existence commenced is to admit that the commencement of the existence was determined by some cause; which is contrary to our hypothesis. In order, therefore, to conceive self-existence, we must conceive existence throughout infinite past time; and to do this manifestly exceeds our powers.

The Pantheistic hypothesis of self-creation is similarly incomprehensible. Self-creation, equally with self-existence, excludes the idea of any extraneous determining cause. If the passage of the universe from non-existence, or from potential existence, into actual existence, were determined by any extrinsic cause, manifestly it would not be self-created. Nevertheless, to suppose that existence, after remaining for a long period in one form, suddenly took on of its own accord another form, requires us to imagine a change without any cause,—which is impossible.

Of the Theistic hypothesis, also, we must perforce admit, that, whatever may be urged in favour of our accepting it as a help to our thinking, it is no less incomprehensible than the other two. In the first place, the creation of something out of nothing is a process which we are wholly incapable of representing in thought. In the second place, granting that the universe was made from nothing by an external agency, we are compelled to ask whence came this agency? We must either admit for it another extrinsic cause still further back, and so on for ever; or we must regard it as self-existing, in which case we are again brought face to face with the same ultimate difficulties which attend upon the atheistic hypothesis. For, as Mr. F. W. Newman observes, "a God uncaused and existing from eternity is quite as incomprehensible as a world uncaused and existing from eternity." Which conception is the more likely to be true, I repeat, does not for the present concern us. What we have now to notice is merely the incapacity of the human intellect for realizing either the one or the other. In spite of their great apparent diversity, the atheistic, pantheistic and theistic hypotheses all contain, in one form or another, the same fundamental assumption. Sooner or later they all require us to conceive some form of existence which has had neither cause nor beginning; and to do this is impossible.

Nevertheless, in spite of the impossibility of conceiving it, this fundamental assumption is one which we are compelled to adopt, unless we abstain from theorizing altogether upon the subject. For it is impossible to enter into any inquiry concerning causation without eventually postulating some First Cause. We are obliged to do so from sheer inability to follow out in thought an infinite series of causes.

Assuming, then, the existence of a First Cause, let us inquire for a moment into its nature. The First Cause must be *infinite.* For if we regard it as finite, we regard it as bounded or limited, and are thus compelled to think of a region beyond its limits, which region is uncaused. And if we admit this, we virtually abandon the doctrine of causation altogether. We therefore have no alternative but to regard the First Cause as infinite.

We are no less irresistibly compelled to regard the First Cause as independent. For if it be dependent, that on which it depends must be the First Cause. The First Cause can therefore have no necessary relation to any other form of Being; since if the presence of any other form of existence is necessary to its completeness, it is partially dependent upon such other form of existence, and cannot be the First Cause. Thus the First Cause, besides being infinite must be complete in itself, existing independently of all relations,—that is, it must be *absolute.*

To such conclusions, following the most refined metaphysical philosophy of the day, are we easily led. By the very limitations of our faculties, we are compelled to think of a First Cause of all phenomena; and we are compelled to think of it as both infinite and absolute.

Nevertheless, it will not be difficult to show that such a conclusion is utterly illusive; and that in joining together the three conceptions of Cause, of Infinite, and of Absolute, we have woven for ourselves a network of contradictions more formidable, more disheartening than any that we have yet been required to contemplate.

For, in the first place, that which is a cause cannot at the same time be absolute. For the definition of the Absolute is that which exists out of all relations; whereas a cause not only sustains some definite relation to its effect, but it exists, as a cause, only by virtue of such relation. Suppress the effect, and the cause has ceased to be a cause. The phrase "Absolute Cause," therefore, which is equivalent to "non-relative Cause," is like the phrase "circular triangle." The two words stand for conceptions which cannot be made to unite. "We attempt," says Mr. Mansel, "to escape from this apparent contradiction by introducing the idea of succession in time. The Absolute exists first by itself, and afterwards becomes a Cause. But here we are checked by the third conception, that of the Infinite. How can the Infinite become that which it was not from the first? If causation is a possible mode of existence, that which exists without causing is not infinite; that which becomes a cause has passed beyond its former limits."

But supposing all these obstacles overcome, so that we might frame a valid conception of a Cause which is also

Absolute and Infinite: have we then explained the origin of the universe? Have we advanced one step toward explaining how the Absolute can be the source of the Relative, or how the Infinite can give rise to the Finite? To continue with Mr. Mansel, "if the condition of causal activity is a higher state than that of quiescence, the Absolute . . . . . has passed from a condition of comparative imperfection to one of comparative perfection; and therefore was not originally perfect. If the state of activity is an inferior state to that of quiescence, the Absolute, in becoming a cause, has lost its original perfection. There remains only the supposition that the two states are equal, and the act of creation one of complete indifference. But this supposition annihilates the unity of the Absolute."

These examples must suffice for my present purpose, which is to illustrate and enforce, at the beginning of our investigation, the doctrine of the Relativity of Knowledge. They constitute but a small, though an important, portion of the mass of evidence which might be alleged. The history of metaphysical speculation—if we leave out of the account all psychological inquiry, which is a very different matter—is little else than the history of a series of persistent attempts to frame tenable hypotheses concerning the origin of the universe, the nature of its First Cause, and the ultimate constitution of the matter which it contains. History teaches us that all such attempts have failed; and furnishes us with ample inductive or empirical evidence that the human mind is incapable of attaining satisfactory conclusions concerning the First Cause, the Infinite, the Absolute, or the intimate nature of things. We accordingly say for brevity's sake that we cannot know the Absolute, but only the Relative; and in saying so, we implicitly assert two practical conclusions:—

*First*, we cannot know things as they exist independently of our intelligence, but only as they exist in relation to our intelligence.

*Secondly*, the possibilities of thought are not identical or coextensive with the possibilities of things. A proposition is not necessarily true because we can clearly conceive its terms; nor is a proposition necessarily untrue because it contains terms which are to us inconceivable.[1]

This great truth, which I have thus illustrated by a few empirical examples, must now be illustrated deductively. It must be shown how the impossibility of knowing or conceiving anything save the Relative results from the very constitution of our minds—from the very manner in which our thinking takes place. And this may be shown by several distinct lines of argument.

In the first place, all *knowing* is *classifying*. What do we mean when we say that any given phenomenon has been explained? We mean simply that it has been ranked along with similar phenomena which, having previously been grouped together, are said to be understood. For example, in walking out some clear November evening, your attention is arrested by a bright, but suddenly vanishing track of light across the sky, which you recognize as the appearance of a "falling-star." In doubt, perhaps, as to the true *explanation* of this phenomenon, you appeal to some astronomer, who tells you that a zone of planetary matter encircles the sun; that the course of this zone, lying near the course of the earth's orbit and not being concentric with it, must intersect it at sundry points; and that when, at certain seasons of the

[1] Hence, as will appear more fully hereafter, we have no criterion of absolute or objective truth. But it will also appear that, in the realm of phenomena, with which alone are we practically concerned in forming the conclusions which make up our common-sense, our science, and our philosophy, we do possess a valid criterion of relative truth in the test of inconceivability. A proposition concerning phenomena, which contains an inconceivable term, is *ipso facto* a proposition without a basis in our experience of phenomena, and is accordingly inadmissible. But a proposition concerning noumena, which contains an inconceivable term, is entirely out of relation with experience, since we have no experience of noumena; and we have accordingly no means of judging whether it is true or not. This is what is meant by the statement in the text.

year, such intersection occurs, the gravitative force of the earth pulls down some of the fragments constituting this zone, and unites them with its own mass. That is to say, he ranks the phenomenon which is to be explained along with the more familiar phenomena of heavy bodies which circulate about a vast central mass, and which, by their gravitative power, draw to themselves whatsoever comes within a certain distance of them. And this you feel to be a perfectly satisfactory *explanation.* Similarly, when Newton explained the manner in which these planets are kept revolving about the sun, he had recourse to the hypotheses of gravitation and tangential momentum. By the former he classified the unknown force which keeps the moon from flying away from the earth along with the familiar force which causes unsupported terrestrial bodies to fall toward the earth's centre. By the latter he classified the unknown force which keeps the moon from tumbling down upon the earth along with the familiar force which urges a stone whirled at a sling's-end to fly away upon a tangent. In each case he did nothing but classify phenomena which had hitherto remained unclassified; and this was rightly felt to be a triumphant explanation; although the ultimate *nature* of the forces operating remained as mysterious as before.

If now we proceed still further, and ask in what sense the force which makes apples fall can be regarded as known by us, —we can only reply, it is not known in itself, but only in its manifestations throughout a number of phenomena which can be classed together, and any one of which is said to be known when it is perceived to be like its congeners previously presented to our consciousness. We know a thing only when we classify it in thought with some other thing; only when we see it to be like some other thing. In short, *cognition* is possible only through *recognition.* In the infant, we may see that there are no cognitions until the feelings awakened by the presence of external objects have been arranged into groups, so that when certain sensations occur they may be recognized as belonging to such or such a group. And in the adult, as our examples already cited suffice to show us, an object is known just in so far as the impressions which it produces upon us can be assimilated to previous impressions. Or if this is still not perfectly clear, a brief citation from Mr. Spencer will make it clear. "An animal hitherto *unknown*, though not referable to any established species or genus, is yet *recognized* as belonging to one of the larger divisions—mammals, birds, reptiles, or fishes; or should it be so anomalous that its alliance with any of these is not determinable, it may yet be classed as vertebrate or invertebrate; or if it be one of those organisms of which it is doubtful whether the animal or vegetal characteristics predominate, it is still known as a living body; even should it be questioned whether it is organic, it remains beyond question that it is a material object, and it is cognized by being recognized as such. Whence it is manifest that a thing is perfectly known only when it is in all respects like certain things previously observed; that in proportion to the number of respects in which it is unlike them, is the extent to which it is unknown; and that hence when it has absolutely no attribute in common with anything else, it must be absolutely beyond the bounds of knowledge." [1]

The bearing of all this upon our main thesis is so obvious as to need but the briefest mention. Manifestly the First Cause, the Infinite, the Absolute, can be known only by being classified. We can conceive it at all only by conceiving it as of such or such kind—as like this or that which we have already conceived. There can be but one First Cause; and this, being uncaused, cannot be classified with any of the multiplicity of things which are caused. The Infinite, again, cannot be conceived as like the Finite; nor can it be classed with any other Infinite, since two Infinites, by mutu-

[1] *First Principles*, p. 80.

ally limiting each other, would become finite, and thus destroy each other. And likewise the Absolute cannot, without a manifest contradiction in terms, be regarded as sustaining a relation of likeness to anything else. For by the definition of the Absolute, it is that which exists out of all relation. Thus by the very constitution of the knowing process, we are for ever debarred from knowing anything save that which is caused, which is finite, and which is relative.

If we start from another point of view, and contemplate the process of knowing under a different but correlative aspect, we shall be driven to the same inevitable conclusion. In order to know anything, we must not only recognize it as *like* certain other things, but we must recognize it also as *different* from certain other things. We cognize whiteness, not only by its likeness to the whiteness previously presented to our consciousness, but also by its difference from redness, blueness, or blackness. If all things were white we should have no knowledge of whiteness. To constitute an act of cognition, distinction is as necessary as assimilation. As Mr. Mansel has ably shown, "The very conception of consciousness necessarily implies distinction between one object and another. To be conscious, we must be conscious of something; and that something can only be known as that which it is, by being distinguished from that which it is not. But distinction is necessarily limitation; for if one object is to be distinguished from another, it must possess some form of existence which the other has not, or it must not possess some form which the other has." Accordingly, if we are to conceive the First Cause at all, we must conceive it as limited; in which case it cannot be infinite: and we must conceive it as different from other objects of cognition; in which case it is relative, and cannot be absolute.

Finally, we cannot know the Absolute, because all knowledge is possible only in the form of a relation. There must be a Subject which cognizes and an Object which is cognized.

The subject is a subject only in so far as it cognizes the object, and the object is an object only in so far as it is cognized by the subject. Eliminate either one, and the act of cognition is destroyed. Hence the Absolute, if it is to be known, must be an object existing in relation to a subject; it cannot be known in itself, but only in its relations to the knowing mind; that is, it can be known only by ceasing to be the Absolute.

Thus by whatever road we travel, we are brought up at last against the same impassable barrier. By no power of conception or subtilty of reasoning can we break down or undermine the eternal wall which divides us from the knowledge of things in themselves. If we attempt to frame any hypothesis concerning their nature, origin, or modes of action, we find ourselves speedily checkmated by alternative impossibilities. And if, resting in despair after all our efforts have proved fruitless, we inquire why this is so, we find that from the very organisation of our minds, we can frame no cognition into which there do not enter the elements of *likeness, difference*, and *relation;* so that the Absolute, which presents none of these elements, is utterly and for ever unknowable.

What is the meaning of this conclusion, when translated from the metaphysical language in which I have expressed it, into language that is somewhat more familiar? It means not only that the Deity, in so far as absolute and infinite, is inscrutable by us, and that every hypothesis of ours concerning its nature and attributes, can serve only to illustrate our mental impotence; but it also means much more than this. It means that the Universe in itself is likewise inscrutable; that the vast synthesis of forces without us, which in manifold contact with us is from infancy till the close of life continually arousing us to perceptive activity can never be known by us as it exists objectively, but only as it affects our consciousness. It means, in short, that we cannot transcend the organically-imposed limits of our own intelligence. We do not know matter, but we know a group of coexistent states of consciousness which we call the perceptions of resistance, extension and colour, sound or odour. We do not know motion, but we know the group of sequent states of consciousness produced by minute alterations in the muscles of the eyes, or perhaps of the tactual organs, in the act of attending to the moving object. Nor do we know force, but we know continual modifications of our consciousness which we are compelled to regard as the manifestations of force. Nor do we even know consciousness absolutely and in itself: we know only states of consciousness in their relations of coexistence and sequence, likeness and unlikeness.

Although this is one of the best-established conclusions of modern psychology, it is still a conclusion which requires considerable effort to understand in all its implications; and for this reason, as well as on account of its supreme importance, it will be desirable briefly to illustrate it from yet another point of view. We shall be assisted in comprehending the general truth by a set of considerations which show that, although our internal feelings or states of consciousness are constantly produced by external agents, yet we have no warrant whatever for assuming that the external agent in any way resembles the internal feeling. For instance, although the feelings of redness and resistance are caused by agencies without us, we have no warrant for assuming that the external cause of redness resembles the feeling of redness, or that the external cause of resistance resembles the feeling of resistance. In other words, we know redness and resistance only as phenomena, only as modifications of consciousness; and although we are compelled to refer these phenomena to causes which exist externally and which would still exist if there were no minds to be affected by them, we are nevertheless unable to assert that these external causes—

the real things corresponding to the phenomena of redness and resistance,—are in any wise like the phenomena.

To any one accustomed to examine these matters, such a conclusion seems much like a truism; amounting, indeed, merely to the statement that we cannot get outside of our own minds. Nevertheless, it will perhaps not be considered a needless prolonging of the argument if I add a few concrete illustrations.

In the first place, it is extremely probable that the kinds of feeling awakened by the same external cause are not quite alike in any two species of animals. When Wieniawski plays his violin in the Music Hall, his human auditors have awakened in them those feelings which we designate as the consciousness of musical sound; but if he were to play his violin over a tank containing a number of those mollusks which have no organs of hearing, the feelings awakened in them would be wholly different. They would feel a sort of nervous shiver or jar, like that which our fingers experience when holding a vibrating tuning-fork; and they would very likely all shrink into their shells. In like manner, the same external agents which arouse well-defined tactual feelings in us, can arouse in a lobster, whose feet and claws are encased in a bony shell, nothing but that vague sort of tactual feeling of which we are conscious when we poke things with a stick.

In the second place, it is extremely probable that the subjective feelings awakened by the same external cause are not quite alike in any two individuals of the same species. In those persons who are troubled with Daltonism, or colour-blindness, luminous undulations so different as those of red and green awaken feelings that are identical. On the other hand, "aerial pulses recurring at the rate of 16 per second, are perceived by some as separate pulses; but by some they are perceived as a tone of very low pitch. Similarly at the other extreme. Vibrations exceeding 30,000 per second, are inaudible through certain ears; while through ears that are, as we may suppose, of somewhat unlike structures, these rapid vibrations are known as an excessively acute sound."[1]

And thirdly, let us notice a set of facts which are so familiar to us that we overlook their significance. "A whiff of ammonia, coming in contact with the eyes, produces a smart; getting into the nostrils, excites the consciousness we describe as an intolerably strong odour; being condensed on the tongue, generates an acrid taste; while ammonia, applied in solution to a tender part of the skin, makes it burn, as we say." "A vibrating tuning-fork, touched with the fingers, gives them a sense of jar; held between the teeth, it gives this same sense to the parts in which they are embedded, while by communication through the bones of the skull, its vibrations so affect the auditory apparatus as to awaken a consciousness of sound—a consciousness which alone results, if the tuning-fork does not touch the body." "The sun's rays falling on the hand cause a sensation of heat, but no sensation of light; and falling on the retina cause a sensation of light, but no sensation of heat." Note that in all these cases the same external cause produces widely-different phenomena according to the different avenues through which it affects our consciousness. The external cause cannot resemble *all* these phenomena, its effects; we do not know which it resembles; what warrant have we, then, for assuming that it resembles any one of them?

To these examples, culled from Mr. Spencer's "Principles of Psychology," let me add another, which, though less obvious, is equally striking. The compound solar ray, when analysed, is found to consist of three sets of relatively simple

[1] "It is probable that the antennæ of insects respond to stimuli which leave us insensible, while stimuli which affect us leave them undisturbed. . . . We know there are a thousand tremours in the air which beat upon our ears unheard; and if more sensitive organs are capable of hearing some of these, there must be tremours which no organism can feel."—Lewes, *Problems of Life and Mind*, vol. i. p. 255.

rays. First, we have the visible rays of medium refrangibility, ranging from red to violet, and sometimes called the Newtonic rays. Beyond the violet, in the outlying portions of the spectrum, lie the so-called Ritteric rays, of greatest refrangibility, which are not visible, but are manifested through their actinic or chemical effects ; these are the rays with which we photograph. Beyond the red, at the other end of the spectrum, lie the so-called Herschellic rays, of least refrangibility, which also are not visible, but are manifested through their thermal effects. These invisible rays differ from the visible physically, only by their different periods of motion or wave-lengths, in which respect the visible rays differ also among themselves, as is indicated by their different colours. Bearing this in mind, let us contemplate the remarkable series of effects produced in our consciousness by gradually increasing rates of vibration in the particles of matter. Vibrations occurring less frequently than 16 times in a second, produce in us the consciousness of a succession of noises. Vibrations which occur oftener than 16 times, but less often than 30,000 times, in a second, produce in us the consciousness of musical notes, which are higher and higher in pitch as the vibrations are more rapid. Vibrations occurring oftener than 30,000 times, but less often than 458,000,000,000,000 times, in a second, do not affect us through the ears, but the more rapid ones affect us through the nerves of the skin, and produce in us the consciousness of heat. Vibrations occurring at the rate of 458,000,000,000,000 in a second, affect us through the eyes, and produce in us the consciousness of red light ; at the rate of 577,000,000,000,000 in a second, they produce in us the consciousness of green light ; at the rate of 727,000,000,000,000 in a second, they produce in us the consciousness of violet light. At still higher rates than this, they cease to affect us through the eyes, and indeed produce in us no definite state of consciousness at all, though they may be remotely concerned in keeping up that vague organic feeling of *bien-être* or pleasurable existence, which is in part due to the indirect effects of the Ritteric portion of the solar rays upon the chemical actions going on throughout our bodies. Here, then, we have one and the same external agency—vibrations among particles of matter—producing in us feelings so different as those of sound, heat, and light. And when it is asked which of these feelings the external cause resembles, is not the answer sufficiently obvious that in all probability it resembles none of them, and is comparable with none of them? May we not clearly see that what appears to us as a series of widely-distinguished phenomena may after all correspond to a set of objective realities between which there is no such wide distinction? And do we need any more evidence to convince us that *phenomena*—by which I mean the effects produced upon our consciousness by unknown external agencies—are all that we can compare and classify, and are therefore all that we can *know?*

Perhaps, however, it may still appear that, in the illustration just cited, we have assumed a knowledge of the external cause, to a certain extent. In asserting that the feelings of sound, of heat, and of light, are alike caused by vibrations among particles of matter, we may perhaps seem to imply that we do know these vibrations, and we may be suspected of formulating the various states of consciousness in question, in terms of the objective reality.[1] But a moment's reflection will convince us that this is not the case. After the illustration with which this chapter opened, it is hardly necessary to say that the knowledge of a vibration of particles as an objective reality, is utterly unattainable by us. We reach the concep-

[1] In his paper on "Hibernicisms in Philosophy" (*Contemporary Review*, January 1872, p. 147), the Duke of Argyll himself commits the following exquisite bull:—"We now know what light is 'in itself'—*that is to say*, we know the nature and constitution of it, not in terms of the sensation it gives to us, but *in terms of a wholly different order of conception*." The italics are mine.

tion of a vibration of particles only by inference from the states of consciousness aroused in us by visible or palpable vibrations. Certain subjective experiences of undulatory movement, as when a pebble is dropped into still water, or as when a string is made fast by one end and twitched at the other, beget in us the conception of vibration; and this conception we transfer in thought to those molecules and atoms of which we believe material bodies to be constituted. So far, then, from interpreting our feelings of light, heat, and sound, in terms of the objective reality, we have merely been interpreting certain states of consciousness in terms of other states. Or, to put the same statement into different language, we have regarded the phenomena of sound, heat, light, and actinism, as adequately *explained*, when we have classified them with certain other phenomena of vibratory motion. We merely affirm that a cause which, under a given set of conditions, will produce certain states of consciousness within us, will, under a different set of conditions, produce certain other states of consciousness. Concerning the *nature* of the cause, whether we call it vibration, or are content to go on calling it heat or light, we affirm nothing, and can know nothing.

## CHAPTER II.

### THE SCOPE OF PHILOSOPHY.

In setting forth and illustrating the conclusion that we can only know that which is caused, which is finite, and which is relative, we have virtually rejected as impracticable and useless a large number of the inquiries with which philosophy has habitually concerned itself. Both by practical examples, and by a series of mutually-harmonious deductions from the mode in which our intelligence works, as revealed to us by psychologic analysis, it has been shown that we are for ever debarred from any knowledge of the Absolute, the Infinite, or the Uncaused; that we can affirm nothing whatever concerning the ultimate nature of Matter or Mind; and that all our knowledge consists in the classification of states of consciousness produced in us by unknown external agencies. Nevertheless from the earliest times, philosophy has busied itself in attempts to reach tenable conclusions respecting the nature and attributes of the absolute and infinite First Cause; it has ever tacitly assumed that the ultimate nature of Matter as well as of Mind constitutes a legitimate subject of investigation; and that from the knowledge formed by the organized experience of recurring states of consciousness, we can in some mysterious way rise to a so-called higher grade of knowledge, in which realities no less than phenomena may become the object of thought. The earliest philosophic speculations of the Greeks dealt almost exclusively with the origin of the Universe, and the nature of its *πρώτη ἀρχή* or First Cause, or with just such theories of the ultimate constitution of matter as we saw in the previous chapter leading us to alternative impossibilities of thought. In the *Parmenides* and *Sophistes* of Plato we may find, presented with unrivalled acuteness, though rendered dreary by endless verbal quibbling, many of the same inquiries concerning the nature of the Absolute which we have been led to condemn as impracticable. Is the Absolute One or Many? Is the One Finite or is it Infinite? And these inquiries, in the first-named dialogue, lead up to the same sort of startling paradoxes which we have already signalized as the inevitable outcome of speculation upon such subjects. In his first argument, Parmenides demonstrates that the One is neither in itself nor in anything else, neither at rest nor in motion, neither the same with itself nor different from itself. In his second argument, he demonstrates that the One is both in itself and in other things, both at rest and in motion, both the same with itself and different from itself. That is, while his first demonstration denies both of two opposite and mutually destructive propositions, his second affirms them both.

There is no doubt that after Plato's time the Greeks felt, though they did not distinctly comprehend, the futility of such inquiries. By the successors of Plato, philosophy was brought into a state of more or less complete scepticism as to the possibility of any trustworthy knowledge whatever. "We assert nothing,—not even that we assert nothing," was the extravagant dictum of one of the later schools of Greek philosophy. And finally philosophy ceased from its independent inquiries, being merged in theology by Proklos, who, hopeless of attaining absolute knowledge by any exertion of the intellectual powers, was driven to assert the existence of a divine supernatural light, by which the soul being irradiated might thus alone catch glimpses of the external reality.

The later career of philosophy furnishes us with the same kind of illustrations as its earlier stages. After its revival in the Middle Ages, philosophy again proceeded to treat of the same kind of questions as those which had baffled the keenest and most subtle intellects of antiquity. In the eager scrutiny of the nature of things, the scholastic metaphysicians thought little of ascertaining the relations of coexistence and succession among phenomena. Their disputes were about quiddities, entities, occult virtues, and efficient causes. Nor in modern times do we find that philosophy has been at all disposed to recognize the limits which we have here found ourselves obliged to impose upon it. On the other hand, modern metaphysicians have generally proceeded upon the tacit assumption that the possibilities of thought are co-extensive with the possibilities of things, and that any train of propositions which can be clearly conceived and logically concatenated, must be true. It was upon this assumption that Malebranche founded his theory of Occasional Causes, and Leibnitz his doctrine of Pre-established Harmony. It was upon this that Spinoza constructed a theory of the universe, the most gigantic in conception, and the most unflinchingly logical in execution, of all metaphysical theories. Upon this also, rests the Kantian doctrine of Necessary Truths; and upon this most treacherous foundation has been more recently built the lofty but unstable structure of Hegelism.

Since Bacon's time, it is true, there have appeared—for the most part in England—a number of eminent thinkers, who, asserting the relativity of human knowledge, and avowedly renouncing the attempt to solve the mysteries of objective existence, have occupied themselves with psychological problems. To these thinkers—Hobbes, Locke, Berkeley, Hume Hartley, Brown, James Mill, Hamilton, and Mansel—a large proportion of the conceptions now current and dominant in philosophy are due. Nevertheless, as we shall see by and bye, even these philosophers have not always made their practice coincide with their preaching. Though they have asserted, and were indeed the first to assert clearly, the doctrine of the Relativity of Knowledge, they did not always carry in their minds its full import; and were betrayed not unfrequently into making statements which imply that the possibilities of thought are coextensive with the possibilities of things.

It may appear, therefore, that in our rigorous denial of the possibility of absolute knowledge, we shall not have the countenance of the most eminent philosophers who have lived. It may be thought that their works will testify against us. We shall perhaps be accused of regarding the noble labours of so many generations of gifted thinkers as a mere impracticable striving after that which no striving can procure,—as the crying of infants for the moon, or as the groping of the alchemist for the philosopher's stone. And it will no doubt be indignantly asked, by what title do we pretend to philosophize at all? In rejecting as for ever insoluble so large a proportion of the inquiries with which philosophy has until lately busied itself, do we not virtually declare philosophy to be antiquated and useless?

To neither of these accusations can we consent to plead guilty. In replying to the first, it may indeed be granted that those who rigorously maintain that Absolute Being is unknowable, will naturally regard the labours of Plato and Spinoza, and Hegel, as a vain seeking after that which cannot be found. But it does not follow that such seeking is to be condemned as worthless. It was only after many attempts had failed, that we could learn that the failure was due not to curable but to incurable weakness.[1] It was only after all

[1] "The study of the master-minds of the human race is almost equally instructive in what they achieved and in what they failed to achieve; and speculations which are far from solving the riddle of existence have their use in teaching us why it is insoluble."—Mansel, *Metaphysics*, p. 23.

possible devices of attack had proved fruitless, that we could realize the truth that we had been assailing an inexpugnable fortress. Had we not been taught by many a bitter defeat, we should never have learned the real extent of our powers. Had not metaphysics reared many an apparently-solid edifice, which fell into unshapely ruin at the first rude blast of criticism, psychology might never have troubled itself to examine the soil upon which all such edifices must be founded. Nay, it may be truly said, that though philosophers have failed in what they have consciously attempted, they have nevertheless unwittingly achieved a result greater than any of those which they have sought to obtain. By their long career of heroic defeat, they have furnished us with a concrete demonstration, almost superfluously ample, of the relativity of human knowledge. By exhausting all possible hypotheses respecting the objective reality, they have made it apparent that no tenable hypothesis can be framed. In the very failure to obtain one kind of truth, they have demonstrated for us a truth of another sort,—a truth which must for the future lie at the bottom of all successful research. Is not this then a worthy result? Remembering how steep and laborious is the path of human progress, is not the definite establishment of one fundamental truth like the Relativity of Knowledge an achievement worthy to crown the efforts of twenty-five centuries? Shall it take two or three generations of weary experimenting to bring into existence some incarnation of material force like the steam-engine, and may it not take a hundred generations for the human mind to ascertain for itself experimentally what it can know and what it cannot know?

To the second accusation we may return a straightforward denial. In asserting the impossibility of acquiring absolute knowledge, or of ascertaining aught respecting the nature of mind and matter and the origin of the universe, we do not dethrone Philosophy; we do not condemn it as antiquated and useless; we do not leave it nothing with which to occupy itself. On the contrary, we do but enthrone it more securely than ever; and we leave it in possession of quite as goodly a realm as that in which our metaphysical predecessors would fain have established it.

In order to show how this can be true, it will be necessary for me to define, somewhat at length, the Scope of Philosophy, —to indicate the nature of the inquiries with which philosophy may profitably be concerned. And since philosophy may be correctly though rudely defined as a kind of knowledge, it will first be desirable to indicate the essential distinctions between the different orders of knowledge,—to show in what respect philosophy differs from science, and in what respect both philosophy and science differ from that comparatively imperfect kind of knowledge which is the common property of uncultivated minds.

Though science has been often vaguely supposed to be something generically distinct from ordinary knowledge, yet the briefest consideration will suffice to show us that this is not the case, but that scientific knowledge is only a higher development of the common information of average minds. In the first place we shall see that the process gone through, and the results attained by the process, are not generically different in scientific and in ordinary thinking.

All knowledge whatever is, as we have seen, a classification of experiences. No intelligence or intelligent action is possible unless the distinctions among surrounding phenomena be detected and registered in the mind. Even the lowest animal can only preserve its existence on condition that different external agencies shall affect it in different ways,—that different sets of circumstances shall cause it to put forth correspondingly different sets of correlated actions. Perhaps it is sufficient for these simply constituted creatures to distinguish between the organic and inorganic matters present in their environment, or between light and darkness, as we see a freshwater polyp seek the darkest corner of a vessel exposed to direct sunlight. Among the higher animals possessed of developed organs of sense and of relatively-complex nervous systems, the classifying process is carried to much greater completeness. Along with a tolerably wide set of distinctions between various classes of plants and weaker animals that are more or less useful and desirable as food, and between various classes of inorganic phenomena that are serviceable or dangerous, and of stronger animals that are to be dreaded as enemies,—there is also a clear perception of the distinct modes of action involved in the acquisition of desired objects, and in the escape from menacing dangers; forming an aggregate of knowledge which implies quite an extensive comparison and classification of experiences. Besides all this, there is a set of special distinctions between special orders of phenomena, between the various kinds and degrees of sound, odour and temperature, which in some cases exceed in discriminative accuracy any of the corresponding empirical distinctions which the human mind is able to recognize. And in the dog, who has from time immemorial been the friend and servant of man, there is superadded to all this a rudimentary moral classification of actions as praiseworthy or blameworthy, as is seen, for instance, in his guilty attitude when detected in committing a raid upon some neighbouring sheepfold. Coming lastly to man, but little illustration will be needed to show that his acquisition of knowledge is in like manner the progressive establishment of distinctions. The supremely important knowledge which we acquire during early infancy consists in the mental grouping of objects according to their various properties; in the gradual recognition of distinctions between hardness and softness, sweetness and acidity, rigidity and elasticity, roughness and smoothness, humidity and dryness, roundness and angularity,—between various shades and intensities of temperature, of sound, and of colour,—between matter which resists, and space which does not resist. Later in life, our intellectual education consists still in the progressive grouping of experiences. That portion of it which we habitually designate as practical consists in the more and more complete distribution of ends (as variously desirable or undesirable), and of the relations between ends and means; while the education which we more especially characterize as theoretical consists in the more and more complete distribution of our acquired notions into well-defined groups, mathematical, physical, or physiological, legal or ethical. He who has so distinctly classified his experiences of the connections between certain courses of action and the resulting feelings of happiness or misery that he can usually decide upon any line of conduct with a clear perception of its consequences, is what we call a prudent man, or a man of sound judgment. While, as Mr. Mill has somewhere observed, that man is most completely educated who has the clearest sense of the connotations of the words which he uses; who understands most thoroughly and feels most keenly the fine shades of distinction between allied groups of conceptions, which less perfectly educated persons are liable to confuse together and to reason about as if they constituted but a single group. Such a man possesses what Sainte-Beuve calls the sense of *nuance;* an intellectual characteristic which is, perhaps, nowhere more habitually exemplified than in the charming pages of that most consummate of critics.

And this leads me to observe—what indeed the whole of the above survey implies—that since knowledge is classification, the completeness of the classification varies with the degree of intelligence. Minds in a low stage of development can distinguish only between widely-contrasted phenomena. The classifications of which they are capable consist of but few groups, indefinite in their extent and incoherent in their materials; while the progressive increase of intelligence consists in the progressive establishment of sub-classes of phenomena, that are continually less and less widely contrasted, that are more and more accurately defined in their limits and more and more coherent in their materials. And the ultimate perfection of knowledge would be the recognition of all the distinctions which exist between phenomena, and the consequent establishment of classes whose members would be completely alike among themselves, while unlike the members of all other classes. Manifestly such knowledge would be, in the fullest sense of the term, scientific knowledge; which is thus seen to be merely a higher and more complex development not only of the knowledge of ordinary matters which we do not regard as scientific, but of the rudimentary knowledge possessed by infants, by savages, and by the lower animals. The dog or lion has no doubt established in his mind the distinction between the bright sky of day, illuminated by a single dazzling orb, and the pale sky of night, spangled with a multitude of twinkling points. The savage who in his nocturnal prowlings guides himself by the stars has rudely classified these objects in their relations of position. The shepherds of Mesopotamia and the agriculturists of Attika superadded the distinctions between stars which regularly traverse the same apparent paths and stars which pursue an erratic course; and in their classifications of stars according to their times of rising and setting we have an example of a rudely-scientific method of proceeding. Finally by the modern astronomer the heavenly bodies are minutely classified according to their mutual relations as suns, planets, or satellites; according to their visible magnitudes, or the angles which they subtend on the field of vision; according to their orbital courses, their angular velocities, their axial inclinations, their specific gravities, etc., wherever these have been ascertained; and lately in some few instances, according to their physical constitutions in so far as light has been thrown upon this point by spectrum-analysis. In like manner the lowest savage has noted the wide contrast between plants and animals; and in each of these great groups has furthermore made sub-classes comprising respectively those which are useful as food or as medicine for wounds, and those which are to be shunned as poisonous or otherwise dangerous. While, on the other hand, the scientific naturalist divides and subdivides until he acquires distinct conceptions of thousands of species of insects, and ranks trees in separate classes according to the myriad-fold shapes of their leaves, the spiral arrangement of their branches, the number of their cotyledons, or the mode of disposition of their woody fibre.

All this will appear in a still clearer light when we remember that the various processes which we habitually group together under the name of "reasoning" are all of them acts of classification. "The savage, having by experience discovered a relation between a certain object and a certain act, infers that the like relation will be found in future cases." . . . When in consequence of some of the properties of a body, we attribute to it all those properties in virtue of which it is referred to a particular class, the act is an act of *inference*. "The forming of a *generalization* is the putting together in one class all those cases which present like relations; while the drawing a *deduction* is essentially the perception that a particular case belongs to a certain class of cases previously generalized. So that, as classification is a grouping together of *like things*, reasoning is a grouping together of *like relations* among things. And while the perfection gradually achieved in classification consists in the formation of groups of *objects* which are completely alike, the perfection gradually achieved in reasoning consists in the formation of groups of *cases* which are completely alike."[1]

Since knowledge consists in classifying, it follows conversely that ignorance consists in inability to classify—in the failure to group together similar phenomena; and that

[1] Spencer's *Essays*, 1st series, p. 189.

error consists in wrongly classifying, in the grouping together of phenomena which are really distinct. When we say that a child is ignorant that nitric acid will burn, we mean that he has never ranked together the like cases of a finger immersed in nitric acid and a finger thrust against heated metal. When we say that the ancients were in ignorance concerning the force which keeps the planets in their orbits, we mean that they did not know what that force is like—that they had never grouped together the like cases of the earth attracting the moon and the earth attracting an apple. And when we say that they were in error in attributing the moon's motion to the volition of a presiding goddess, we mean that they grouped together the unlike cases of the motion of a heavenly body through the sky and the motion of a chariot driven by its charioteer along the ground. So when we say that we do not fully understand the coronal flames and other singular phenomena presented by the eclipsed sun, we mean that we have not yet entirely succeeded in grouping them with other phenomena of which we have heretofore had experience. And when we say that we cannot now or at any future time know the Absolute, we mean that there is not now and never can be, anything given in our experience with which we can classify it.

Having thus, at the risk of tediousness, shown in detail the essential identity of the processes involved in science and in ordinary knowledge, let us go on to enumerate the respects in which science differs from ordinary knowledge, bearing in mind as we proceed that such distinctions can only hold good to a certain extent. They are not differences of kind, but differences of degree.

In the first place we may say that science differs from ordinary knowledge in its power of *quantitative prevision*—of assigning beforehand the precise amount of effect which will be produced by a given amount of cause. Mere prevision is not, as is sometimes assumed, peculiar to science. We frequently hear it assigned, as the distinguishing characteristic of scientific knowledge, that it enables us to predict; and the infallibility of the predictions of science is commonly alluded to as among its greatest triumphs. Nevertheless, when the schoolboy throws a stone into the air, he can predict its fall as certainly as the astronomer can predict the recurrence of an eclipse; but his prevision, though certain, is rude and indefinite. The servant-girl has no need of chemistry to teach her that, when the match is applied, the fire will burn and smoke ascend the chimney; but she is far from being able to predict the proportional weights of oxygen and carbon which will unite, the volume of the gases which are to be given off, or the intensity of the radiation which is to warm the room. Her prevision is qualitative, not quantitative in its character: she can foresee the kind of effect, but not its amount.

A moment's reflection, however, will show us that this statement, as it stands, does not convey the whole truth. It is not quite true that our servant-girl can foresee the kind of effect. She can foresee a part of it: she can tell us that the wood will burn, but she will know nothing about the union of oxygen with carbon; and will thus illustrate the superiority of science even with respect to qualitative prevision. On the other hand, she can, after a rude fashion, foresee the amount of effect which will follow her proceedings; since she can, if intelligent, estimate the amount of fuel which will be required to produce a comfortable warmth. So the savage can estimate the amount of tension which he must impart to his bow in order to send his arrow to the requisite distance. Thus we see that, even with respect to quantitative prevision, science can be distinguished from ordinary knowledge only by the superior accuracy and greater extent to which it carries such prevision. Just this same difference of degree between science and ordinary knowledge constitutes also the chief difference between the more developed and the less developed sciences. The sciences which have arrived at the highest perfection are those which have carried quantitative prevision to the farthest extent. Between astronomy, which can foretell the precise moment at which a solar eclipse will begin a hundred thousand years hence, and meteorology, which cannot surely foretell from week to week the state of the weather, there is an almost immeasurable difference in scientific completeness. The chemist can predict the exact quantity of effect which will be produced by mingling a new substance with any given compound, the properties of which have been studied; while the physiologist cannot surely predict the exact amount of effect which will be produced by a drug that is introduced into the organism; and we accordingly consider chemistry a much more advanced science than physiology. And lastly, let us note that the date which we habitually assign for the commencement of any science is the date at which its previsions began to assume a definitely quantitative character. Dynamics is said to have become a science when Galileo determined the increment of velocity of falling bodies. Chemistry became a science when Lavoisier, De Morveau, and Dalton discovered the exact proportions in which the most important chemical combinations take place. No science of heat was possible until the invention of the thermometer enabled men to measure the degrees of temperature. There was no science of optics until it had been ascertained that the sines of the angles of incidence and reflection or refraction bear to each other a constant ratio. And with Mr. Joule's discovery that a certain number of degrees of heat is equivalent to a certain amount of mechanical motion, there becomes possible a science of thermodynamics which shall express by a single set of formulas the activities of forces hitherto treated as generically different.

The second difference of degree between science and ordinary knowledge consists in the greater *remoteness* of the relations of likeness and unlikeness which science detects and classifies. The child who, when an orange is presented to him, infers that on sucking it he shall experience a pleasant taste; the savage who, finding the half-eaten carcass of a sheep, concludes that a lion has been in the neighbourhood; and Leverrier, who, noticing that the observed motions of Uranus do not coincide with its motions as predicted, suspects the existence of a still remoter planet which disturbs it—go, all of them, through what is essentially the same process. The child has mentally grouped together the attributes of an orange; and when certain members of the group—as the shape and colour are afterwards presented to his consciousness, there occurs a mental representation of the remaining member—the agreeable taste. The savage, from direct or hearsay experience, has grouped together many cases of the eating of sheep by lions, and from the presence of a certain number of the customary phenomena, he classifies this new case with his already-formed group of cases; he assigns for the phenomenon a cause like the causes which he has known. The astronomer has linked indissolubly in his mind the phenomena of celestial motions with the phenomena of gravitative force, and has grouped many cases in which such force, brought to bear on a planet from different quarters, causes irregularities of motion. When, therefore, in the instance before him, after calculating the resultant of all the known forces in operation, he finds a residuum of motion which is unaccounted for, what does he do? He infers a like force as the cause of the residuary motion; and since there is no force without matter, he infers the existence of planetary matter other than the planetary matter already taken into account. He enlarges his group of cases in which planets perturb each other's courses, by admitting a hypothetical like case; and forthwith proceeds to calculate, from the amount of residuary motion, the size, distance, and orbit of the unknown planet.

Nothing can better illustrate the statement that scientific and ordinary knowledge are alike in kind, while different in degree. While the processes gone through by the child, the savage, and the astronomer, are manifestly the same, the immeasurable difference in the complication of the processes is equally manifest. While the inference in the one case is made instantaneously, so as almost to seem a part of the original perception, and while it admits of verification by a series of simple acts,—in the other case the inference is one which depends ultimately upon a long chain of dependent propositions, and the task of verifying it mathematically is exceedingly complicated and difficult. Thus to our statement, that science differs from ordinary knowledge in the *definiteness* of its previsions, we have to add that it differs also in the *remoteness* and *complexity* of its previsions.

Thirdly, science differs from ordinary knowledge in the greater *generality* of the relations which it classifies. And this continuous increase in generality is one of the most striking characteristics of advancing science. "From the *particular* case of the scales, the law of equilibrium of which was familiar to the earliest nations known, Archimedes advanced to the more *general* case of the unequal lever with unequal weights; the law of equilibrium of which includes that of the scales. By the help of Galileo's discovery concerning the composition of forces, D'Alembert established for the first time the equations of equilibrium of *any* system of forces applied to the different points of a solid body—equations which include all cases of levers and an infinity of cases besides." But, as Comte observes, "before hydrostatics could be comprehended under statics, it was necessary that the abstract theory of equilibrium should be made so general as to apply directly to fluids as well as solids. This was accomplished when Lagrange supplied, as the basis of the whole of mechanics, the single principle of virtual velocities," —or the principle that whenever weights balance each other, "the relation of one set of weights to their velocities equals the relation of the other set of velocities to their weights." So geometry in ancient times treated of questions relating to particular figures ; but since the great discovery of Descartes, it has dealt with questions relating to any figure whatever. So, in the progress of analytical mathematics, we have first arithmetic which "can express in one formula the value of a particular tangent to a particular curve;" and, at a later date, algebra, which can express in one formula the values of all possible tangents to a particular curve; and, at a still later date, the calculus, which can express in one formula the values of all possible tangents to all possible curves.[1]

Fourthly, science is continually more and more clearly differentiated from ordinary knowledge by the continually increasing *abstractness* of the relations which it classifies. This proposition is involved in the preceding one. For clearly the progress towards higher and higher generality is the progress towards a knowledge more and more independent of special circumstances—towards a study of the phenomena most completely disengaged from the incidents of particular cases.

And finally science differs from ordinary knowledge in its higher degree of *organization*—in the far greater extent to which it carries the process of coordinating groups of like orders of relations, and subordinating groups of higher and lower orders of relations. This we habitually regard as such a fundamental characteristic of scientific knowledge that we grant the title of science to some departments of inquiry which possess it, in spite of the fact that the only prevision which is possible in them is neither certain nor quantitative. Take, for instance, the case of biology. If quantitative prevision were the only thing which distinguishes science, we could hardly pretend to possess a science of life. Our power of prevision in biology is for the most part strictly limited to

[1] Spencer's *Essays*," 1st series, pp. 177—180.

the kind of effect which will follow a given cause; it is seldom, if ever, that we can foretell the precise amount of effect; and even with respect to the kind of effect, we cannot always be sure beforehand. Biology is not an exact science, like chemistry, and perhaps never will be. Nevertheless, biology is such an admirably organized body of truths; its classification, both of objects and of relations, has been carried to such a considerable extent; and the subordination, the mutual coherence and congruity of its verified propositions is so striking; that we should no more think of doubting its claims to be called a science than we should doubt the claims of astronomy.

Thus we may end our comparison of scientific with unscientific knowledge. Along with generic identity between the two, we have noted five points of gradational difference. We have seen that science and common knowledge alike consist in the classification of phenomena in their relations of coexistence and sequence. But we have also seen that science differs from common knowledge in its superior power of quantitative prevision, in the remoteness, the generality, and the abstractness of the relations which it classifies, and in the far more complete mutual subordination and coherence of its groups of notions. Such are the distinctive marks of science, regarded as a kind of knowledge. What now are the distinctive marks of philosophy, regarded as a kind of knowledge?

The metaphysical philosophers, whose conclusions, methods, and postulates were rejected in the preceding chapter, would have replied to the above question, that philosophy is generically different from science,—that philosophy is the knowledge of the absolute, the infinite, the uncaused, the objective reality, while science is the knowledge of the relative, the finite, the caused, the subjective state,—that while the latter can concern itself only with phenomena, or things as they exist in relation to the percipient mind, the former can aspire to the knowledge of noumena, or things as they exist independently and out of relation to the percipient mind. Such would have been their answer. But we have seen that no such knowledge of noumena is possible, that the very nature of the cognitive process precludes any such knowledge, and that, if philosophy is to be regarded as knowledge at all, it can have no such scope and function as metaphysicians have assigned to it. What scope is there left for philosophy? If, like science and common knowledge, it is nothing more than a classification of phenomena in their relations of coexistence and sequence, what is there left for it to do which science cannot do as well?

We reply that science can, after all, deal only with particular orders of phenomena. No matter how vast the generalities to which it can attain, it only proclaims truths which hold throughout certain entire classes of phenomena. It does not proclaim truths which hold throughout all classes of phenomena. Its widest truths are astronomic, or chemical, or biological truths; they are not Cosmic truths, in the fullest sense of that expression. For by science we mean merely the sciences,—the sum of knowledge obtained by systematic inquiries into the various departments of phenomena. Such knowledge is, after all, only an aggregate of parts, each of which is more or less completely organized in itself: it is not an organic whole, the parts of which are in their mutual relations coordinated with each other. Or, to put the same truth in another form:—The universe of phenomena is an organic whole, the parts of which are not really divisible, though we must needs separate them for convenience of study. We find it necessary to pursue separate lines of investigation for gravitative, or thermal, or chemical, or vital, or psychical, or social phenomena; but in reality these phenomena are ever intermingled and interactive. Let us, for example, arrive at the widest possible generalization respecting astronomic phenomena; we have still not constructed a body of doctrine concerning the universe, but only concerning a portion of it. It is only when the deepest truths respecting physical, chemical, vital, psychical, and social phenomena come to be regarded as corollaries of some universal truth—some truth common to all these orders of phenomena —that such a body of doctrine becomes possible.

Such a body of doctrine is what we call philosophy in distinction from science. While science studies the parts, philosophy studies the whole. While science, in its highest development, is an aggregate of general doctrines, philosophy, in its highest development, must be a Synthesis of all general doctrines into a universal doctrine. When Lagrange, by his magnificent application of the principle of virtual velocities to all orders of mechanical phenomena, fused into an organic whole the various branches of mechanics which had hitherto been studied separately, this was a scientific achievement of the highest order. When Grove and Helmholtz, by showing that the various modes of molar and molecular motion can be transformed into each other, furnished a common basis for the study of heat, light, electricity, and sensible motion, the result, though on the very verge of philosophy, still remained, on the whole, within the limits of science. But when the principle of virtual velocities and the principle of the correlation of forces were both shown to be corollaries of the principle of the persistence of force—were both shown to be necessitated by the axiom that no force is ever lost—then the result reached was a philosophical result. So when Von Baer discovered that the evolution of a living organism from the germ-cell is a progressive change from homogeneity of structure to heterogeneity of structure, he discovered a scientific truth. But when Herbert Spencer applied Von Baer's formula to the evolution of the solar system, of the earth, of the totality of life upon its surface, of society, of conscious intelligence, and the products of conscious intelligence, then he discovered a truth in philosophy,—a truth applicable not merely to one order of phenomena, but to all orders.

These illustrations, however, do not bring out distinctly enough the point which I am endeavouring to elucidate. The difference between philosophy and science, like the difference between science and common knowledge, is a difference in degree only. But the distinction is nevertheless a broad one, and as such is somewhat understated in the foregoing paragraph, because the examples there cited on the side of science are all taken from that transcendental region of science in which its problems begin to have implications almost as universal as the problems of philosophy. Thoroughly to estimate the character of the distinction, we shall do well to start somewhat further down, and note what the science is which is contained in text-books or in original monographs. Viewed from this stand-point, a science like biology, for example, has for its subject-matter questions concerning the changes undergone by starch or fibrine within the stomach, the distribution of cells and fibres in the tissue of the brain, the relations of blood-supply to the functional activity of any organ, the manner in which the optic nerve is made to respond diversely to rays of different refrangibility impinging upon the retina, or the growth of bone from sundry centres of ossification starting here and there in the primitive cartilage; or again such questions as concern the generic or ordinal relationships of barnacles, or bats, or elephants, the homologies between a bird's wing and a dog's fore-leg, the geographical distribution of butterflies, or ferns, or pine-trees, the typical structures of vertebrates or annulosa, or the kinships between fossil forms of the horse and pig. In these questions, and a thousand others like them, we see at once that we are in the special domain of biology, and that our reasonings belong unmistakably to science, and not to common knowledge on the one hand, or to philosophy on the other. If now, after mastering countless details of this sort, we go on to inquire into the cause of the bilateral symmetry of lobsters and centipedes, or of the spiral arrangement of leaves around a stem; if we seek to generalize the phenomena of heredity, or hybridity, or adaptation, or, if we endeavour, with Mr. Darwin, to determine the agency of natural selection in modifying the characteristics of species; we are still no doubt within the territory of science, but we have arrived at a region in which the inquiries take so wide a sweep, and the results have so immediate a bearing upon other inquiries outside of biology, that our study may seem to demand some especially descriptive name. Accordingly we find the phrase "transcendental biology" employed by French writers, and elsewhere we meet with the significant title "philosophical biology." Still more significantly Mr. Spencer, whose treatise on biology is occupied with researches of this high order, speaks of them as constituting a domain of "special philosophy." That is to say, just where this science has reached the widest *generality* consistent with its being called biology at all, it is characterized as a *special* kind of philosophy. But one more step is needed to reach the level of that philosophy which need not be qualified as special. If, pursuing the same line of advance, we proceed—as I shall hereafter do—with the aid of the most general principles of heredity, adaptation, and natural selection, to elucidate some comprehensive theory of life; and if we contemplate this theory of life, on the one hand, as dependent on certain universal laws of matter, motion, and force, and on the other hand, as furnishing a basis for sundry doctrines relating to intellectual, moral, and social phenomena; then we have clearly come into the domain of philosophy, strictly so called. And the result would have been the same had we started from astronomy, or physics, or any other science; save that nowhere else, perhaps, could the true character of the process have been so fully illustrated as in the case of biology—the great central science upon the theorems of which so closely depend the views which we must hold concerning ourselves and our relations to the universe about us.

That such transcendental inquiries as those last mentioned belong strictly to philosophy, and constitute the all-essential part of it, can be questioned by none save those who, with Hegel, would make philosophy synonymous with ontology. Upon these it is incumbent, if they would establish their position, to dispose of the facts and reasonings which have made the relativity of all knowledge the fundamental theorem of modern psychology. For us it may suffice to point out that the province of philosophy, as here defined, includes all such inquiries into cosmology, into psychology and ethics and religion, as philosophers have occupied themselves with in the past, excepting those only in which the necessary limitations of human thinking have been expressly or tacitly ignored. Far from dethroning philosophy, we are assigning to it a scope as wide as was recognized for it by the early Greeks; while in approaching its problems, we are enabled to profit by that physical investigation which Sokrates not unjustly stigmatized, in his own day, as hopelessly misleading, but which now, conducted upon sounder methods, is our surest guide to the knowledge of truth.

Thus is philosophy vindicated, and its function is seen to be as important as that of science. Rejecting, as we were compelled to do, the metaphysical assumption that philosophy is a kind of knowledge generically distinct from all other kinds, and asserting for it a common root with science and with ordinary knowledge, we have nevertheless seen that it differs from the two latter, much in the same way that the one of them differs from the other. Accurate quantitative prevision is, in the nature of things, confined to the most special of the special inquiries with which science is concerned. Limited as it is to individual cases occurring under general laws, it must be left on one side in enumerating the distinctive features of philosophy. But from what has been brought forward, it at once appears that philosophy differs from science in the greater generality, abstractness, and remoteness of the relations which it formulates, and also in its larger and more complex organization of general truths into a coherent system. Or, to sum up by a set of rough and general, though not severely accurate, contrasts (which, after all the foregoing explanation, we may safely do):—Common Knowledge expresses in a single formula a particular truth respecting a particular group of phenomena; Science expresses in a single formula a general truth respecting an entire order of phenomena; Philosophy expresses in a single formula a universal truth respecting the whole world of phenomena.

Philosophy, therefore, remains, as of old, the study of the Cosmos,—save that it is the study of phenomena not of noumena, of evolution not of creation, of laws not of purposes, of the How? not of the Why?

## CHAPTER III.

### THE TEST OF TRUTH.

HAVING now indicated the limits of human knowledge, and marked out the province of that most highly organized kind of knowledge called philosophy, it becomes us next to inquire what are the sources of knowledge, and what is its guaranty? What is the test of truth which our philosophy shall recognize as valid? And first, what is Truth?

Truth may be provisionally defined as the exact correspondence between the subjective order of our conceptions and the objective order of the relations among things. Now since by the very constitution of the knowing process we are debarred from knowing things in themselves, since our highest philosophy must for ever concern itself with phenomena and can never hope to deal with objective realities, the question arises, how can we ever ascertain the objective order of the relations among things? How can we compare this objective order with the subjective order of our conceptions? And without such comparison, how can we ever be certain that the two orders correspond? Can we then ever hope to possess an objective canon of truth? And if we cannot obtain any such canon, are we not irresistibly driven to Idealism or to Scepticism,—to the philosophy which denies the existence of any objective reality, or to the philosophy which denies that truth can be attained at all?

Such questions as these have arisen whenever in the long career of philosophic inquiry an approach has been made toward demonstrating the relativity of knowledge. They dictated the criticisms of Leibnitz upon Locke's doctrine that all knowledge is the result of experience. The Cartesians had postulated the existence of innate ideas; a postulate which was destroyed when Locke showed that there can be no ideas until the mind has come into contact with environing agencies. But to Locke's reassertion of the scholastic formula, *Nihil est in intellectu quod non prius in sensu*, Leibnitz added the important qualification, *nisi intellectus ipse*. Rejecting, equally with Locke, the Cartesian doctrine of innate ideas, recognizing fully that there can be no knowledge until the mind has been awakened into activity by the presence of objects to be cognized, Leibnitz nevertheless maintained that in each act of cognition there is an element furnished by the mind as well as an element furnished by the environment,—that the subject is not passive, but cooperates actively with the object. In all this, let us note, there is nothing that conflicts with the established doctrine of the relativity of knowledge. It will be remembered that in our first chapter the necessary cooperation of subject and object in every act of cognition was shown to be one of those very facts which enforce the conclusion that all knowledge is of the Relative. No competent psychologist would now subscribe to the Lockian opinion that previous to the reception of experiences the mind is like a blank sheet. Physiology has taught us better than that,—has taught us that mind is strictly correlated with a complex nervous system, which, according to minute peculiarities of organization, modifies the experiences resulting from its intercourse with environing agencies. We, therefore, recognize as fully as Leibnitz, that the subject actively cooperates with the object in each act of consciousness. And we insist that, *for that very reason*, our knowledge, being the product of subjective and objective factors, can never be regarded as a knowledge of the objective factor by itself. This is, indeed, the import of our illustration, above given, from the phenomena of vibratory motion. Since a homogeneous phenomenon, like the undulation of molecules, can produce in us such heterogeneous states of consciousness as the feelings of sound, heat, or colour, we argued that the constitution of the percipient mind must modify in every case the character of the phenomenon perceived; and that, *therefore*, the phenomenon cannot be regarded as like the external noumenon, its part-cause. What is this but saying, with Leibnitz, that the subject actively cooperates with the object in each act of conscious knowledge? The Leibnitzian criticism, therefore, only serves to bring out in a stronger light the doctrine that all knowledge is of the Relative. Though powerful against the hypothesis of Locke, it is powerless against the position held by modern psychology.

Such a result, however, was the farthest possible from Leibnitz's thoughts. Far from intending to re-enforce the doctrine of relativity as shadowed forth in the writings of the Lockian school, his object was to crush it at the start by showing that we can obtain a criterion of absolute or objective knowledge. And he accordingly gave to his statement an interpretation quite inconsistent with the doctrine of the relativity of knowledge as we are now obliged to hold it. He held that in many acts of cognition, the mind contributes an element of certainty which could never have been gained from experience, which could never have flowed from the intercourse of the mind with its environment; and that propositions obtained by such acts of cognition are Necessary Truths,—truths which are true of the objective order of things as well of the subjective order.

After Hume, by drawing out the Lockian doctrine to its extreme corollaries, had enunciated a set of conclusions which deny all that the doctrine of relativity explicitly denies, but which differ from the doctrine of relativity in ignoring what the latter implicitly asserts, the Leibnitzian theorem was again taken up by Kant, who made it his own by his manner of illustrating it, and whose arguments on this topic still carry conviction to the minds of many able metaphysicians. The immense importance of Kant's views makes it desirable for us to give them some farther consideration than is implied in merely stating them.

In the first place, it must be borne in mind that Kant maintained, no less stoutly, and perhaps no less consistently, than Hume, the doctrine of the relativity of all knowledge. As Mr. Lewes truly observes, "the great outcome of the *Kritik* was a demonstration of the vanity of ontological speculation." Kant would have repudiated Schelling and Hegel, as he did in fact openly repudiate the claims of Fichte to be considered his legitimate successor and expounder. It was Kant who first showed that every hypothesis which we can frame respecting the Absolute, the Infinite, the First Cause, or the ultimate essences of things, must inevitably commit us to alternative impossibilities of thought. It was Kant also who showed psychologically, from the necessary cooperation of subject and object in each act of cognition, that a knowledge of the pure object as unmodified by the subject is for ever impossible. Kant held that a phenomenon, inasmuch as it is an appearance, presupposes a noumenon—a thing *which appears*,—but this noumenon, which is a necessary postulate, is only a negation to us. It can never be positively known; it can only be known under the conditions of sense and understanding, *ergo*, as a phenomenon. "And accordingly," says Kant, "though the existence of an external world is a necessary postulate, its existence is only logically affirmed." Of its existence out of relation to our consciousness we can know nothing; and it consequently appears that 'we can never predicate of our knowledge that it has objective truth."[1] Even so, reiterates Kant, in the introduction to the *Kritik*, "to attempt to transcend the sphere of the subjective is vain and hopeless; nor is it wise to deplore that we are 'cabin'd, cribbed, confined' within that sphere from which we never can escape. As well might the bird, when feeling the resistance of the air, wish that it were *in vacuo*, thinking that there it might fly with perfect ease. Let us therefore content ourselves with our own kingdom, instead of crossing perilous seas in search of kingdoms inaccessible to man."

Up to this point we may regard Kant as equally with Hume the precursor of the modern philosophy of relativity. In the above conclusions there is little to which Hume would have objected. But when we come to examine the Test of Truth set up by the two great adversaries, the point of irreconcilable antagonism between them becomes apparent. Though conducted with a wider historic experience, and with more extensive psychologic resources, the combat was essentially the same which had been waged in the preceding epoch between Leibnitz and Locke. Hume had said: the sole criterion of truth is uniformity of experience; that to which human experience has invariably testified, we are compelled to accept as true; though it may not be true of the pure objective order of things, it is true for us,—true of the order of things as presented to our intelligence. Kant, on the other hand, distinguished between contingent and necessary truths; and asserted that while uniformity of experience is a sufficient criterion of contingent truth, it is not a trustworthy criterion of necessary truth. For experience, says Kant, can tell us that certain phenomena always occur in certain relations; but it cannot tell us that they *must* always so occur. Uniformity of experience cannot assure us that two and two must make four, or that two straight lines cannot enclose a space. We cannot conceive that these things should be otherwise, and we must therefore know them, independently of

[1] Lewes, *History of Philosophy*, 3rd edition, vol. ii. pp. 471, 472.

experience, and by the very constitution of our minds. This element of necessity and universality is the element which the mind furnishes in the duplex act of cognition.

This theorem contains two assertions, the one implicit, the other explicit. It asserts implicitly that the subjective element in cognition can be isolated from the objective element, at least so far as to be independently defined. It asserts explicitly that absolute uniformity of experience is inadequate to produce in us the belief in the necessity of any given relation among phenomena. With reference to the first of these assertions, I shall be content with citing the excellent remarks of Mr. Lewes:—

"There was an initial misconception in Kant's attempt to isolate the elements of an indissoluble act. It was one thing to assume that there are necessarily two coefficients in the function; another thing to assume that these could be isolated and studied apart. It was one thing to say, Here is an organism with its inherited structure, and aptitudes dependent on that structure, which must be considered as necessarily determining the forms in which it will be affected by external agencies, so that all experience will be a compound of subjective and objective conditions; another thing to say, Here is the pure *à priori* element in every experience, the form which the mind impresses on the matter given externally. The first was an almost inevitable conclusion; the second was a fiction. Psychology, if it can show us anything, can show the absolute impossibility of our discriminating the objective from the subjective elements. In the first place, the attempt would only be possible on the ground that we could, at any time and in any way, disengage Thought from its content; separate in Feeling the object as it is out of all relation to Sensibility, or the subject as pure subject. If we could do this in one instance, we should have a basis for the investigation. The chemist who has learned to detect the existence of an acid by its reactions in one case can by its reactions determine it in other cases. Having experience of an acid and an alkaloid, each apart from the other, he can separate them when finding them combined in a salt, or he can combine them when he finds them separate. His analysis and synthesis are possible, because he has elsewhere learned the nature of each element separately. But such analysis or synthesis is impossible with the objective and subjective elements of thought. Neither element is ever given alone. Pure thought and pure matter are unknown quantities, to be reached by no equation. The thought is necessarily and universally subject-object; matter is necessarily, and to us universally, object-subject. Thought is only called into existence under appropriate conditions; and in the objective stimulus, the object and subject are merged, as acid and base are merged in the salt. When I say that the sensation of light is a compound of objective vibrations and retinal susceptibility, I use language which is intelligible and serviceable for my purpose; but I must not imagine that the external object named vibration is the *Ding an sich*, the pure object out of all relation to sensibility; nor that the retinal susceptibility is pure subject, involving no vibratory element. Kant himself would assure me that the vibrations were as subjective as the susceptibility. Indeed, seeing that he denied altogether the possibility of a knowledge of pure object, the *Ding an sich*, it was a violent strain of logic to conclude that in thought he could separate this unknowable object from the subject knowing it."[1]

A violent strain of logic it was, no doubt. After proving, almost to superfluity, that subject and object are inseparably united in each act of cognition, and after triumphantly using this fact against the ontologists who pretended to a knowledge of the objective reality in itself, Kant turns around and tells us that we may after all acquire a knowledge of the subjective reality in itself! Though we can never determine what the

[1] Lewes, *History of Philosophy*, 3rd edition, vol. ii. p. 483.

E 2

environment furnishes in the duplex act of cognition, we can none the less determine exactly what the mind furnishes. By this wonderful inconsistency Kant opened the way for the later German idealism. Through this inlet entered Fichte, Schelling, and Hegel, with their swarm of mediæval conceptions, to perturb the onward course of philosophy. Kant might in vain protest. It was in vain that "he showed that the subjective *à priori* nature of these truths was peremptory proof of their objective falsehood; that they could not be truths of things, precisely because they were purely subjective conditions of thought." Once granted that the subject could of itself possess truth independent of experience, independent of intercourse with the objective environment, the inference was inevitable that the subject might impose its necessities upon the object, that the possibilities of thought might be rendered coextensive with the possibilities of things. Thus Kant, after laboriously barring out ontology at the main entrance, carelessly let it slip in at the back door. Thus, by admitting the possibility of arriving at truth otherwise than through experience, did he render nugatory his elaborate demonstration of the relativity of knowledge.[1]

This will appear still more evident as we proceed to examine the second portion of Kant's theorem,—the assertion that uniformity of experience, however long continued, can never afford us a sufficient guaranty of necessary truth. The argument here is at first sight a plausible one. Any particular experience can only tell us that a phenomenon, or a

[1] "The truth is," says Mr. Lewes, in his new work just now appearing, "Kant tried to hold contradictory positions. The whole drift of his polemic against the ontologists was to show that knowledge was limited, relative, and could not extend beyond the sphere of possible experience; but while thus cutting the ground from under the ontologists, he was also anxious to cut the ground from the sensationalists and sceptics, and therefore tried to prove that the Mind brought with it an *à priori* fund of knowledge."—*Problems of Life and Mind*, vol. i. p. 453. In the present chapter I quote by preference from Mr. Lewes, because it seems to me that he has illustrated both the strength and the weakness of Kant's position (and thus, virtually, of all modern metaphysics) more thoroughly and more clearly than any other critic.

relation between phenomena, is thus and thus; not that it *must* be thus and thus. And any number of experiences can only tell us that certain phenomena have hitherto always occurred in certain relations; not that they must always and for ever occur in the same relations. Or, as Dr. Brown phrases it, "Experience teaches us the past only, not the future." Let us take as an illustration, our belief that every event must universally and necessarily have a cause,—that no change can ever take place anywhere without an antecedent. This is what the Kantian would call a necessary truth. And the Kantian would say, All that experience can tell us is, that in an immense number of instances, and in an immense number of places, every event which has occurred has had a cause. It cannot tell us that in all future instances, and in all places throughout the universe every event must have a cause. To test such a belief by experience would require that our experience should be extended through infinite time and infinite space, which is, of course, impossible. Without such infinite and eternal experience we can never be sure but sooner or later, somewhere or other, some event may happen without a cause, and thus overturn our belief. Nevertheless, we have such a belief—an invariable and invincible belief. And since our limited experience cannot have produced such a belief, it must have arisen in us independently of experience; it must be necessitated by the very constitution of our thinking minds; and must therefore be universally and necessarily true. Such is the Kantian argument.

Upon all this it is an obvious comment, that, if the belief in the universality of causation is an inherent belief necessitated by the very constitution of our thinking minds, it is a belief which ought to be found wherever we find a thinking mind. It is hardly necessary to say that this is not the case. Children, savages, and other persons with undeveloped powers of reasoning believe in particular acts of causation, but not in the universality of causation—a conception which is too abstract for their crude intelligence to grasp. Nay, I have known educated people who maintained that there might be regions of the universe where the law does not hold, and who thought it hardly safe to deny that even on our own planet events might occasionally happen without any determining antecedent. Besides which, all those who still accept the doctrine of the so-called "Freedom of the Will," implicitly, and sometimes explicitly, assert that the entire class of phenomena known as volitions are not causally determined by groups of foregoing circumstances. The belief in the universality of causation was certainly not prevalent in antiquity, or in the Middle Ages: its comparative prevalence in modern times is due to that vast organization of experiences which we call physical science; and even at the present day it is not persistently held, except by those who are accustomed to scientific reasoning, or to the careful analysis of their own mental operations.

But this argument does not strike to the root of the matter, for though the belief in the universality of causation is not a universal belief, the belief in its necessity in each particular case is undoubtedly universal. And, as we have seen, the Kantian denies the power of accumulated experience to produce the belief that the future must inevitably resemble the past. He reminds us that for many ages it was supposed that all swans were white, until finally swans were discovered in Australia which were not white; and he asks what better warrant can uniformity of experience give us than it gave in this case. If after three thousand years a black swan turns up, must we not suppose it possible that in three thousand years more we may see a candle burn in an atmosphere of pure nitrogen?

In answering this query, let us begin by observing that in many cases, the mere accumulation of experiences is a matter of but little consequence. A child believes, after one experience, that fire will burn. When the chemist has shown, by a single experiment, that nitrogen will not support combustion, we believe that it will be just the same through all future time. If we withhold our assent, "it is from a doubt whether the one experiment was properly made, not whether if properly made it would be conclusive."[1] Here, then, as Mr. Mill says, "is a general law of nature inferred without hesitation from a single instance; a universal proposition from a singular one. Now mark another case, and contrast it with this. Not all the instances which have been observed since the beginning of the world, in support of the general proposition that all crows are black, would be deemed a sufficient presumption of the truth of the proposition, to outweigh the testimony of one unexceptionable witness who should affirm that in some region of the earth not fully explored, he had caught and examined a crow, and had found it to be grey."

What is the explanation of this difference? "Why is a single instance in some cases sufficient for a complete induction, while in others myriads of concurring instances, without a single exception known or presumed, go such a very little way towards establishing a universal proposition?" The solution is to be sought in the extreme complexity of the conditions in the one case as contrasted with their extreme simplicity in the other. The scientific thinker does not consider blackness a necessary attribute of a crow, because he believes that some inappreciable variation in the nutrition of the bird, by altering the deposit of pigment in the feathers, might give us a grey or a white crow instead of a black one. Or if we do not reflect upon the matter so carefully as this, we at least regard a crow as a very complex aggregate of conditions and results, and find no difficulty in imagining that some of the conditions varying might affect the sum-total of results. Or if this also be taken to imply too much conscious philosophizing in us, it is undeniable that our conception of a cro , as of any other vertebrate, is made up of a large number

[1] Mill, *System of Logic*, vol i. p. 352.

of conceptions, of which the conception of blackness is not the one upon which the specific identity of the sum-total depends. We have had experience of bay and of sorrel horses, of black and of white bears, of grey and of tortoise-shell cats; and, in accordance with such experience, we find it perfectly easy to regard any other animal as varying colour while retaining its specific identity. Our belief that all crows are black rests, therefore, upon purely negative evidence,—upon the absence of any experience of crows that are not black; and no amount of negative evidence can outweigh a single well-established item of positive evidence.

Quite otherwise would it be if our explorer should assert that he had discovered crows destitute of a vertebrate skeleton. We should reply, with confidence, that in the absence of such a skeleton the animal in question could not have been a crow. And the justice of the reply becomes apparent when we turn to the case of the nitrogen, where the conditions are so simple that we can keep them all in mind at once, and where we can imagine no variation which shall not at once alter the whole character of the case. We cannot imagine nitrogen supporting combustion, for as soon as it did so it would cease to be nitrogen. That A is A, is an identical proposition only when the attributes of A are constant. Now the incapacity to support combustion is one of the attributes by the possession of which nitrogen is nitrogen. And to say that nitrogen may at some future time support combustion, is to say that A will cease to be A, and become something else.

Now, why are we compelled to think thus? *Because we are incapable of transcending our experience.* Our experience of nitrogen is that it will not support combustion, and we are incapable of imagining it to be otherwise in contradiction to our experience. Our conception of nitrogen, formed by experience, is that of a substance which will not support combustion, and we cannot mentally sever the substance from its attribute without destroying the conception altogether. So we cannot conceive that a lump of iron will float in water. Why? Because our conception of iron, formed solely by experience, is that of a substance which sinks in water; and to imagine it otherwise is to suppress the conception, either of iron or of water, and to substitute some other conception in its place. We may try the experiment for ourselves. Try to imagine a lump of iron floating in water, and you will find that you cannot do it, without mentally endowing either the iron or the water with other attributes than those by virtue of which these substances are what they are, and thus your attempt destroys itself. Yet no Kantian would deny that your conception of iron or of water is wholly formed by experience. Your conception is just what experience has made it, and you cannot alter it without destroying it, simply because you cannot transcend experience.

Here then we come to a conclusion quite the reverse of that maintained by the Kantians. "The irresistible tendency we have to anticipate that the future course of events will resemble the past, is simply that we have experience *only* of the past, and as we cannot *transcend* our experience, we cannot conceive things really existing otherwise than as we have known them. The very fact of our being compelled to judge of the unknown by the known—of our irresistibly anticipating that the future course of events will resemble the past—of our incapacity to believe that the same effects should not follow from the same causes—this very fact is a triumphant proof of our having no ideas *not* acquired through experience. If we had *à priori* ideas, these, as independent of, and superior to, all experience, would enable us to judge the unknown according to some *other* standard than that of the known. But no other standard is possible for us."[1]

The same general considerations will apply to the truths of mathematics, which some Kantians regard as the necessary

[1] Lewes, *History of Philosophy*, 2nd edition, p. 668.

truths *par excellence*,—habitually speaking of them as if they were in some way truer than physical and chemical truths. Bearing in mind what was said a moment ago, it will be sufficient to observe that in mathematics we utter propositions with respect to certain particular relations alone, without regard to other conditions, and hence there is absolutely no room for contingency. Let me conclude this portion of the subject by a citation from Mr. Lewes :—"When we say that twice two is four, or that the internal angles of a triangle are equal to two right angles, we abstract the relations of Number and Form from all other conditions whatever, and our propositions are true, whether the objects counted and measured be hot or cold, large or small, heavy or light, red or blue. Inasmuch as the truths express the abstract relations only, no change in the other conditions can affect these relations; and truths must always remain undisturbed until a change take place in their terms. Alter the number *two*, or the figure *triangle*, by an infinitesimal degree, and the truth is thereby altered. When we say that bodies expand by heat, the proposition is a concrete one, including the variable conditions; but although these variable conditions prevent our saying that all bodies will under all conditions be always and for evermore expanded by heat, the case is not really distinguished from the former one, since both the Contingent and the Necessary Truth can only be altered by an alteration in the terms. If a body which does not expand by heat (there are such) be brought forward as impugning the truth of our proposition, we at once recognize that this body is under different conditions from those which our proposition included. This is the introduction of a new truth, not a falsification of the old. Our error, if we erred, was in too hastily assuming that all bodies were under the same conditions. Hence the correct definition of a Contingent Truth is 'one which generalizes the conditions'; while that of a Necessary Truth is 'one which is an unconditional generalization.' The first affirms that whatever is seen to be true, under present conditions, will be true so long as these conditions remain unaltered. The second affirms that whatever is true now, being a truth irrespective of conditions, cannot suffer any change from interfering conditions, and must therefore be universally true."[1]

To this lucid exposition it is hardly necessary to add that the mental compulsion under which we accept mathematical truths is of precisely the same character as that under which we accept physical or chemical truths. Our conception of parallel lines—a conception which the Kantian admits to have been formed by experience—is a conception of lines which do not enclose space. And just as we found that, in order to imagine nitrogen supporting combustion, we were obliged to suppress the conception of nitrogen altogether and substitute for it some other conception, we also find that, in order to imagine two parallel lines enclosing a space, we must suppress the conception of parallel lines altogether, and substitute for it the conception of bent or converging lines. The two cases are exactly similar. In the one case, as in the other, our conceptions are but the registry of our experience, and can therefore be altered only by being temporarily annihilated. Our minds being that which intercourse with the environment—both their own intercourse and that of ancestral minds, as will be shown hereafter—has made them, it follows that our indestructible beliefs must be the registry of that intercourse, must be necessarily true, not because they are independent of experience, but because they are the only complete unqualified expression of it. Here then, on the ruins of the Kantian hypothesis, we may erect a canon of truth, as follows:—

[1] *History of Philosophy*, 4th edit. vol. i. p. cv. This view, which I hold to be the most important contribution ever made to the discussion of Necessity and Contingency, is still more thoroughly and forcibly presented by Mr. Lewes in his new work, *Problems of Life and Mind*, vol. i. pp. 390–414.

A necessary truth is one that is expressed in a proposition of which the negation is inconceivable, after all disturbing conditions have been eliminated.

A proposition of which the negation is inconceivable is necessarily true in relation to human intelligence.

This test of inconceivability is the only ultimate test of truth which philosophy can accept as valid.

Thus the uniformity-test of Hume and the inconceivability-test of Kant are fused together in a deeper synthesis, —the deepest which philosophy can reach. As Mr. Spencer forcibly states it: "Conceding the entire truth of the position that, during any phase of human progress, the ability or inability to form a specific conception wholly depends on the experience men have had; and that, by a widening of their experiences, they may by-and-bye be enabled to conceive things before inconceivable to them; it may still be argued, that as at any time the best warrant men can have for a belief is the perfect agreement of all pre-existing experience in support of it, it follows that, at any time, the inconceivableness of its negation is the deepest test any belief admits of. Objective facts are ever impressing themselves upon us; our experience is a register of these objective facts; and the inconceivableness of a thing implies that it is wholly at variance with the register. Even were this all, it is not clear how, if every truth is primarily inductive, any better test of truth could exist. But it must be remembered, that whilst many of these facts impressing themselves upon us are occasional; whilst others again are very general; some are universal, and are unchanging. These universal and unchanging facts are, by the hypothesis, certain to establish beliefs of which the negations are inconceivable; whilst the others are not certain to do this; and if they do, subsequent facts will reverse their action."

As this position has been vehemently attacked by Mr. Mill, who hardly admits for the test of inconceivableness any validity whatever, some further explanation is desirable. It must not be supposed that, in erecting such a canon of truth, we are imitating those high *à priori* metaphysicians, who regard all their cherished traditional notions as infallible intuitions, because of their professed inability to disbelieve them. This is a confusion of which Mr. Mill has not succeeded in keeping clear, and which has led him unintentionally to misrepresent the position taken by Mr. Spencer and Mr. Lewes.

The confusion arises from the double sense of the word *belief*,[1] and the accompanying ambiguous use of the term *inconceivable*. By a singular freak of language we use the word *belief* to designate both the least persistent and the most persistent coherence among our states of consciousness,—to describe our state of mind with reference both to those propositions of the truth of which we are least certain, and to those of the truth of which we are most certain. We apply it to states of mind which have nothing in common, except that they cannot be justified by a chain of logical proofs. For example, you believe, perhaps, that all crows are black, but being unable to furnish absolutely convincing demonstration of the proposition, you say that you believe it, not that you know it. You also believe in your own personal existence, of which, however, you can furnish no logical demonstration, simply because it is an ultimate fact in your consciousness which underlies and precedes all demonstration. So with the axioms of geometry. If asked what are our grounds for believing that two straight lines cannot enclose a space, we can only reply that the counter-proposition is inconceivable; that we cannot frame the conception of two straight lines enclosing a space; that in any attempt to do so, the conception of straight lines disappears and is replaced by the conception of bent lines. We believe the axiom simply because we must believe it.

[1] The source of this confusion is the failure to distinguish between the kind of belief which remains after "the reduction of inferences to sensations," and that which is founded in a "reliance on unverified inferences."—See Lewes, *Problems of Life and Mind*, vol. i. p. 369.

It is only in this latter sense that the word *belief* is employed in the canon of truth above stated, and when Mr. Spencer says that a given proposition is inconceivable, he means that it is one of which the subject and predicate can by no amount of effort be united in consciousness. Thus (to take Mr. Spencer's illustration), that a cannon-ball fired from England will reach America is a proposition which, though utterly incredible, is not inconceivable,—since it is quite possible to imagine the projectile power of cannons increased four-hundredfold, or one-thousandfold, were the requisite conditions at hand; but that a certain triangle is round is an inconceivable proposition, for the conceptions of roundness and triangularity will destroy each other sooner than be united in consciousness. And manifestly we can have no deeper warrant for the truth of a proposition than that the counter-proposition is one which the mind is incompetent to frame. Such a state of things implies that the entire intercourse of the mind with the environment is witness in favour of the proposition and against its negation.

It is indeed a popular misconception,—a misconception which lies at the bottom of that manner of philosophizing which is called Empiricism,—that nothing can be known to be true which cannot be demonstrated. To be convinced that this is a misconception, we need but to recollect what a demonstration is. Every demonstration consists, in the first place, of a series of steps in each of which the group of relations expressed in a proposition is included in some other and wider group of relations,—is seen to be like some other group previously constituted. Now if this process of inclusion is not to be carried on for ever, we must come at last to some widest group,—to some generalization which cannot be included in any wider generalization, and of which we can only say that the truth which it expresses is so completely abstracted from perturbing conditions that it can be recognized by a simple act of consciousness as self-evident. If, for example, "we ascribe the flow of a river to the same force which causes the fall of a stone," and if, "in further explanation of a movement produced by gravitation in a direction almost horizontal, we cite the law that fluids subject to mechanical forces exert reactive forces which are equal in all directions," we are going through a process of demonstration,—we are including a special fact under a more general fact. If now we seek the warrant for this more general fact, and find it in that most general fact that force persists, we are still going through a process of demonstration. But if lastly we inquire for the warrant of this most general fact, we shall get no reply save that no alternative can be framed in thought. That force persists we are compelled to believe, since the proposition that force can arise out of nothing or can lapse into nothing is a verbal proposition which we can by no amount of effort translate into thought. Thus at the end of every demonstration we must reach an axiom for the truth of which our only test is the inconceivability of its negation.

Secondly, from a different point of view, a demonstration is a series of propositions, every one of which is necessarily involved in the preceding one. How do we know it to be thus necessarily involved? How do we know that the statement that action and reaction are equal and opposite is necessarily involved in the statement that force persists? Simply because we can conceive no alternative. since to do so would be to perform the impossible task of formulating in consciousness an equation between something and nothing. Thus our only warrant for each step of a demonstration is the fact that any alternative step is one which the mind cannot take.

Such is indeed our only warrant for that most certain of all facts—the existence of our own states of consciousness. If you say that you have a sensation of redness, and I require you to prove the statement, you can only reiterate that such is the fact, the testimony of consciousness as to the existence of its own states being final, and admitting of no appeal. You cannot conceive it to be otherwise. During the presence of the sensation of redness it is impossible for any opposite state of consciousness, such as the sensation of blueness, to emerge. With regard to the cause of the sensation, the case is wholly different. The sensation of redness may be due to the presence of an external object from which emitted red rays impinge upon the retina; or it may be due to the presence of certain foreign substances in your blood which excite in the optic nerve such a rate of undulation as to produce the consciousness of red colour. All this is matter of inference, and must be verified by the repeated application of the test of truth. But for the ultimate dictum—that the given state of consciousness exists—you have the direct warrant of consciousness itself.

In the light of this explanation, does not our canon of inconceivability seem almost a truism, and does it not seem a singular *ignoratio elenchi* when Mr. Mill urges against us that the ancients could not conceive the existence of the antipodes, which nevertheless exist? It is quite true that the ancients could not *believe* that men could stand on the other side of the earth without falling off; and this was because they falsified one of the conditions of the complex case. They imagined gravity continually acting downwards, not knowing that downwards means toward the centre of the earth. What they could not *conceive* was that an unsupported body will not fall; and this is still strictly inconceivable, since to assert that an unsupported body will not fall is to assert that a given amount of gravitative force, when not counteracted by an equivalent opposing force, will not manifest itself in motion,—a verbal assertion which can by no effort be construed into thought.

A similar reply awaits Mr. Mill's argument from the old belief in the destructibility of matter. It is now inconceivable that a particle of matter should either come into existence or lapse into non-existence. But before the use of the balance in chemistry had shown experimentally that nothing ever disappears, hypotheses were freely propounded in which the indestructibility of matter was entirely ignored; and, accordingly, Mr. Mill appears to believe that in former times the annihilation of matter was thinkable. In reply it is enough to observe that, so long as human intelligence has been human intelligence, it can never have been possible to frame in thought an equation between something and nothing: yet this is the impossibility which must be surmounted before the annihilation or the creation of a particle of matter can become representable in consciousness. The truth is that whoever, before the discoveries of chemistry, maintained that matter is destructible, defended a verbal proposition, which answered to no framed or frameable conception. Of a piece with this is the fact that in all ages men have tortured, slain, calumniated, or otherwise persecuted each other in their zeal to get sundry propositions established, the subject and predicate of which could never be united in thought. It is not so very long since Michael Servetus was burned at the stake for a heresy partly based upon doubts as to the possible equality or identity of three and one; yet not even Mr. Mill would maintain that it has ever been possible for human intelligence to join together the members of the quantitative theorem implied in the doctrine of the Trinity. It appears, therefore, that men may believe, or at least maintain, what they can in nowise conceive. As Mr. Spencer well says, "Refrain from rendering your terms into ideas, and you may reach any conclusion whatever. That the whole is equal to its part is a proposition that may be quite comfortably entertained so long as neither wholes nor parts are imagined." This is one of the ways in which so many absurd theories obtain currency, and having once become current are so difficult to banish from circulation. The philologist A. W. Schlegel once suggested that the terminations of words may have grown out from the roots, just as branches of trees grow from axillary buds. Inductive philology has proved this notion to be false, and has shown that in all cases a termination is the abraded relic of an originally distinct qualifying word, which by constant use and through rapid pronunciation, during primitive ages when words were addressed only to the ear, has become inseparably agglutinated to the qualified word or root. This discovery, which has long been completely verified, of course supersedes and renders antiquated the hypothesis of Schlegel. But the point which here concerns us is that no such elaborate induction was needed to show that the notion of a budding termination is in itself absurd. All that was needed to reveal its absurdity was to stop and translate the words used into ideas. To say that a termination buds out from a root, is to combine words which severally possess a meaning into a phrase which has no meaning. We can severally form concepts of a word-termination, of a word-root, and of the process of budding; but the three concepts are wholly disparate and refuse to unite into a thinkable proposition. The hypothesis had no other foundation than the vague associations with the processes of vegetal life which cluster about such a word as "root"; and the fact that a scholar like Schlegel could seriously found a theory of language upon such a mere chaos of half-shaped conceptions shows us how easy it is for highly-educated men to think in a very slovenly manner. But it likewise conclusively shows us that the assent of philosophers in past ages, or of uneducated people in our own age, to sundry unthinkable propositions, is not to be cited as evidence that there are minds which can think what is unthinkable. The building up of enormous theories out of purely verbal propositions, which do not correspond to any thinkable concatenation of conceptions, has always been the besetting sin of human philosophizing. It has been known, since the Middle Ages, by the apparently incongruous epithet of

Realism, because at that time it was most conspicuously illustrated in the famous theory that wherever there is a general term there must be a real objective thing corresponding to it,—a general Horse, for example, in addition to all individual horses. This single phase of the mental habit in question might be cited as an all-sufficient answer to Mr. Mill's objection. Mr. Mill would be the last to admit that the realists were able to conceive of Horse except as some particular horse; yet they stoutly maintained that they could and did frame such a conception. The Platonic theory of Ideas was based upon this realistic tendency to lend an objective value to the mere verbal signs of subjective conceptions, which was dominant in the philosophy of the Greeks and of the scholastics, and which, in modern times, is well exemplified in the philosophy of Hegel.

We thus see that men may believe—or believe that they believe—propositions which they cannot, in the strict sense of the word, conceive. Until men have become quite freed from the inveterate habit of using words without stopping to render them into ideas, they may doubtless go on asserting propositions which conflict with experience; but it is none the less true that valid conceptions wholly at variance with the subjective register of experience can at no time be framed. And it is for this reason that we cannot frame a conception of nitrogen which will support combustion, or of a solid lump of iron which will float in water, or of a triangle which is round, or of a space enclosed by two straight lines. So that when Mr. Mill hints that it was once possible for men to frame conceptions which cannot now be framed, he tacitly assumes that conceptions may have been framed of which the elements have never been joined together in experience. Yet of all possible psychological theorems there is none, I suppose, which, when overtly stated, Mr. Mill would more emphatically deny than this. To see Mr. Mill unwittingly arrayed in the lists against the experience-theory is indeed a singular spectacle; but it is only one instance, out of many, of the way in which that theory has suffered from its association with empiricism. When in a future chapter we come to treat of the evolution of intelligence, we shall see that Mr. Spencer was the first to penetrate to the very core of the experience-philosophy when he perceived that the deepest warrant for the perfect conformity of a given proposition with experience is the unthinkableness of the counter-proposition.[1]

But now, what do we mean when we say that, after eliminating all perturbing conditions, a proposition of which the negation is unthinkable must be necessarily true? By a confusion of ideas very unusual with him, Mr. Mill seems to think that we mean to accredit such propositions with expressing some necessary relation among objective realities *per se*, apart from their relation to our intelligence: for he somewhere charges Mr. Spencer with "erecting the incurable limitations of the human conceptive faculty into laws of the outward universe." When correctly interpreted, however, Mr. Spencer will be found to have done no such thing. He simply erects them, as Mr. Lewes expresses it, into "laws of the conceptions we form of the universe." Holding as we do, that all our knowledge is derived from experience, that we have no experience of the objective order of the relations among things, and hence can never know whether it agrees or disagrees with

[1] Since my final revision of this chapter, I find the case thus admirably put into a nut-shell by Mr. Lewes, in his now forthcoming work, *Problems of Life and Mind*, vol. i. p. 396:—"The arguments which support the *à priori* view have been ingeniously thrown into this syllogism by Mr. Killick: The necessary truth of a proposition is a mark of its not being derived from Experience. (Experience cannot inform us of what *must* be:) *The inconceivability of the contradictory* is the mark of the necessary truth of a proposition: Therefore *the inconceivability of its contradictory is a mark of a proposition not being derived from Experience.*—This syllogism is perfect in form, but has a radical defect in its terms. The inconceivability of a contradictory results from the entire absence of experiences on which a contradiction could be grounded. If there were any truths independent of Experience, contradictions to them would be conceivable, since there would be no positive obstacle to the conception; but a contradiction is inconceivable only when all Experience opposes itself to the formation of the contradictory conception."

the subjective order of our conceptions,—it is passing strange that we should ever have been called upon to correct such a misinterpretation. All that Mr. Spencer or his followers have ever maintained is this: that although we have no experience of the objective order in itself, we have experience of the manner in which the objective order affects us. Though we have no experience of noumena, we have experience of phenomena. And when experience generates in us a subjective order of conceptions that cannot be altered, we have the strongest possible warrant that the order of our conceptions corresponds to the order of phenomena. Expressed in this abstract terminology, the precise shade of my meaning may be difficult to catch and fix; but a concrete illustration will, I trust, do away with the difficulty. If the subjective order of my conceptions is such that the concept of a solid lump of iron and the concept of a body floating in water will destroy each other rather than be joined together, and I therefore say that a solid lump of iron will not float in water, what do I mean by it? Do I intend any statement concerning the unknown external thing, or things, which when acting upon my consciousness causes in me the perceptions of iron, and water, and floating or sinking? By no means. I do not even imply that such modes of existence as iron or water, or such modes of activity as floating or sinking, pertain to the unknown external reality at all. It is impossible for us to realize, but it is nevertheless imaginable, that to some form of impressibility quite different from what we know as conscious intelligence, the same unknown reality might be manifested as something quite different from iron or water, sinking or floating. By my statement I only imply that whenever that same unknown thing, or things, acts upon my consciousness, or upon the consciousness of any being of whom intelligence can be properly predicated, there will always ensue the perception of iron sinking in water, and never the perception of iron floating in water. And in stating this, I only reveal my incapacity for conceiving that, under identical conditions, the Unknowable can ever act upon human intelligence otherwise than it has always acted upon it. In other words, I am showing that I cannot transcend the limits of experience; and I am reaffirming, in the most emphatic manner, the relativity of all knowledge.

We are now in a position to answer the queries which were propounded at the beginning of this chapter. At the outset of our inquiry, Truth was provisionally defined as the correspondence between the subjective order of our conceptions and the objective order of the relations among things. But this is the definition of that Absolute Truth, which implies an experience of the objective order in itself, and of such truth we can have no criterion. It was this which Mr. Mill must have had in mind, when he let fall the much criticized suggestion that in some distant planet the sum of two and two might be five. But such a statement is inadequate; for when we speak of planets and numbers, we are tarrying within the region of things accessible to intelligence, and within this region we cannot admit the possibility of two and two making five. It is nevertheless imaginable that somewhere there may be a mode of existence, different from intelligence, and inconceivable by us because wholly alien from our experience, upon which numerical limitations like ours would not be binding. The utter blankness of uncertainty in which such a suggestion leaves us may serve as an illustration of the theorem that we can have no criterion of Absolute Truth, or of truth that is not correlated with the conditions of our intelligence.

But the lack of any such criterion in no way concerns us as intelligent beings. The only truth with which we have any concern is Relative Truth,—the truth that is implicated with whatever can in any way come within our cognizance. For relative truth our inquiry has established this criterion

—When any given order among our conceptions is so coherent that it cannot be sundered except by the temporary annihilation of some one of its terms, there must be a corresponding order among phenomena. And this, as we have seen, is because the order of our conceptions is the expression of our experience of the order of phenomena. I will only add that what we mean by *reality* is "inexpugnable persistence in consciousness"; so that when the unknown objective order of things produces in us a subjective order of conceptions which persists in spite of every effort to change it, the subjective order is in every respect as real to us as the objective order would be if we could know it. And this is all the assurance we need, as a warrant for science, and as a safeguard against scepticism. In the next chapter I shall endeavour to show that we are no whit the worse off for not being able to transcend the conditions within which alone knowledge is possible. Since "experience" means merely the consciousness of the manner in which the Unknowable affects us, it follows that our very incapability of transcending experience is the surest guaranty we could desire of the validity of the fundamental conceptions by which our daily life is guided, and upon which our philosophy must be built.

## CHAPTER IV.

### PHENOMENON AND NOUMENON.

SUMMING up the results of the foregoing discussion, we have seen that neither the test of truth proposed by Hume, nor that proposed by Kant, can be regarded as valid, considered by itself; but that, when fused together in the crucible of modern psychologic analysis, the two can be regarded as making up a criterion of truth adequate to all the needs of intelligent beings. It has been proved that, since the series of our conceptions is but the register of our experience, perfect congruity of experience must generate in us beliefs of which the component conceptions can by no mental effort be torn apart. Whence it follows that, if relative truth be defined as the correspondence between the order of our conceptions and the order of phenomena, we have this for our test of truth :—When any given order among our conceptions is so coherent that it cannot be sundered except by the temporary annihilation of some one of its terms, there must be a corresponding order among phenomena. And this statement, while it expresses the fundamental theorem of what is known as the experience-philosophy, recognizes also a germ of truth in the Kantian doctrine of necessity. When, in a future chapter, the exposition of the Doctrine of Evolution shall have advanced so far that we may profitably consider the nature of the process by which intelligence has arisen, we shall be enabled to carry much farther the reconciliation, here dimly foreshadowed, between the great opposing theories of the experientialists and the intuitionalists. However difficult it may be to realize that this apparently interminable controversy is at length to be decided and passed over as antiquated, like the yet longer dispute between Nominalism and Realism, it will nevertheless be shown that this is the case. It will be shown that the Doctrine of Evolution affords the means of reconciling the psychology of Locke and Hume with the psychology of Leibnitz and Kant, not by any half-way measures of compromise, but by fusing the two together in a synthesis deeper and more comprehensive than either of them singly has succeeded in making.

At present, however, merely hinting at these conclusions which are by and by to follow, we must address ourselves to a yet more arduous task of reconciliation,—the task of reconciling our ineradicable belief in the existence of something external to ourselves with the scientific reasoning which shows that we cannot directly know anything save modifications of ourselves. We have to examine the theory concerning objective reality which, along with more or less important qualifications, is held in common by Idealism, by Scepticism, and by Positivism, as represented respectively by Berkeley, Hume, and Mill. And by characterizing, with the aid of the principles now at our command, the fundamental error of that theory, we shall be enabled properly to define the very different position held by Mr. Spencer and adopted in the present work.

Our argument must concern itself chiefly with Berkeley, since the conclusion reached in dealing with his doctrine will apply directly to the doctrine of Hume, and will point the way to the criticism needful to be made upon the doctrine of Mr. Mill. Indeed, as Mr. Mill has well remarked, there is a sense in which all modern philosophy may be said to date from Berkeley. To say nothing of his discovery of the true theory of vision, the first truth ever discovered in psychology which stands upon the same footing as the demonstrated truths of physical science; to say nothing of the magnificent arguments by which he brought to a close the seven hundred years' war between the Realists and the Nominalists; his doctrine of Idealism, the psychologic basis of which has never been shaken, forms the pivot upon which all subsequent metaphysical speculation has turned. It is the first point which inevitably presents itself for discussion in any system of philosophy which, after settling upon its criterion of truth, attempts with the aid thereof to found a valid explanation of the relations of man with the Cosmos of which he is a part. Nay more, it is, as Berkeley himself held, narrowly implicated with our theories of religion, though not in the way which Berkeley supposed, but in a way which he did not foresee, and could not have been expected to foresee.

In characterizing the Idealism of Berkeley as contrary to our ineradicable belief in the existence of something independent of ourselves, it is well to note at the outset that the point of antagonism is not what—with extreme, though perhaps excusable carelessness—it was assumed to be by Reid. The objective reality which Berkeley denied was not what is known as the external world of phenomena. What Berkeley really denied was the Absolute Existence of which phenomena are the manifestations.[1] He denied the Noumenon. "It is a mere abstraction, he says. If it is unknown, unknowable, it is a figment, and I will have none of it; for it is a figment worse than useless; it is pernicious, as the

[1] Or, to speak more accurately, what Berkeley really denied was the scholastic theory of occult substrata underlying each group of phenomena. In this denial we maintain that he was right; but his denial was made in such wise as to ignore the fact of an Absolute Existence of which phenomena are the manifestations, and herein, as we maintain, was his fundamental error,—an error which has been adopted by Positivism, and which vitiates that system of philosophy from beginning to end.

basis of all atheism. If by *matter* you understand that which is seen, felt, tasted, and touched, then I say matter exists: I am as firm a believer in its existence as anyone can be, and *herein I agree with the vulgar.* If, on the contrary, you understand by matter that occult substratum which is *not* seen, *not* felt, *not* tasted, *not* touched—that of which the senses do not, cannot inform you—then I say I believe not in the existence of matter, *and herein I differ from the philosophers, and agree with the vulgar.*" [1] The "grin," therefore, with which "coxcombs" sought to "vanquish Berkeley," revealed only their incapacity to understand him. Nevertheless the antagonism between Idealism and common sense remains, though its position is shifted; as appears from the expressions of a very able idealist, the late Prof. Ferrier, when he says that Berkeley sided with those "who recognize no distinction between the reality and the appearance of objects, and *repudiating the baseless hypothesis of a world existing unknown and unperceived,* he resolutely maintained that what are called the sensible shows of things are in truth the very things themselves." [2] In this mode of statement the antagonism between Idealism and common sense is forcibly brought out, though the intention of the writer was rather to insist upon their harmony. For as the "very things themselves" which are known and perceived were held by Berkeley, and are still held by psychologists generally, to consist in modifications of our consciousness, it follows that, according to Berkeley, the only real existence is mind with its conscious modifications. What common sense affirms is the existence of something independent of our consciousness: but this is just what Berkeley denied.

Suppose now we grant, for the sake of the argument, that the only real existence is mind with its conscious modifica-

[1] Lewes, *History of Philosophy*, 3rd edit. vol. ii. p. 284.
[2] Ferrier, *Philosophical Remains*, vol. ii. p. 297.

tions. The question at once arises, what is the cause of these modifications? Since consciousness is continually changing its states, and indeed exists only by virtue of a ceaseless change of states, what is it that determines the sequence of states? If, after the congeries of states of consciousness composing the knowledge that I am putting out my hand in the dark, there supervenes the state of consciousness known as the feeling of resistance, what is it that determines the sequence? According to Berkeley, it is the will of God. God has predetermined for us the sequence of states of consciousness, having so arranged things that whenever we ideally thrust an ideal head against an ideal chimney-piece, the states of consciousness known as the perception of resistance and the sensation of headache, complicated with divers unpleasant emotional states, will necessarily ensue. Now for two reasons this is an explanation which science cannot recognize. In the first place, it is either a restatement, in other words, of the very fact which is to be explained, or else it substitutes a cumbrous explanation, involving a complex group of postulates, for the simple ordinary explanation which involves but a single postulate. In the second place, it is a hypothesis which can be neither proved nor disproved; and, as we shall hereafter see, all such hypotheses must be regarded as illegitimate. But, unless we admit the existence of an external reality, is there any alternative hypothesis? Must we not accept Berkeley's explanation, in default of any other?

There is one alternative hypothesis, and only one. As Berkeley drew his idealism from Locke, so when Kant demonstrated that we cannot know the objective reality, Fichte drew the inference that the objective reality does not exist. Fichte, like Berkeley, held that the only real existence is mind with its sequent conscious states. But Fichte differed from Berkeley in his explanation of the sequence of our states of consciousness. Fichte held that this sequence is determined by itself—that it depends upon the internal constitution of the mind. Or, in other words, he maintained that the subject creates the object. From this doctrine have lineally descended all the vagaries of modern German idealism—vagaries of method as well as vagaries of doctrine, as anyone may see who, after some familiarity with scientific methods, looks over the so-called "Nature-philosophy" of Schelling and Oken. Its extreme corollaries have been stated by Hegel, who, if I do not misinterpret him, regards the universe as nothing but the self-determined sequence of states of consciousness of an Absolute Intelligence, of which our individual intelligences are partial manifestations. Manifestly we have here arrived at logical suicide. We begin, with Kant, by saying that we have no knowledge of the objective order of things; we continue, with Fichte, by saying that there is no objective order, save that which the mind creates for itself; and we end, with Hegel, by identifying the objective order with the subjective, and maintaining that whatever is true of the latter is true also of the former. In saying this, we virtually maintain that the possibilities of thought are not only coextensive but identical with the possibilities of things; and thus destroy the doctrine of relativity with which we started. The post-Kantian idealism may therefore be described as a linear series of corollaries, the last of which destroys the axiom upon which the first of the series rests.

A similar suicide must be the fate of any doctrine of idealism. We often hear it said that Berkeley's clear scientific reasoning has never been, and can never be, refuted. This is to a certain extent true. What never has been, and never can be, refuted, is the clear scientific reasoning by which Berkeley proves that we cannot know the objective reality. What can be, and has already been, refuted, is the unphilosophic inference that there is no objective reality. Reid, with his so called "Common-Sense

Philosophy," failed because he attacked the scientific doctrine instead of the unphilosophic inference. Out of sheer fright at what he considered the conspicuous absurdity of Berkeley's position, Reid maintained that we do know objects *per se;* that in every act of perception the objective reality is immediately given in consciousness. Reid laid great stress upon Locke's distinction, useful in some respects, between the primary and secondary qualities of matter, and held that we know the first in themselves, although we know the second only in their effects upon our consciousness. Thus, while admitting that redness is only the name of a state of consciousness produced in us by an unknown external agent, Reid insisted that, on the other hand, in our consciousness of weight or resistance we know the external agent itself, and not merely a state of consciousness. Plausible as this opinion appeared, not only to the superficial Reid, but to that much abler though rather fragmentary thinker, Sir William Hamilton,[1] it is nevertheless irreconcilable with some very obvious psychological facts. To cite one or two examples from Mr. Spencer's "Principles of Psychology": "The same weight produces one kind of feeling when it rests on a passive portion of the body, and another kind of feeling when supported at the end of the outstretched arm." In which of these cases, then, do we know the real objective weight? We cannot know it in both, since in that case the substance of the two cognitions would be the same. Again, if one hand is laid palm downwards upon the table, and "a knuckle of the other hand is thrust down with some force on the back of it, there results a sensation of pain in the back of the hand, a sensation of pressure in the knuckle, and a sensation of muscular tension in the active arm. Which of these sensations does the mechanical force in

[1] Even the great Locke had not freed himself from this error. See the *Essay on Human Understanding*, book ii. chap. viii.

action resemble, qualitatively or quantitatively? Clearly, it cannot be assimilated to one more than another of them; and hence must in itself be something alien from, or unrepresentable by, any feeling."[1]

This disposes of Reid, who was indeed but an indifferent psychologist, and rested his refutation of Berkeley chiefly upon misplaced ridicule and equally misplaced appeals to common sense. He tauntingly asked why the great idealist did not illustrate his doctrine by walking over a precipice or thrusting his head against a lamp-post, as if Berkeley had ever denied that such a congeries of phenomenal actions would be followed by disastrous phenomenal effects. No wonder that a philosophy founded upon such flimsy psychological analysis should never have obtained wide acceptance among trained thinkers; and no wonder that Idealism should still by many persons be considered as unrefuted.

It is by making the unphilosophic inference that because we cannot know the objective reality therefore there exists none, that Idealism destroys itself. As long as we admit that the possibilities of things are limited by the possibilities of thought, we cannot overturn Idealism: we must go on and grant that because we can form no conception of matter apart from the conditions imposed upon it by our intelligence, therefore no thing can exist apart from such conditions. As Prof. Ferrier forcibly states the case, "I defy you to conceive anything existing unperceived. Attempt to imagine the existence of matter when mind is absent. You cannot, for in the very act of imagining it, *you include an ideal percipient.* The trees and mountains you imagine to exist away from any perceiving mind, what are they but the very ideas of *your* mind, which you transport to some place where you are not? In fact, to separate existence from perception is radically impossible. It is God's synthesis, and man cannot undo it." All this is equivalent to saying that

[1] Spencer, *Principles of Psychology,* vol. i. p. 206.

we cannot "imagine an object apart from the conditions under which we know it. We are forced by the laws of our nature to invest objects with the forms in which we perceive them. We cannot therefore conceive anything which has not been subject to the laws of our nature, because in the very act of conception those laws come into play."[1] But when the idealist proceeds to infer that because we cannot conceive objects otherwise, therefore they cannot exist otherwise, he assumes that knowledge is absolute, and thus knocks away the psychological basis upon which his premise was founded. If we would consistently refrain from violating the doctrine of relativity, we must state the idealist's premise, but avoid his conclusion. We admit that "the trees and mountains you imagine to exist away from any perceiving mind" do not really exist *as trees and mountains* except in relation to some perceiving mind. We admit that matter does not exist *as matter*, save in relation to our intelligence; since what we mean by matter is a congeries of qualities—weight, resistance, extension, colour, etc.—which have been severally proved to be merely names for divers ways in which our consciousness is affected by an unknown external agency. Take away all these qualities, and we freely admit, with the idealist, that the *matter* is gone; for by *matter* we mean, with the idealist, the phenomenal thing which is seen, tasted, and felt. But we nevertheless maintain, in opposition to the idealist, that *something* is still there, which, to some possible mode of impressibility quite different from conscious intelligence, might manifest itself as something wholly different from, and incomparable with, matter; but which, to anything that can be called conscious intelligence, must manifest itself as matter. We freely admit that what we mean by a tree is merely a congeries of qualities that are visual and tactual, and perhaps odorous, sapid, or sonorous. If we were destitute of sight, touch, smell,

[1] Lewes, *History of Philosophy*, vol. ii. p. 302.

taste, hearing, and muscular sensibility, all these qualities would cease to exist, and therefore the tree would cease to be tree. But it does not follow that the Unknown Reality which caused in us these groups of sensations has ceased to exist. Our ineradicable belief is that it still exists, and would assume the qualities which constitute tree as soon as our capacity of sensation were restored. And we recognize, as in accordance with the dictates of common-sense, the suggestion that if some Being with seventy senses, like the denizen of the planet Saturn in Voltaire's inimitable satire, were to come into the presence of this same Unknown Reality, there would undoubtedly arise in this Being the consciousness of a congeries of qualities different from that which constitutes tree. We further recognize that if this Being were endowed with some mode of impressibility so different from ours that the name "intelligence" would not apply to it, this same Unknown Reality might generate in such a Being some state or states wholly different from what we know as the cognition of a material object. I say, we regard these conclusions as consistent with that extended and systematized common-sense which is called science. In stating them, we assert, to the fullest extent to which the exigencies of human language will admit of our asserting it, the relativity of all knowledge; and we admit everything which the idealists have established upon the sound basis of psychologic induction. What we refuse to admit is the legitimacy of the idealist's inference that the Unknown Reality beyond consciousness does not exist. We assert, on the contrary, that the doctrine of relativity cannot even be intelligibly stated without postulating the existence of this Unknown Reality, which is independent of us. The proposition that the tree or the mountain exists *as tree or mountain* only in so far as it is cognized, becomes utter nonsense when we seek to suppress the conception of a persistent Something which becomes tree or mountain in being cognized.

Before proceeding farther to develope this argument, we may fitly include Positivism along with Idealism as opposed to the conclusion which we are about to defend. The position of Positivism with reference to this question has never been definitely stated by Comte, or by his most eminent and consistent disciple, M. Littré, and it may indeed be doubted whether, with all their remarkable endowments of another sort, either of these thinkers has ever given evidence of enough power of psychologic analysis to grapple with such a problem. It is certain that M. Littré neither admits nor understands (so as to state it correctly) the Spencerian doctrine that there exists an Unknowable Reality; and it will be amply shown hereafter that Comte not only ignored the existence of such a Reality, but implicitly and practically denied it. It is to Mr. Mill, who has on different occasions given in his assent to nearly all the doctrines which are distinctively characteristic of the Positive Philosophy, that we must look for an explicit declaration of the precise relation of Positivism to Idealism. Happily Mr. Mill has given us, in his work on the Hamiltonian philosophy, an elucidation of his views which leaves no room for misconception; and in his recent essay on Berkeley he has presented, in a single sentence, the clue to the Positivist position. Among the unimpeachable discoveries which philosophy owes to Berkeley, says Mr. Mill, was that of "the true nature and meaning of the externality which we attribute to the objects of our senses: that it does not consist in a substratum supporting a set of sensible qualities, or an unknown somewhat, which, not being itself a sensation, gives us our sensations, but consists in the fact that our sensations occur in groups, held together by a permanent law, and which come and go independently of our volitions or mental processes." Note that Mr. Mill does not endorse the Berkeleian denial of the objective reality. True to the fundamental canon of Positivism, he states merely the contents of the observed facts, which, as we also admit, were correctly stated by Berkeley; but concerning the existence of the Unknowable Reality, which we regard as the inevitable implication of the observed facts, he is silent. And his silence, as well as his assertion, is strictly in harmony with the spirit of Positivism.

The distinction, then, between Idealism and Positivism may be taken to be this. The former asserts that the unknowable objective reality is a mere figment of the imagination, while the latter refrains from making any assertion with reference to it. The former, therefore, tacitly violates the doctrine of relativity by assuming that the possibilities of our thinking are to be taken as the measure of the possibilities of existence: the latter perceives that such an assumption is illegitimate, but seeks to escape the difficulty by ignoring the question at issue. In other words, while unwilling to contravene the doctrine of relativity upon which it professes to found itself, it is yet content to state but half the doctrine.

Bearing this in mind, we may return to the argument, which will now be understood as directed against the position which Idealism and Positivism hold in common. And we may observe, first, that the very sentence just quoted from Mr. Mill affords a most excellent illustration of the impossibility of stating either the position of Idealism or that of Positivism without implying the existence of that objective reality which the former would impugn and which the latter would ignore. The sum of the whole matter, according to Mr. Mill, is "the fact that our sensations occur in groups, held together by a permanent law, and which come and go independently of our volitions or mental processes." How comes it that our sensations occur in groups? Why is it that they are held together by a permanent law? And, above all, how does it happen that they come and go independently of our volitions or mental processes? Suppress the notion of a Something outside of consciousness which determines this coming and going of our sensations, and we have no alternative but to regard them either as self-determined, which leads us finally to Hegelism, or as not determined at all, which is inconceivable. Mr. Mill's statement is either nonsense, or else it tacitly postulates that Absolute Existence which it overtly professes to ignore. It is as impossible, therefore, to ignore as it is to deny Absolute Existence. Without assuming Something independent of consciousness, it is impossible for either Idealism or Positivism to state the theorem in which it is sought either to impugn or to ignore the existence of anything beyond consciousness.

The suicide to which Idealism or Positivism is inevitably driven is further exhibited in the following citation from Mr. Spencer. After reminding us that all the arguments which go to demonstrate the relativity of knowledge set out by assuming objective existence, he goes on to say: " Not a step can be taken towards the truth that our states of consciousness are the only things we can know, without tacitly or avowedly postulating an unknown Something beyond consciousness. The proposition that whatever we feel has an existence which is relative to ourselves only cannot be proved, nay, cannot even be intelligibly expressed without asserting, directly or by implication, an external existence which is not relative to ourselves. When it is argued that what we are conscious of as sound has no objective reality as such, since its antecedent is also the antecedent to what we are conscious of as jar, and that the two consequents, being unlike one another, cannot be respectively like their common antecedent; the validity of the argument depends wholly on the existence of the common antecedent as something that has remained unchanged while consciousness has been changing. If, after finding that the same tepid water may feel warm to one hand and cold to the other, it is inferred that warmth is relative to our own nature and our own state, the inference is valid only supposing the activity to which these different sensations are referred, is an activity out of ourselves which has not been modified by our own activities.

"One of two things must be asserted:—either the antecedents of each feeling, or state of consciousness, exist only as previous feelings or states of consciousness; or else they, or some of them, exist apart from, or independently of, conciousness. If the first is asserted, then the proof that whatever we feel exists relatively to ourselves only, becomes doubly meaningless. To say that a sensation of sound and a sensation of jar cannot be respectively like their common antecedent because they are not like one another, is an empty proposition; since the two feelings of sound and jar never have a common antecedent in consciousness. The combination of feelings that is followed by the feeling of jar, is never the same as the combination of feelings that is followed by the feeling of sound; and hence not having a common antecedent, it cannot be argued that they are unlike it. Moreover, if by antecedent is meant constant or uniform antecedent (and any other meaning is suicidal) then the proposition that the antecedent of sound exists only in consciousness, is absolutely irreconcilable with the fact that the feeling of sound often abruptly breaks in upon the series of feelings otherwise determined, where no antecedent of the specified kind has occurred. The other alternative, therefore, that the active antecedent of each primary feeling exists independently of consciousness, is the only thinkable one. It is the one implicitly asserted in the very proposition that feelings are relative to our own natures; and it is taken for granted in every step of every argument by which this proposition is proved."

"Hence our firm belief in objective reality—a belief which metaphysical criticisms cannot for a moment shake. When we are taught that a piece of matter, regarded by us as existing externally, cannot be really known, but that we can know only certain impressions produced on us, we are yet, by the relativity of our thought, compelled to think of these in relation to a positive cause—the notion of a real existence which generated these impressions becomes nascent. The momentum of thought inevitably carries us beyond conditioned existence to unconditioned existence; and this ever persists in us as the body of a thought to which we can give no shape. . . . At the same time that by the laws of thought we are rigorously prevented from forming a conception of absolute existence, we are by the laws of thought equally prevented from ridding ourselves of the consciousness of absolute existence; this consciousness being, as we here see, the obverse of our self-consciousness. And since the only possible measure of relative validity among our beliefs, is the degree of their persistence in opposition to the efforts made to change them, it follows that this which persists at all times, under all circumstances, and cannot cease until consciousness ceases, has the highest validity of any." [1]

We have now reached a point at which we may make specific mention of the Scepticism of Hume, which is simply Idealism carried a step farther, to the denial of the existence of any subjective, as well as of any objective reality. It was easy for Hume, in criticizing Berkeley, to show that we know no more of Mind in itself than of Matter in itself; since what we know is only our states of consciousness. But when Hume proceeded to argue that nothing can be known to exist save the series of impressions or states of consciousness which we interpret as occurring in ourselves, he fell into the very same error of inference into which Berkeley had fallen. We may admit, with Hume, that we know nothing directly save modifications of consciousness. Changes of consciousness are indeed the materials out of which our knowledge is entirely built. But there can be no changes in our consciousness unless there exist something which

[1] Spencer, *Principles of Psychology*, vol. i. p. 209; *First Principles*, pp. 93–96.

is changed, and something which causes the changes. There can be no impressions unless there exist a something which is impressed and a something which impresses. Take away from the argument all the terms which relate to real existence, and the argument becomes nonsense. The Sceptic, like the Idealist, cannot stir a step without admitting that real existence which he is striving to deny. Abolish object and subject, and the states of consciousness vanish also. Abolish the noumenon, and the phenomenon is by the same act annihilated.

Thus our ineradicable belief in the absolute existence of Something which underlies and determines the series of changes which constitutes our consciousness, rests upon the strongest of foundations,—upon the unthinkableness of its negation. Thus it becomes apparent that the arguments of the Idealists and the Sceptics "consist of a series of dependent propositions, no one of which possesses greater certainty than the single proposition to be disproved." Without postulating Absolute Being—existence independent of the conditions of the process of knowing—we can frame no theory whatever, either of internal or of external phenomena. And since, as I have already observed, what we mean by *reality* is "inexpugnable persistence in consciousness," it follows that Absolute Being is the Reality of Realities, and that we are justified in ever tacitly regarding it as such.

But now, what do we mean by this affirmation of absolute reality independent of the conditions of the process of knowing? Do we mean to recur to the style of thinking in vogue anterior to Berkeley, and affirm, in language savouring strongly of scholasticism, that beneath the phenomena which we call subjective there is an occult substratum Mind, and beneath the phenomena which we call objective there is an occult substratum Matter? Our conclusion cannot be stated in any such form, and we need have no hesitation in acknowledging our debt of gratitude to Berkeley for having swept philosophy clean of such a rubbish of scholastic terminology. Our conclusion is simply this, that no theory of phenomena, external or internal, can be framed without postulating an Absolute Existence of which phenomena are the manifestations. And now let us carefully note what follows. We cannot identify this Absolute Existence with Mind, since what we know as Mind is a series of phenomenal manifestations: it was the irrefragable part of Hume's argument that, in the eye of science as in the eye of common-sense, Mind means not the occult reality but the group of phenomena which we know as thoughts and feelings. Nor can we identify this Absolute Existence with Matter, since what we know as Matter is a series of phenomenal manifestations; it was the irrefragable part of Berkeley's argument that, in the eye of science as in the eye of common-sense, Matter means not the occult reality but the group of phenomena which we know as extension, resistance, colour, etc. Absolute Existence, therefore,—the Reality which persists independently of us, and of which Mind and Matter are the phenomenal manifestations,—cannot be identified either with Mind or with Matter. Thus is Materialism included in the same condemnation with Idealism.

See then how far we have travelled from the scholastic theory of occult substrata underlying each group of phenomena. These substrata were mere ghosts of the phenomena themselves; behind the tree or the mountain a sort of phantom tree or mountain which persists after the body of the perception has gone away with the departure of the percipient mind. Clearly this is no scientific interpretation of the facts, but is rather a specimen of naïve barbaric thought surviving in metaphysics. The tree or the mountain being groups of phenomena, what we assert as persisting independently of the percipient mind is a Something which we are unable to condition either as tree or as mountain.

And now we come down to the very bottom of the problem. Since we do postulate Absolute Existence, and do not postulate a particular occult substance underlying each group of phenomena, are we to be understood as implying that there is a single Being of which all phenomena, internal and external to consciousness, are manifestations? Such must seem to be the inevitable conclusion, since we are able to carry on thinking at all, only under the relations of Difference and No-difference. We cognize any phenomenal object, as tree or mountain, only through certain likenesses and unlikenesses among our states of consciousness; and only through a revival of the same likenesses and unlikenesses can we represent the same object in memory or imagination. It may seem then that, since we cannot attribute to the Absolute Reality any relations of Difference, we must positively ascribe to it No-difference. Or, what is the same thing, in refusing to predicate multiplicity of it, do we not virtually predicate of it unity? We do, simply because we cannot think without so doing. Nevertheless we must bear in mind that the relations of Difference and No-difference under which we are compelled to do all our thinking, are relations just as subjective as any of the more complex relations of colour, or resistance, or figure, which are built up out of them; and we cannot say that there exists, independently of consciousness, anything answering to what we know as Difference or as No-difference. "This"—to quote Mr. Spencer—"is readily demonstrable. The sole elements, and the indissoluble elements, of the relation [of Difference] are these:—a kind of feeling of some kind; a feeling coming next to it, which, being distinguishable as another feeling, proves itself to be not homogeneous with the first; a feeling of shock, more or less decided, accompanying the transition. This shock, which arises from the difference of the two feelings, becomes the measure of that difference—constitutes by its occurrence the consciousness of a relation of difference, and by its degree the consciousness of the amount of difference; that is, the relation of difference as present in consciousness is nothing more than a change in consciousness. How, then, can it resemble, or be in any way akin to, its source beyond consciousness? Here are two colours which we call unlike. As they exist objectively the two colours are quite independent—there is nothing between them answering to the change which results in us from contemplating first one and then the other. Apart from our consciousness they are not linked as are the two feelings they produce in us. Their relation as we think it, being nothing else than a change of our state, cannot possibly be parallel to anything between them, when they have both remained unchanged." [1]

Since, therefore, the relations of Difference and No-difference, which lie at the bottom of our conceptions of unity and plurality, are shown to be subjective relations which cannot be predicated of objective existence, it follows that in strictness the Absolute Existence of which phenomena are the manifestations cannot be regarded as either single or multiple. Nevertheless, as was hinted a moment ago, by the very relativity of our thinking we must speak of it as either the one or the other. From this dilemma there is no escape. Yet, provided we recognize the purely symbolic character of the language employed, we may speak of Absolute Existence in the singular number; especially if we bear in mind that by such a mode of expression we mean merely to indicate that while the nature of That which is manifested in phenomena proves to be inscrutable, "the order of its manifestations throughout all mental phenomena proves to be the same as the order of its manifestations throughout all material phenomena." [2]

Here we touch upon a point which cannot profitably be considered until after we have expounded the axiom of the Persistence of Force and the Doctrine of Evolution which

[1] Spencer, *Principles of Psychology*, vol. i. p. 224.
[2] Spencer, op. cit. vol. i. p. 627.

is founded thereon. And before we can even begin with this exposition, there remain to be discussed sundry preliminary questions, which will occupy us through several chapters. For the present it will be enough for us to carry in mind, as the net result of the whole foregoing inquiry, the conclusion that the doctrine of relativity, when fully stated, affirms the objective existence of an Unknowable Reality, of which all phenomena whatever are the knowable manifestations.

With the statement of this conclusion, our chapter properly ends. It is desirable, however, that, before proceeding to consider the questions next in order, we should briefly sum up the results at which we have already arrived. By adding a little here and a little there, now a definite outline and now a bit of shading, we have gradually produced a rough sketch of a general theory of things. The inquiry will proceed through future chapters, in the hope of slowly converting this rough sketch into a more or less finished picture; but for the moment we may advantageously take a step backward, and contemplate, in a single view, the main characteristics of our work.

At the outset our philosophy was seen to be characterized by the assertion that all knowledge is relative,—an assertion which carried with it the rejection of all ontological speculation, whether metaphysical or theological, concerning the nature of that which exists absolutely. But in thus characterizing our philosophy we went but half-way toward defining it. In order to know thoroughly what anything is, we must also know what it is not. Few philosophers, since the seventeenth century, have rejected the doctrine of relativity. The footing upon which this doctrine stands resembles too much the footing upon which rest the demonstrated truths of physical science, to admit of its being explicitly rejected, unless by those bold spirits who, like Hegel,[1] do not scruple to hurl their anathemas in the face of physical science itself. It is none the less quite possible for the doctrine to be at the same time explicitly asserted and implicitly ignored. Berkeley and Hume, Kant and Hamilton, and Comte, have one and all asserted the relativity of knowledge and the vanity of ontological speculation. But our philosophy is not that of Kant, or Hamilton, or Berkeley, or Hume, or Comte. It is not the philosophy of Kant, for it denies that we can have any criterion of truth save that which is furnished by perfect congruity of experience. At the same time it differs in many respects from the experience-philosophy which is associated with the name of Locke; since it denies that the subject is the passive recipient of effects wrought by the object, and, accepting the Leibnitzian view that the subject actively cooperates with the object in each act of cognition, it grounds upon this very fact its doctrine of the relativity of knowledge. In its criterion of truth also it differs from the experience-philosophy of Locke and Hume as represented to-day by Mr. Mill; for it finds its criterion of truth in that indissoluble coherence among inner phenomena, which, in accordance with the postulate that all knowledge is the product of experience, must have been generated by an equally indissoluble coherence among outer phenomena. Thus, too, it avoids the empiricism which has in too many ways hampered the Lockian philosophy: for it keeps clear of the misconception that all truths are susceptible of logical demonstration, and recognizes the fact that at the bottom of all proof there must be an

[1] Even Hegel, indeed, in the following passage, admits the impossibility of knowing things in themselves:—"Das *Dingansich* als solches ist nicht Anderes als die leere Abstraction, von dem man allerdings nichts wissen kann, eben daran weil es die Abstraction von aller Bestimmung sein soll."—*Logik*, ii. 127. The admission, however, is in Hegel's case utterly fruitless, since he falls into the same inconsistency as Kant, maintaining that we have a test of truth independent of experience, and thus setting up the Subjective Method, as will appear in the next chapter.

ultimate datum of consciousness which transcends proof. Thus our philosophy can be identified neither with that of Kant nor with that of Locke. Again, it differs from the philosophy of Hamilton, both in other points not needful to be mentioned, and in this, that it does not regard the assertion of the doctrine of relativity as compatible with the assertion that we can know the primary qualities of matter otherwise than as modifications of our consciousness. But, while refusing to assist in this violation of the doctrine of relativity committed by the philosophy of Reid and Hamilton, it refuses also to join in the very different violation of the doctrine which is committed by the philosophy of Berkeley and Hume. For while it admits, to the fullest extent, the position that we can never know the Absolute Existence of which phenomena are the manifestations, it at the same time asserts that the doctrine of relativity cannot even be intelligibly expressed unless Absolute Existence is affirmed.

In this last assertion our philosophy declares itself antagonistic to Positivism. For the Positive Philosophy, refusing to deal with anything beyond the immediate content of observed facts, utterly ignores the Absolute Existence which is manifested in the world of phenomena, neither affirming nor denying it. I shall point out hereafter the complicated embarrassment in which this indifferent attitude has left the Positive Philosophy. It must suffice now to insist upon the fact that any philosophy which, like the system here expounded, affirms Absolute Existence is by such affirmation fundamentally distinguished from Positivism. Because our philosophy, like Positivism, rejects all ontological speculation; and because, like Positivism, it seeks to found itself upon scientific doctrines and employ none but scientific methods; and because, moreover, it is arrayed, like Positivism, in opposition to sundry popular metaphysical and theological doctrines; it is customary to confound our philosophy with Positivism, and thus to accredit us with a whole group of opinions which we unreservedly repudiate. Our philosophy, however, is quite as distinct from Positivism as it is from Idealism or Scepticism, or from the so-called Critical Philosophy of Kant. In all these systems we recognize a germ of truth; to all of them we acknowledge our indebtedness for sundry all-important suggestions; but to none of them do we owe allegiance.

In the case of Positivism, the error is, for reasons just now indicated, one which is likely to be often committed. And on this account I shall, in the course of the following exposition, have frequent occasion to examine and criticize the opinions characteristic of the Positive Philosophy. By the time we have arrived at the end of our journey, no possible excuse will be left available for those who would seek to identify our philosophy with Positivism.

But now for this system of philosophy, which, in our crude outline-sketch, is seen to be different from the systems of Locke, Berkeley, Hume, Kant, Hamilton, and Comte, some characteristic title is surely needed. There are, indeed, grave objections to be urged against fettering philosophy with names which may very soon come to connote divers unessential opinions of which philosophy would be glad to rid itself. Nevertheless we cannot get along without names. If only to avoid tedious circumlocution, some name is needed by which to designate this philosophy which has been rudely delineated. The required name is suggested by the definition of the scope of philosophy given in the second chapter of this work. It was there shown that, while acknowledging a common genesis with science and with ordinary knowledge, philosophy has still to concern itself with those widest truths which hold throughout all classes of phenomena, and with which science, restricted as it is to the investigation of special classes of phenomena, is incompetent to deal. In other words, we declared the scope of our philosophy to be the study of the universe or Cosmos; and in accordance with this definition, we may fitly designate our philosophy as Cosmic Philosophy. We shall hereafter discover in this epithet sundry points of fitness not yet indicated. But for the present we may go on to use the phrase whenever required, entrusting our complete justification to the inquiries which are to follow.

In conclusion, let me say a few words in reply to the objection, sometimes urged from metaphysical quarters, that such a philosophy as this Cosmic Philosophy, here sketched out, is not adequate to supply our highest intellectual needs. At the bottom of this objection, as at the bottom of that persistent clinging to ontological speculations (in spite of their often-demonstrated worthlessness) which we frequently meet with, there lies the vague half-defined belief that in giving up our knowledge of noumena or the Noumenon, we are leaving for ourselves nothing but shadows. "We increase the seeming unreality of that phenomenal existence which we can alone know, by contrasting it with a noumenal existence which we imagine would, if we could know it, be more truly real to us." But we are led astray by the unavoidable ambiguity of words. To make a supposition which savours somewhat strongly of hibernicism:—even if we could know objects apart from the conditions imposed upon them in the act of knowing, such (so-called) knowledge would be utterly useless. This is admirably illustrated in a passage from Mr. Spencer's "First Principles" with which I will conclude this chapter:—

"The maintenance of a correspondence between internal actions and external actions, which both constitutes our life at each moment and is the means whereby life is continued through subsequent moments, merely requires that the agencies acting upon us shall be known in their coexistences and sequences, and not that they shall be known in themselves.

If $x$ and $y$ are two uniformly connected properties in some outer object, while $a$ and $b$ are the effects they produce in our consciousness; and if while the property $x$ produces in us the indifferent mental state $a$, the property $y$ produces in us the painful mental state $b$ (answering to a physical injury); then, all that is requisite for our guidance, is, that $x$ being the uniform accompaniment of $y$ externally, $a$ shall be the uniform accompaniment of $b$ internally; so that when, by the presence of $x$, $a$ is produced in consciousness, $b$, or rather the idea of $b$, shall follow it, and excite the motions by which the effect of $y$ may be escaped. The sole need is that $a$ and $b$ and the relation between them, shall always answer to $x$ and $y$ and the relation between them. It matters nothing to us if $a$ and $b$ are like $x$ and $y$ or not. Could they be exactly identical with them, we should not be one whit the better off; and their total dissimilarity is no disadvantage to us."

Obviously this same illustration will apply equally to cases where moral injury or intellectual error is to be avoided. And since the ultimate function of philosophy is to be the intellectual guide of our lives,—since our ultimate aim in ascertaining the relations of coexistence and sequence among phenomena, is to shape our actions, physical, mental and moral, in accordance with these relations,—it follows that the philosophy whose character and scope I have here indicated is sufficient for our highest needs. And thus we are led to the conclusion that the object of that metaphysical philosophy which seeks to ascertain the nature of things in themselves, is not only unattainable, but would have no imaginable value, even if it could be attained. The proper attitude of the mind, when face to face with the Unknown Reality, is, therefore, not a speculative, but an emotional attitude. It belongs, as we shall by and by more distinctly see, not to Philosophy, but to Religion.

## CHAPTER V.

### THE SUBJECTIVE AND OBJECTIVE METHODS.

TOWARD the close of the preceding chapter I enumerated some of the principal characteristics which distinguish our Cosmic Philosophy, regarded as a synthesis of scientific truths, from the various metaphysical systems which, by overtly or implicitly contravening the doctrine of relativity, have sought to arrive at some higher or remoter kind of truth than that which the scientific coordination of experiences can furnish. So far as the psychology of the question is concerned, the doctrine of relativity, with its various implications, has been expounded as fully as is needful for our purposes. But this fundamental doctrine has also an all-important logical aspect, which we shall do well to consider in the present chapter. Having marked out the field to which our inquiries must be confined, the next thing in order is to indicate the Method upon which our inquiries must be conducted. The possession of a legitimate method of research is even more important than the possession of sound doctrine, since it is only through the former that the latter can be attained. Clearly we shall never reach Truth if we begin by mistaking our guide-post, and start on the road that leads to error. A false method leads to false doctrine which, reacting on the mind, confirms it in the employment of the false method. Hence the supreme importance which the history of philosophy attaches to those thinkers—like Aristotle, Bacon, Descartes, and Comte—who have signalized themselves as the founders of new methods. And hence the immense influence, for good or for ill, which such thinkers have exerted.

The two general views of philosophy which it has been the aim of the previous chapters to exhibit in radical opposition and contrast, are still farther distinguished by the adoption of two very different methods of inquiry. That metaphysical philosophy, which exhausts its energies in the vain attempt to frame tenable hypotheses concerning the objective order of things, reaches its ephemeral conclusions by the use of a method which, on grounds that will presently appear, is called the Subjective Method. The Cosmic Philosophy, which aims only to organize into a universal body of truth the sum of general conclusions obtained by science, adopts as the only trustworthy guide for its inquiries the method of science, which, in contrast to the other, is called the Objective Method. To describe these different methods, and thus to arrive at a clear notion of the practical distinction between a metaphysical and a scientific philosophy, is the object of the present chapter.

The subjective method rests upon the assumption that the possibilities of thought are coextensive or identical with the possibilities of things. Having built upon some subjective foundation, assumed as axiomatic, a given order of conceptions, it assumes that the order of phenomena must correspond to it. It is satisfied with confronting one thought with another thought, and does not trouble itself to confront the thought with the phenomenon. If its hypothesis is made up of congruous elements, it takes it for granted that the internal congruity must be matched by an external congruity. It applies to the order of conceptions a logical, not an experimental test. If its conclusions flow inevitably from its premises, it proclaims the conclusions as true, forgetting that the premises need testing as much as the inferences. It is ever on its guard against fallacies of ratiocination, but ever unprotected against fallacies of observation. If a conclusion is "involved in the idea," according to the current phrase, it assumes without challenge that it is also conformable to fact. That I may not be supposed to be caricaturing instead of describing the only method which can enable us to stir one step in ontological speculation, let me cite some of the canons of that method, as enunciated by its most illustrious masters.[1]

"There is one basis of science," says Descartes, "one test and rule of truth, namely, that whatever is clearly and distinctly conceived is true." Schelling tells us: "It is a fundamental belief that not only do things exist independently of us, but that our ideas so completely correspond with them that there is nothing in the things which is not in our ideas." And now let us hear Hegel: "What is Truth? In ordinary language we name the concordance of an object with our conception of it, truth. In philosophical language, on the contrary, truth is the concordance of the meaning with itself." Or, as one of Hegel's followers expresses it, in more characteristic terminology: "Since the Whole is ideally in the Mind, the I has only to yield itself to its I-hood, in order to see the Absolute in itself as there immediately given." To the same effect says Plato, in the Phædo: "It seemed to me, therefore, that I ought to have recourse to reasons, and in them to contemplate the truth of things. Thus always adducing the reason which I judge to be strongest, I pronounce that to be true which appears to me to accord with it; those which do not accord with it, I deny to be true." And in the Republic, he tells us: "Whenever a person strives by the help of dialectics to start in pursuit

[1] The illustrations given in the following paragraph may be found, along with others, in Mr. Lewes's excellent work on Aristotle, pp. 79–81, 103, 104.

of every reality by a simple process of reason independent of all sensuous information, never flinching until by an act of pure intelligence he has grasped the real nature of good, he arrives at the very end of the intellectual world."

Plato furnishes an excellent illustration of the statement above made, that a false method leads to false doctrine, which, reacting on the mind, confirms it in the employment of the false method. From the fact that a comparatively uninstructed mind can, with a little explanation, be made to perceive the necessary truth of a few simple geometrical axioms, and to follow the steps of a demonstration founded thereon,—Plato, in that charming dialogue, the Meno, infers that all knowledge is reminiscence. How could the uneducated youth have come by that knowledge which enables him to see at once that when a square is divided by a line which bisects the two opposite sides, the two portions are equal? The naïve reply is, that he must have acquired it in a prior state of existence, when the soul, not yet encumbered with the body, had free communion with Ideas. See what an enormous hypothesis Plato erects upon a slender basis of fact, and forthwith accepts as a justification of that very subjective method by the aid of which it was erected. For he elsewhere tells us that *since* all knowledge is a revival of pre-existent ideas, *therefore* "from any one idea we can arrive at all others, owing to the logical connection existing between them;" and in this conclusion he states the fundamental canon of the subjective method, as employed by modern metaphysicians from Descartes to Hegel.

This illustration shows us, in a curious and unexpected way, how intimately the Method of the *à priori* metaphysician is wrapped up with his Psychology, and how closely akin to each other have been the multifarious manifestations of the two in ancient and modern times. Between the subjective method and the doctrine of the *à priori* character of necessary truths the kinship is so close that Mr. Lewes is justified in declaring that "all that has been written on method [from the scientific point of view] is imperilled if there can be any valid evidence for the existence of an avenue through which knowledge may be reached without recourse to experience." Granting the *à priori* origin of necessary truths, the validity of the subjective method is established, at least so far as transcendental inquiries are concerned. It is therefore interesting to observe the remarkable similarity between the positions held respectively by Plato, Descartes, and Kant, with reference to this twofold question. In each case the psychological problem is to explain the existence of knowledge, or at least of conceptive faculty, that is apparently congenital, and that is also apparently inexplicable as the product of individual experience. How does the uneducated youth come by his rapid intuition of space-relations? Plato, as we have seen, replies with his hypothesis of reminiscence, Descartes with his hypothesis of innate ideas, and Kant with his hypothesis of *à priori* forms of thought; and between the three answers, in spite of the wide superficial divergences, how striking is the fundamental similarity! We shall hereafter see how the Doctrine of Evolution, proceeding strictly upon the objective method, supplies us with an interpretation which adequately accounts for the phenomena, but which leaves no room for the inferences which metaphysicians, from Plato to Kant, have founded thereon. Meanwhile, it has already been sufficiently proved that the universality and necessity of unconditional propositions, whether relating to space-relations or to any other relations whatever, must inevitably result from absolute uniformity in the organic registration of experiences, and therefore does not involve any *à priori* element.

For the present, returning to Plato, let us note some of the results to which his method not unnaturally led him, especially as we shall thus perceive the true affiliation of modern metaphysics upon the crude attempts of the ancients at general science, in so far as concerns the method employed. "We open the Timæus," says Mr. Lewes, "and learn that the Universe was generated as an animal, with a soul, because that was best. Whatever is generated must necessarily have body, and be visible no less than tangible. Nothing can be visible without Fire, nothing tangible without a Solid, nothing solid without Earth. Thus the first step in creation was the production of two elements. But it is impossible for two things to cohere without the intervention of a third. A bond is necessary, and of all bonds the most beautiful is that which as nearly as possible unites into one both itself and the things bound. Had the substance of the universe been a superficies without depth, one medium or bond would have sufficed: but as it was a solid, and solids are never one only, but always joined by two bonds, therefore the Creator placed Water and Air between Fire and Earth. These are the Four Elements, and the reason has been given why they are only four. The elements are fashioned into a perfect sphere, because the sphere is the most perfect of figures, and most resembles itself. Although this universe was made an animal, it was made becoming and congruous. Hence it had neither eyes nor ears, there being nothing external for it to see and hear; no lungs, for it needed not respiration; no digestive organs; no secretory organs; no feet, for its motion is peculiar, namely circular, and circular motion requires no feet, since it is not progression. The mathematicians having discovered the five regular solids, Plato naturally made great use of them in his cosmology. Four of them were represented by the four elements—the Earth was a Cube, Fire a Tetrahedron, Water an Octahedron, and Air an Icosahedron. This left the fifth, the Dodecahedron, without a representative; accordingly, it was assigned to the universe as a whole. . . . It is needless to add that Plato never thinks of offering any better reason for these propositions than that they are by him judged sufficient. If one of his hearers had asked him why water might not be a cube, and air an octahedron,—or what proof there was of either being one or the other,—he would have replied 'It is thus I conceive it. This is best.'[1] Let us proceed. The universe, we learn, has a soul which moves in perpetual circles. Man also has a soul which is but a portion thereof, consequently it also moves in circles. To make the resemblance more complete, man's soul is also enclosed in a spherical body,—namely, the head. But the gods foresaw that this head, being spherical, would roll down the hills and could not ascend steep places; to prevent this, a body with limbs was added, that it might be a locomotive for the head."[2]

It will perhaps be said that such speculations as these could not be found in the writings of any modern philosopher, no matter what his method might be; yet in view of certain vagaries presently to be cited from Hegel and Comte, it will hardly be safe for us to seek refuge in any general assertion as to the superiority of the moderns over the ancients in sobriety of philosophizing. These speculations of Plato exhibit in strong relief the treacherousness of the subjective method when left to itself and allowed to range at large over the field of phenomena. In ancient times there was no organized physical knowledge to stand in the way of such vagaries as those just cited. In modern times there exists an immense body of established scientific truth which checks the natural extravagance of the intellect left to itself. Moreover, as the subjective and objective methods have always coexisted, and as one has never been exclusively employed without the other, the majority of systems have worn a semblance of probability which prevents their shocking us like the almost

[1] It is to be noted, however, that this wildest use of the subjective method characterized Plato chiefly in his old age, when, like Comte, he had begun to assume a pontifical tone. Of this more anon.

[2] Lewes, *Aristotle*, p. 105.

purely subjective system of the Platonic Timaios. Nevertheless, that even modern science, in all the plenitude of its power, is unable to rein in the obstinately metaphysical mind, may be seen in the following morsel from Hegel, of all modern thinkers the most consistent in his adherence to the subjective, and in his scorn of the objective, method. "The substance or essence of matter," says Hegel, "is Gravity; that of spirit is Freedom. But matter is only heavy inasmuch as it tends to a centre. It is composite; its very existence is external to itself—*sie besteht ausser einander.* Thus the essence of matter consists in the search for a unity which would be its destruction." Speculations of this sort would not carry us very far toward the construction of a science of mechanics. Yet they are quite in keeping with the fundamental tenet "that Nature being only the result of the idea of a Creative Intelligence from which we ourselves emanate, we may, without the assistance of experience, and by our pure intellectual activity, find the Creator's ideas."

Compare also these explanations which the subjective method gives of the crying of newly-born infants. Physiology explains this crying as the result of the novel impression of the cool atmosphere upon the surface of the infant's body, and of the sudden inrush of air into the lungs, which combine to excite the reflex action of screaming. If there is anything distinctly psychical about it—which is in the highest degree improbable—it could be merely a sub-conscious sense of discomfort. But according to Hegel, the cry of the child just born indicates "a revelation of his exalted nature." "His ideas being excited into activity, (!) the child feels himself straightway penetrated with the certitude that he has a right to exact from the external world the satisfaction of his needs,—that the external world compared to the soul amounts to nothing." According, however, to Hegel's follower, Michelet, the cry of the new-born child reveals "the horror felt by the soul at being enslaved to nature;" or according to another German writer, it is an outburst of wrath on the part of the new-comer at finding himself powerless against environing circumstances! Wherein is all this better than the cosmological vagaries of Plato? Or wherein is it better than the speculations of those early Christian theologians who adduced the crying of the new-born babe in proof of its innate wickedness, and erected thereupon an argument in support of the doctrine that the unbaptized child is in danger of damnation?

These wilder extravagances of the subjective method may serve to illustrate for us the close kinship between metaphysics and mythology, and to justify the pregnant observation of Mr. Chauncey Wright, that the method of the *à priori* philosopher is but an evanescent form of the method employed by the barbarian in constructing his quaint theories of the universe. When deeply considered, the subjective method, whether employed by the metaphysician or by the mythmaker, will be seen to consist in following the lead of a train of associated ideas, without pausing to test the validity of the association by interpreting the ideas in terms of sensible experiences,—or, in other words, without confronting the order of conceptions with the observed or observable order of phenomena. As I have elsewhere observed, "it is through the operation of certain laws of ideal association that all human thinking, that of the highest as well as that of the lowest minds, is conducted; the discovery of the law of gravitation, as well as the invention of such a superstition as the Hand of Glory, is at bottom but a case of association of ideas. The difference between the scientific and the mythologic inference consists solely in the number of checks which in the former case combine to prevent any other than the true conclusion from being framed into a proposition to which the mind assents. Countless accumulated experiences have taught the modern that there are many associations of ideas which do not correspond to any actual connection of cause and effect in the world of phenomena; and he has learned accordingly to apply to his newly-framed notions the rigid test of Verification. Besides which the same accumulation of experiences has built up an organized structure of ideal associations into which only the less extravagant newly-framed notions have any chance of fitting. The primitive man, or the modern savage who is to some extent his counterpart, must reason without the aid of these multifarious checks. That immense mass of associations which answer to what are called physical laws, and which in the mind of the civilized modern have become almost organic, have not been formed in the mind of the savage; nor has he learned the necessity of experimentally testing any of his newly-framed notions, save perhaps a few of the commonest. Consequently, there is nothing but superficial analogy to guide the course of his thought hither or thither, and the conclusions at which he arrives will be determined by associations of ideas occurring apparently at hap-hazard.[1] Hence the quaint or grotesque fancies with which European and barbaric folk-lore is filled, in the framing of which the myth-maker was but reasoning according to the best methods at his command."[2] Obviously the broad contrast here indicated between modern and primeval thinking is at bottom simply the contrast between the use of the objective and the subjective methods,—between the constant recourse to experimental tests and the implicit reliance upon mere subjective congruity.

But it may fairly be urged that we ought to consider the

[1] Do we not see here how close is the connection, psychologically, between dreaming, insanity, myth-making, and reasoning according to the subjective method? It is not without reason that we commonly speak of the "dreams" of metaphysicians; and the distinguishing mark of insanity is the inability to test the validity of one's conceptions by confronting them with the phenomena. On the other hand it is in constantly applying the test of Verification that waking-thought, common-sense, and scientific reasoning exhibit their kinship with one another.

[2] *Myths and Myth-makers*, p. 216.

subjective method as exhibited in some of its more plausible proceedings, if we would properly contrast it with the objective method by which scientific discoveries are made. Let us do so; and, as we have just now alluded to the discovery of the law of gravitation as an instance of association of ideas corroborated by the employment of the objective method, let us choose our example from the history of that discovery. Doubtless the reasoning seemed very sound and plausible to the Greeks, which, starting from the assumptions that the circle is the most perfect of figures, and that all motion is naturally circular, proceeded to the inferences that the planets move in circular orbits, and that their motion is uniform. For twenty centuries this reasoning passed unchallenged. Until Kepler's time no one thought it necessary to make observations and ascertain whether, as a matter of fact, the planetary orbits were circular; nor previous to Galileo did any one think of verifying the premise that all motion is naturally circular; nor did it occur to any one that the conclusion might not inevitably follow from the premise, —since the planets might, as in fact they do, move in an orbit which is not the natural path of motion when uninterfered with. Now mark how ill it fared with this subjective order of conceptions as soon as it was confronted with the order of phenomena. In the first place, Galileo proved, by reasoning upon direct observations, that all motion is naturally rectilinear, and not circular,—that, if you could set a body moving, apart from all disturbing conditions, it would go on for ever in a straight line. This destroyed the premise of the subjective syllogism. Secondly, Kepler proved, by actual observation, that the planets do not move in circular orbits, with a uniform rate of velocity; but that they move in elliptic orbits, with a velocity which periodically increases and diminishes. This upset the subjective conclusion. And thirdly, the passage from premise to conclusion was seen to have been wrongly made, since while the planets would naturally move in straight lines (supposing the motion of each one to be independent), they do actually move in ellipses.

In this example is seen the essential vice of the subjective method, the feature by which it is distinguished from the objective method. It ignores Verification, which is the comparison, by means of observation, experiment and deduction, of the order of conceptions with the order of phenomena. Now verification is the great engine of the objective method. That method takes little heed of the Cartesian maxim, that whatever complex proposition can be distinctly formulated must be true; the history of science having only too frequently shown that a proposition may be very distinctly formulated and yet be false. "That the velocity acquired by a falling body, at any point, must be proportional to the *space* through which it had fallen," was a very distinct and plausible hypothesis, so long as it was not confronted with the phenomena. Yet it did not withstand the application of the test of truth, "since its negation *was* thinkable, and there was the equally distinct idea of the velocity being proportional to the *time* by which to oppose it. Then came the necessity for verification;" and by this criterion Galileo ascertained that the first-named conception—the one which had been held by the ancients—was erroneous, "and although the alternative conception which replaced it was not more intelligible, it had the supreme advantage of being a more accurate description of the order of nature." Therefore "in all verifiable cases we dare not be confident that an explanation is true because its truth seems possible. Our conceptions of possibility are too contingent to form a secure ground of deduction. Thus, to Galileo, it at first seemed possible that velocity must be proportional to space, because, in so conceiving it, he had not distinctly visible to his mind *all* the elements of the problem; in other words, all the possibilities." But when, in the process of verification the omitted elements of the case were brought before the mind, he discovered "that the seeming possibility was a fiction." The other alternative, that velocity is proportional to time, was found to be the true one, and the only one which could withstand the application of the test of truth. The counter-proposition, that the velocity is not proportional to the time,[1] is strictly unthinkable. For it involves the assertion that the same amount of gravitative force will cause, in a given second of time, an increment of velocity which is either greater or less than the increment of velocity which it will cause in the succeeding second. We are required to suppose, in the first case, an addition to the velocity without any addition to the force which causes it; in the second case, we are required to suppose a subtraction from the velocity without any subtraction from the force; and therefore, in either case, we are required to frame in thought an equation between something and nothing,—which is impossible.

Thus the objective method starts by verifying its premise; and, not content with any apparent congruity in its syllogistic processes, it does not definitely accept the conclusion until that also has been confronted with the phenomena. And, if in the verified conclusion there is involved an unexplained residuum, far from giving up its conclusion out of deference to some imaginary subjective necessity, it acknowledges the need of a new search in order to account for such residuum. The old conclusion, that planetary motion is circular and uniform *because* motion is naturally circular and uniform, left no unexplained residual phenomenon. As an explanation it was complete, though utterly false. If asked *why* the planets move in circles with a uniform velocity, the ancients

[1] To speak of the velocity as *proportional* to the time is, however, a somewhat lax use of mechanical terminology. Strictly speaking, the velocity is a *function* of the time and of gravity. Since gravitative force increases as the body approaches the earth, there are increased increments of velocity in successive equal times. Introducing this correction into the sentences which follow, the reasoning becomes strictly accurate.

might have replied, and in fact did reply, that it is because their motion is uninterfered with. On the other hand Kepler's theorem, that planetary motion is elliptical and rhythmically accelerated and retarded *although* motion is naturally rectilinear and uniform, left an unexplained residual phenomenon. As an explanation it was true, but it was incomplete. When asked *why* the planets do not move in straight lines with uniform velocity, Kepler recognized a difficulty which must be explained, and which he tried to solve. In his perplexity he had recourse to the subjective method, and suggested that the planets were perhaps living animals moved by their own volitions, or else that, as many of the Christian Fathers thought, they were controlled in their movements by presiding archangels. Could we read all the unwritten annals of that time, we should doubtless find that many educated persons rejected Kepler's discoveries on account of this unexplained residuum; attaching a higher value to the mutual congruity of a set of conceptions than to their verification. And in fact we know that many refused to accept the discovery of the accelerated and retarded motion of the planets, on the subjective ground that it was "undignified" for heavenly bodies to hurry and slacken their pace according to Kepler's law.[1] Now mark the different behaviour of the objective method. Attaching a higher value to ascertained conformity with observation than to any presumed subjective congruity of conceptions, Newton recognized the "unnatural" elliptic motion of the

[1] On similar grounds the Aristotelians denied the existence of the solar spots; it being impossible "that the Eye of the Universe should suffer from ophthalmia." See Proctor, *The Sun*, p. 163.—"How can we admit that Nature could so restrict herself as to form all organic and inorganic combinations in the mould of four substances, chosen at hazard,—hydrogen, hydrochloric acid, water, and ammonia,—and to produce nothing but variations on these four themes?" Remark of Kolbe, cited in Wurtz, *Introduction to Chemical Philosophy*, p. 97.—And in like manner we sometimes hear silly people reject the Darwinian theory on grounds of "dignity,"—it being supposed that we are, in some incomprehensible way, "degraded" by the discovery that our remote ancestors were dumb beasts.

planets and the "unnatural" variations of that motion as residual facts which needed to be explained by a verifiable hypothesis. Since the planets are deflected at every instant from the rectilinear paths in which their own momentum would for ever carry them, there must be some unknown force acting in composition with their momentum. What is that unknown force? That it was the same as the force which causes apples to fall, that it varied in amount in an inverse ratio to the square of the distance between the sun and the planet, and would therefore cause acceleration or retardation of velocity according as the planet in its elliptic path approached or receded from the sun,—all this was a most brilliant hypothesis, alleging no unverifiable agency, disposing of the unexplained residual phenomena, and making the Keplerian order of conceptions completely congruous. According to the subjective method, this was quite enough. And doubtless if Newton's mind had been constructed like Hegel's he would at once have announced his discovery on the strength of its presumed subjective necessity, and would have left it for some other more patient inquirer to verify its truth. But Newton, rigorously adhering to the objective method, saw that this was not enough. No matter how perfectly congruous the subjective order of conceptions may be in itself, it must be confronted with the observed order of phenomena and be shown to be congruous with that. According to the hypothesis the moon must be deflected on the average fifteen feet each minute from its natural rectilinear path. But Newton's own observations showed that this is not the case: the moon is deflected thirteen feet in each minute, and thus was revealed a discrepancy between the order of conceptions and the order of phenomena. It must ever be regarded as a truly sublime illustration of the exalted scientific character of Newton's intellect, that in an age when the inexorable requirements of scientific method were generally so little understood, he laid aside for many years his brilliant and plausible conjecture, as being a hypothesis which observation refused to verify. It was thirteen years after this first abortive effort had been made, that Picard's careful measurement of an arc of the meridian revealed the fact that the length of the earth's radius, and consequently the distance of the moon, had hitherto been inaccurately estimated. Thus Newton was enabled to resume his calculations, and by introducing the corrections now rendered necessary, to ascertain that the amount of the moon's deflection, caused by the earth's attractive force, should be on the average thirteen feet per minute ; as observation had shown to be the case. Thus, by the patient application of the objective method, the hypothesis of gravitation was verified, and became an expression of the observed order of phenomena.

I have dwelt at some length upon this concrete example, because it furnishes such manifold illustration of the difference between the metaphysical and the scientific modes of procedure. When rightly considered, it will also enable us to estimate at their proper value the claims of Bacon to be regarded as the chief inaugurator of modern philosophy, as well as the criticisms made upon those claims by Bacon's detractors. We frequently hear it said, on the one hand, that Bacon's great merit consisted in overthrowing the Deductive Method practised by the ancients, and in substituting for it the Inductive Method, upon which all modern scientific discoveries have been made. Now such assertions imply a total misconception of the true state of the case; and perhaps we cannot wonder that some critics believe that, in overthrowing them, they have removed Bacon from the high position which he has hitherto traditionally occupied. But this is a misconception as great as the other. The truth is, Bacon's admirers have advanced in his behalf claims which should never have been made ; while, on the other hand, his detractors, in showing the futility of these claims, have not really succeeded in taking away one jot or tittle of his rightful fame. In point of fact it was not Bacon's great merit, but his great deficiency, that he held in comparatively slight esteem the deductive method. This method is as trustworthy and as powerful as the inductive, provided it starts from verified premises, and ends by verifying its conclusions. Indeed in several of the sciences induction plays a quite subordinate part. Mathematics, mechanics and astronomy (so far, at least, as relates to the dynamics of the solar system) are almost purely deductive sciences, and in the chief problems of biology and political economy deduction is predominant. It was chiefly through deduction that Newton reached the law of gravitation, that Harvey discovered the circulation of the blood, that Goethe arrived at his grand generalizations concerning animal and vegetal morphology, and that Adam Smith obtained the fundamental principles of political economy, These facts are well known to Bacon's adversaries, who remind us also that, unlike Descartes, he never made any discoveries himself, and who further assert, with some exaggeration, that he never even worked out a scheme of induction which could be adopted and utilized by subsequent thinkers. It is true that Bacon never mastered any one science, as Descartes and Leibnitz mastered mathematics. Knowing little of mathematics he underrated the deductive method, which moreover had not yet been illustrated by the splendid triumphs of astronomy and physiology, and which to his mind was chiefly exemplified in what seemed to him the barren word-battles of the scholastic metaphysicians. It is also true that Bacon did not construct a thorough system of inductive logic whereby to illustrate his method. That great achievement was reserved for Comte and Mill; and indeed would have been utterly impossible at any time before the present century, during which the methods of the two chief inductive sciences, chemistry and molecular physics, have first been practically exemplified. All this we may cheerfully admit, without feeling called upon to abate our veneration for Bacon in the least. For after all this has been granted, the fact still remains that Bacon saw, more clearly than any of his great contemporaries, that the subjective method had been definitely weighed in the balance and found wanting, and that henceforth Verification must be insisted on as the essential prerequisite for every trustworthy conclusion. This was the all-important truth which Bacon set forth again and again, impressing it upon men's minds with that majestic eloquence and prodigious fertility of illustration which characterize all his philosophical writings. Nor was he blind to the inevitable results of banishing the subjective method. Bacon saw and declared that ontological inquiries, as not admitting of verification, must be condemned as fruitless; and he was the first to form that grand conception of philosophy, as an organic whole of which the sciences and scientific methods are the organs, which I endeavoured to describe in the second chapter of this work.

The popular misconception of the nature of Bacon's achievements rests upon a not unnatural confusion between the subjective and the deductive methods. The subjective method is indeed mainly deductive, but that is not the source of its weakness. It is not in reasoning downward from a general proposition to a special conclusion that the danger lies. The danger is in reasoning from an unverified premise to a conclusion which you do not stop to verify. Here we come upon the weak point in the system of Descartes. A mathematician whose genius and achievements have perhaps never been equalled save by Newton, Leibnitz, and Lagrange,—Descartes was not likely to underrate the value of deduction; but he overlooked the necessity for constant verification. Though his scientific career was far more brilliant than Bacon's—if, indeed, the latter can be said to have had any scientific career—his conception of philosophy was far less defensible than Bacon's conception. He admitted the necessity of verification in the so-called physical sciences; but between physiology and psychology he drew an arbitrary line, and thought that in the so-called moral sciences which lie beyond that line, verification might safely be dispensed with. Here, in this higher region, he said, all we have to do is first clearly to conceive some premise, and then to reason away *ad libitum*, as in mathematics, never fearing that the order of conceptions may not correspond with the order of phenomena. And this view of metaphysical method is grounded upon the psychological error, that in our transcendental or extra-sensible conceptions of Space, Time, Causality, etc., we possess "innate ideas" endued with a validity quite independent of experience, so that inferences logically deduced from such "innate ideas" can afford to dispense with objective verification.[1] The results of these incompatible teachings are written in history. In science Descartes has been the forerunner of Euler, D'Alembert, Lagrange, Laplace, Fresnel, Leverrier, and Helmholtz: in philosophy he has been the forerunner of Spinoza and Malebranche, Schelling and Hegel.

The subjective method, as laid down by Descartes, has been carried out in metaphysics by no one more rigorously than by Spinoza, the most inexorable in logical consistency of all metaphysicians. With mathematical nicety Spinoza reasoned out a complete system of ontology, in which the conclusions are so inseparably bound up with the postulates that in order to overthrow them it is necessary to begin by

[1] "The truth of a proposition is not given simply by showing that it is a necessary consequence from some preceding proposition; *that* is only showing the logical operation to have been irreproachable; and an operation may be accurately performed although its premises are inexact."—Lewes, *Problems of Life and Mind*, vol. i. p. 381.—Of course Descartes, as a mathematician familiar with the process of *reductio ad absurdum*, would freely admit this. But he would claim that there are sundry premises which, as being framed *à priori* in accordance with the constitution of the thinking mind, are not amenable to the jurisdiction of experience; and that hence conclusions drawn from these premises need be submitted only to a logical test.

invalidating the postulates. Could he have verified his postulates, he might have given us the outlines of a system of absolute truth, thus attaining a more wondrous eminence than Galileo or Newton. Unfortunately his postulates are just the kind of propositions of which it must be said that they can neither be established nor refuted: the data for verifying them are inaccessible, and must ever remain so. His system rests on the assumption that the noumenal cause is like the phenomenal effect as rendered in terms of consciousness, so that whatever is true of the one is *ipso facto* true of the other. Herein lay Spinoza's error. Here is the fundamental distinction between the deductive method as employed in mathematics, and as employed by Spinoza in metaphysics. Mathematics starts from simple propositions concerning quantitative relations of number and extension, which are verified once for all by a direct appeal to experience: it proceeds from the known to the unknown. Metaphysics, as treated by Spinoza, starts from complex propositions concerning substance *per se* and *causa efficiens*, which have not been and cannot be verified. It ventures into the unknown without having first secured a basis of operations in the known. So that, while Hegel was undoubtedly justified, from his own point of view, in declaring that the philosopher must either be a Spinozist or nothing, our refuge from the dilemma is to be found in our denial of the validity of that subjective method by the aid of which Hegel and Spinoza reached their conclusions. The method of mathematical deduction, as legitimately applied by Newton to verifiable postulates, led to a discovery prolific in permanent and magnificent results; as illegitimately applied by Spinoza to unverifiable postulates, it led to an isolated system of ontology, barren of results, accepted in its inexorable completeness by no one,—yet irrefutable, save by the refutation of all metaphysics.

Spinoza's ontological conclusions, being at once obnoxious and apparently inevitable, produced a crisis in philosophy, serving to raise doubts as to the validity of the subjective method, and to call in question the truth of the postulate that whatever is in the Idea is also in the Fact. It was thought necessary to stop and reconsider the processes by which our initial conceptions in metaphysics are obtained; and thus for more than a century pure ontological speculation was subordinated to psychological inquiries. Thus arose the great English school, whose especial function, with regard to metaphysics, has been to demonstrate, on psychological grounds, the relativity of all knowledge. This movement, begun by Hobbes and continued by Locke and Berkeley, though productive of many brilliant and permanent scientific results, was suicidal so far as metaphysics is concerned, for, as we saw in the preceding chapter, it has ended in the Scepticism of Hume, and the Positivism of Comte and Mill. The researches of Hobbes on the laws of association, the admirable though incomplete analysis of mental operations achieved by Locke, and Berkeley's explanation of the phenomena of vision, were genuine additions to our knowledge. But, as has frequently been pointed out, they were obtained only through the employment of the objective method. The precepts of Bacon, so thoroughly in harmony with the cautious and practical temper of the English mind, led these great thinkers to forsake the high road of *à priori* ratiocination for the surer though more tortuous path of patient observation; and so long as they adhered to psychology, they were really scientific inquirers, as much as if they had been physiologists or chemists. This departure from metaphysics was carried still farther by Hartley, who, working the deepest vein of the Lockian philosophy, prepared the way for James Mill to bring psychology still more thoroughly under the sway of scientific methods. But the imperfect condition of biology prevented the significance of this movement from being detected in the eighteenth century. The labours of Hartley were almost entirely overshadowed by the superficial sensationalism of Condillac and the crude materialism of Helvétius and Holbach. The distinctly inferior character of French psychological speculation since the death of Malebranche appears strikingly both in these shallow systems, and in the spiritualistic reaction against them which the present century has seen conducted by Laromiguière and Victor Cousin; a philosophy made up of mere tawdry rhetoric, quite innocent of observation and induction,[1] resting on passionate appeals to the testimony of *"le cœur;"* which finally, in our own times, has (it would appear) harangued itself to death. But in England and Germany things took a different course. The scepticism of Hume, as the most conspicuous consequence of Berkeley's profound analysis, produced a second crisis in philosophy, and led Kant to re-examine the psychological problem, in the hope of arriving at some positive result. We have already remarked upon the inconsistency in Kant's final conclusions; demonstrating as he did, on the one hand, the relativity of knowledge, yet on the other hand maintaining that in necessary truths we possess a kind of knowledge not ultimately referable to the registration of experiences. We have now to note how Hegel has based upon this doctrine of *à priori* knowledge an explicit and uncompromising assertion of the validity of the subjective method, which by reason of its very outspokenness proclaims itself as the *reductio ad absurdum* of metaphysics.

Starting from the postulate that deductions from *à priori* premises furnished by pure reason have a higher validity

[1] "Quiconque entre dans l'étude de l'esprit humain par la voie de la réflexion, marche droit au but. Quiconque ne suit d'autre méthode que la méthode expérimentale de Bacon et de Newton, ne court pas le risque, il est vrai, de tomber dans les hypothèses extravagantes, mais se condamne à des circuits immenses qui aboutissent à des résultats médiocres."—Cousin, *Philosophie Ecossaise*, p. 307. A fair sample of M. Cousin's appreciation of scientific method. The discovery of the law of gravitation, I suppose, was one of these "résultats médiocres"!

than inductions from premises supplied by sensible experience, Hegel speedily arrives at an ingenious solution of the antinomies which baffle the ordinary thinker who seeks to frame hypotheses concerning objective reality. The customary rules of ratiocination, based upon a collation of the results of sensible experience, are set aside with a high hand. If it be declared that we can and do cognize objects apart from the limitations imposed by our intelligence. the apparent contradiction in terms is no obstacle to Hegel. There is a contradiction no doubt, but what of that? Truth has been vulgarly supposed to consist in agreement. Not a bit of it: it consists in contradiction. This is one of the fundamental postulates of the Hegelian logic. The Test of Truth is not that "A is A," but that "A is *not* A." Everything which is, is that which it is not.[1] Non-existence exists, because it is a thought; pure Being also, in the absence of determinative conditions, is not distinguishable from Not-being; therefore Non-existence is the same as Existence, and contraries are identical. An idea is not a modification of the subject; an idea is the object. In coming into existence, the Idea comes into non-existence; it negatives itself. "But the process does not stop there. The negation itself must be negatived. By this negation of its negation, the Idea returns to its primitive force. But it is no longer the same. It has developed all that it contained. It has absorbed its contrary. Thus the negation of the negation, by *suppressing* the negation, at the same

[1] In a certain sense this statement is profoundly true. Nothing is itself without being to some extent something else. Or, in other words, it is impossible sharply to demarcate an individual entity from the remainder of existence, and to cognize it in individual isolation and completeness. For the simplest act of cognition involves a lapse of time, during which the individual entity cognized has lost certain attributes and acquired certain others, and has thus become different from itself. This is the obverse of the scientific truth that nowhere is there such a thing as Rest, or the maintenance of a given *status*,—a truth which lies at the bottom of the Doctrine of Evolution. Hegel's fault, however, is that he does not use this truth scientifically, but employs it as a formula to conjure with.

time *preserves* it." *This* side of the room is *the other side;* because, if you turn around, *this* is *that*, and *that* is *this;* and consequently everything is its own opposite. Everything is thus made easy. We may say, for instance, that matter is infinitely divisible, because it follows *ipso facto* that it is not infinitely divisible, and thus the Gordian Knot is cut.

In the eye of science, as in the eye of common-sense, all this is supremely ridiculous,—the very enthronement of Unreason. Yet the significance of the whole is lost if we fail to remember that Hegel was not a fool or a lunatic, but was unquestionably one of the clearest, strongest, and most consecutive reasoners that the world has ever seen. Much has been said of the unintelligibleness of Hegel,[1] and many a witticism has been made at his expense. But the unintelligibleness of Hegel does not result from indistinctness of thought or slovenliness of expression. On the contrary, it seems to me that his thoughts—or rather, perhaps, the symbols of his thoughts—are very distinct, and that his style of expression is remarkably simple, clear, and direct. When by chance he treats of sublunary topics, his style is often as pithy and lucid as M. Taine's. And had the contents of his thinking consisted of propositions formed from the colligation of sensible experiences, instead of propositions built up of empty verbal symbols, he would no doubt have taken rank among the greatest of the teachers of mankind. The world-wide difference between Hegel and Mr. Spencer, for example, does not consist chiefly in the fact that the latter is a clearer, more patient, and more logical reasoner; it consists chiefly in the fact that the symbols with which Mr. Spencer does his thinking are translateable in terms of sensible experience, while the symbols employed by Hegel are not

[1] The story is current that on being asked to explain some difficult passage written years before, the great metaphysician gave it up in despair, saying: "When I wrote that passage, there were two who understood it,—God and myself. Now, alas, God alone understands it!" A myth, no doubt, but crudely characteristic. like most myths.

thus translateable. The difference is, in the main, a difference of method. Indeed, when a man of Hegel's vast ability gives to the world, as the result of a whole life's arduous toil, such a system as the logic of contradictories above described, it is evident that there must be something incurably vicious in the method upon which he has proceeded. Yet that method is the subjective method in its absolute purity. Starting with the assumption that whatever is in the idea is in the fact, it makes but a short step to the assumption that whatever is in the word is in the fact. It mistakes words for ideas, and ideas for facts. Hobbes has somewhere said that "words are the counters of wise men, but the money of fools." They are certainly the money of Hegelism. That philosophy is built up of propositions which are verbally faultless, but which correspond to no reality, which are in the likeness of nothing existing or, in the true sense of the word, conceivable, in either the heavens above, or the earth beneath, or the waters under the earth. The contempt of Hegel for those deluded creatures, like Newton, who have spent their time in investigating facts, is both amusing and instructive. Far be it from Hegel's logic that it should stoop to look at facts. It makes a statement which is verbally perfect, and if the facts do not confirm it, so much the worse for the facts. Goethe, in one of his conversations with Eckermann, tells a pithy story about the founding of St. Petersburg. The Czar wished it to be situated on the low ground at the mouth of the Neva, so that it might resemble the Amsterdam where he had lived in his youth. An old sailor remonstrated, telling him that a town in that locality would be troubled by the frequent overflowing of the river; and pointed to an ancient tree upon which were marked the various heights to which the water had in past times ascended. But Peter refused to believe the testimony; the tree was cut down, that its unwelcome evidence might be suppressed, and the work of building went on. This was what Hegelism would be if carried out practically and transferred from the world of supra-sensibles to the world of phenomena. When a fact is unwelcome, just take the principle of contradiction, and cut it down. Hegel will not hear of verification; he looks with unutterable scorn upon such men as Bacon for insisting upon the necessity of it. And we need not therefore be surprised when we find him proclaiming the philosophic superiority of the Ptolemaic astronomy over the Copernican, for the subjective reason that it consorts better with the dignity of man that he should occupy the central point of the universe!

This opens to us a new point of view. Hegel is virtually a pre-Copernican. For him modern science and its methods are practically non-existent. His philosophy was born too late. It belongs to the twelfth century rather than to the nineteenth. He is a schoolman reared out of season. Here, I believe, we have the key to Hegel's position.

The realistic tendency—the disposition to mistake words for things—is a vice inherent in all ordinary thinking. It is a vice from which every thinker who would arrive at truth must begin by freeing himself. In all ages, men have fought over words, without waiting to know what the words really signified. Even great thinkers do not always escape the temptation. Mr. Mill, for example, speaks of Cæsar's "overthrowing a free government," as if Cæsar had been a contemporary of Pitt. He reasons solely on the strength of the word "free," forgetting that the "free government" overthrown by Cæsar was in reality a detestable mixture of despotism and anarchy. Words indeed are the money of all of us, until we learn, by severe discipline, to regard them merely as counters. But it was in the Middle Ages that realism was most uncurbed. In those days men maintained, with sober faces, that because we talk about Man in the abstract, there is an actually existing thing called Man, distinct alike from all individual men and from all men taken collectively. This and that man exist; all men exist; and Man exists likewise,—such was one of the fundamental theorems of the realistic philosophy.[1] Scholasticism was a long and hard-fought dialectic battle, in the course of which this realism, as an avowed system, was at last utterly routed. And the great result of scholasticism was the purification of Latin philosophic terminology from its realistic implications. By that long contest, which on a superficial view seems so barren of result, the English as well as the French, and all languages which derive their philosophic nomenclature from the Latin, have been incalculably benefited. There was no likelihood of a Hegel in any language which had passed through the scholastic furnace. But German had never passed through such an ordeal. Its philosophic terms had never been reduced to their real value. As Mr. Lewes very happily observes, it did not recognize the old *ignis fatuus* in its new *Irrlicht*. Nowhere but in Germany would a Hegel have been possible in the nineteenth century. And that the peculiarities of the German language are to a great extent responsible for his aberrations, has been acknowledged by later German critics. The testimony of Büchner, which on most vital points of philosophy I should be very slow to cite, is quite admissible here :—"The playing with high-sounding but thoroughly empty words has been the fatal vice of German philosophy. . . . We have often with justice been advised to translate our philosophic treatises into a foreign tongue, in order to rid them of their unintelligible verbiage. But assuredly few of them could bear the test." A similar com-

[1] "In the great mediæval doctrine of transubstantiation, the schoolman would have been the first to admit that no chemical analysis would detect any change in the consecrated elements. But he asserted that the individuality of the bread (its breadness) was exchanged for the individuality of Christ (his humano-divinity)." — Pearson, *Early and Middle Ages of England*, vol. i. p. 613. An excellent illustration of the realistic method. It was a noumenal, not a phenomenal change : the latter would have been "transaccidentation."

plaint, with especial reference to Hegel, has been made by Schopenhauer.[1]

Again, let us not fail to observe that in characterizing Hegel's logic of contradictories as repugnant to common-sense, we urge an objection which, however valid it may seem to us, would to one in Hegel's position have no weight whatever. For Hegel's fundamental postulate is that deductions from *à priori* premises furnished by pure reason have an incomparably higher validity than inductions from premises supplied by sensible experiences; and consequently, while we are seeking to found philosophy in common-sense —or in science, which is simply common-sense rectified, extended, and methodized,—Hegel, on the other hand, entertains no such purpose. Philosophy, with him, lies quite out of the range of common-sense,—which is merely the organization of sensible experiences,—and if there be conflict between the deliverances of the two, it is common-sense that must go to the wall. With this perfectly logical, though practically absurd, conclusion, we may fitly compare Schelling's declaration that philosophic truth is to be attained only through the exercise of a faculty superior to reason; which faculty Schelling called "Intellectual Intuition." This "was not supposed to be a faculty common to all men; on the contrary, it was held as the endowment only of a few of the privileged: it was the faculty for philosophizing. Schelling expresses his disdain for those who talk about not comprehending the highest truths of philosophy. 'Really,' he exclaims, 'one sees not wherefore Philosophy should pay any attention whatever to Incapacity. It is better rather that we should isolate Philosophy from all the ordinary routes, and keep it so separated from

[1] Schopenhauer, indeed, quite loses his patience over Hegel's verbal legerdemain, and calls him a "geistlosen, unwissenden, Unsinn schmierenden, die Köpfe durch beispiellos hohlen Wortkram von Grund aus und auf immer desorganisirenden Philosophaster." (!) I quote from memory, and cannot now recover the passage where this outbreak occurs.

ordinary knowledge that none of these routes should lead to it. The highest truths of science (!) cannot be proved, they must be apprehended; for those who cannot apprehend them there is nothing but pity; argument is useless.'"[1] Here in the explicit rejection of the fundamental conception of Cosmic Philosophy as a further organization of science, which is itself a further organization of common knowledge, we see at the same time the most explicit adoption of the subjective method. And it is worthy of note that, in this emphatic declaration, modern metaphysics ends in precisely the same *reductio ad absurdum* in which ancient metaphysics met its doom. The incompetence of ordinary reason to construct a science of ontology having been fully demonstrated, the task is transferred, by Schelling as by Proklos, to a "divine light," which is supposed to irradiate the souls of a few privileged teachers. Obviously this is equivalent to the confession that, as a process of rational investigation, the subjective method has been definitely tried in the balance and found wanting. For to recur to a "divine light," or to seek refuge in the identity of contradictories, is only to show the more convincingly that human thought cannot, save by a mere jugglery of words, even appear to escape from the conditions under which alone is valid thinking possible.

We have now sufficiently illustrated, by concrete examples, the difference between the subjective and objective methods, which is the practical difference between metaphysics and science. We are accordingly in a position to consider, somewhat more closely than we have hitherto done, the essential point of difference between the scientific mode of philosophizing which we accept and the metaphysical mode of philosophizing which we reject. It is well that, in our polemic against metaphysics, there should be no room left for ambiguity or misconception. It has already been sufficiently explained that in doing away with metaphysics we do not set

[1] Lewes, *History of Philosophy*, 3rd edit. vol. ii. p. 522.

aside philosophy, but place it on a firmer foundation than before. And while it is thus apparent that we have not identified metaphysics with philosophy, it is also evident that we have by no means fallen into the vulgar error of identifying it with psychology, or the inquiry into the phenomena of consciousness, which is as much a science as chemistry or physiology. How, then, shall we precisely define the metaphysics against which we have, during these five chapters and from various points of attack, been waging war?

To arrive at the true meaning of "Metaphysics," we can hardly do better than go back to the historical origin of the word. Aristotle wrote a treatise on Physics, and also an elaborate dissertation upon sundry transcendental topics, which being placed immediately after the other in his collected works, received the title of *τὰ μετὰ τὰ φυσικά*, or "Things-which-come-after-the-Physics." It was in this way that the term came into use; and it needs but little playing with the elastic significance of the preposition, to arrive at a thoroughly just idea of the meaning of the expression. Metaphysics, thus considered, means a set of inquiries which lie beyond the bounds of Physics. Physics,—in the widest sense of the word,—dealing solely with phenomena in their relations of coexistence and succession, metaphysics deals with something lying beyond the phenomena A physical explanation is content with analyzing phenomena as it finds them; a metaphysical explanation is not content until it has added something not given in the phenomena. Metaphysics, therefore, is not confined to psychology, but may deal with any subject, and has in fact obtruded its explanations upon most subjects. When mercury was seen to rise in a tube, in apparent contradiction to the general phenomena of gravity, metaphysics said that it was because "Nature abhorred a vacuum." Physics, without going beyond the facts given in the case, explained it by a reference to the pressure of the atmosphere upon the mercury without the tube. So the phenomena of causation were metaphysically explained by the supposition of a specific hidden power in the cause, which constrains the effect to follow. Hume denied the existence of any such specific hidden power, and his denial was also metaphysical, because neither the presence nor the absence of such a specific power is a necessary inference from the phenomena. If we would keep clear of metaphysics, we must in such a case neither affirm nor deny concerning a subject which lies utterly beyond our reach. Physics knows nothing of causation except that it is the invariable and unconditional sequence of one event upon another: whether the one event, in a metaphysical sense, *constrains* the other to follow it or not we cannot tell. Physics knows nothing of such constraint —neither that it exists, nor that it does not exist.

For the moment I have, somewhat too freely, used the word "physics" as synonymous with "science"; for I have aimed at bringing out the fundamental distinction between metaphysics and science,—which is this:—*A scientific explanation is a hypothesis which admits of verification,—it can be either proved or disproved; while a metaphysical explanation is a hypothesis which does not admit of verification,—it can neither be proved nor disproved.* Newton's hypothesis of gravitation, to account for the planetary motions, was strictly scientific; and so was Descartes' hypothesis of vortices, to account for the same phenomena. The former admitted of proof, and the latter admitted of disproof. But Stahl's hypothesis of a Vital Principle, to account for the phenomena of life, was strictly metaphysical. Whether it is true or not, we can never know. Push our researches as far as we may, we can know life only as the assemblage of certain phenomena, displaying the activity of certain forces. Whether in addition to this there is a Vital Principle or not, no amount of research can ever tell us. Science has simply nothing to do with it.

Thus we see that the fundamental difference between metaphysics and science is the difference between the subjective and the objective methods. That the difference in method is more fundamental than the difference in the character of the objects which are studied, is shown by the fact that "a theory may be transferred from metaphysics to science, or from science to metaphysics, simply by the addition or the withdrawal of its verifiable element." Thus, as Mr. Lewes observes, "the law of universal attraction becomes pure metaphysics if we withdraw from it the verifiable specification of its mode of operation. *Withdraw* the formula, 'inversely as the square of the distance and directly as the mass,' and Attraction is left standing—a mere 'occult quality.' Indeed the Cartesians reproached it with being such an occult quality, and stigmatized it as a revival of Aristotelianism. On the other hand, *add* this verifiable formula to the 'inherent virtue' of the old metaphysicists, and the result is a strictly scientific proposition." [1]

Here also is revealed the inherent weakness of metaphysics: it is incapable of making discoveries. For verification is absolutely essential to discovery. No theorem can be accepted as a discovery until it has been verified, and the theorems of metaphysics do not admit of verification. Hence the utter barrenness of the metaphysical method. From Thales downwards—according to the current reproach —philosophers have been disputing over the first principles of their subject, and are now no nearer to a solution than when they began to dispute. It is not, however, as is sometimes superficially supposed, because metaphysicians disagree, that their method must be rejected by any philosophy which would found itself upon science; but it is because their disagreement can never end in agreement,—can never lead to knowledge. Since there will always be room for difference of opinion on many subjects, until the human mind shall have explained and classified all the phenomena of nature, it cannot be demanded of any system of philosophy that it

[1] Lewes, *Aristotle*, p. 84.

shall admit only such conclusions as are not open to controversy. Such a requirement would virtually prohibit philosophy altogether. The difference between a scientific and a metaphysical theorem is not that the former is not open to controversy, but that it admits of verification; it can, either now or at some future time, be proved to be either true or false. All such theorems may be admitted by a scientific philosophy. Until they have been verified, we may take account of them provisionally, as legitimate hypotheses: after they have been put to a crucial test, we may either incorporate them with our philosophy or definitely abandon them. Our philosophy, therefore, like all the sciences whence it obtains the general truths which it seeks to organize into a body of universal truth, may admit any number of subjects of dispute; but it can admit no question as a fit subject of dispute, which, from the nature of the case, can never be settled. It is perfectly in keeping, for example, for two upholders of the Doctrine of Evolution, as well as for two scientific specialists committed to no general doctrine, to hold opposite views concerning the hypothesis of spontaneous generation. Since this is strictly a scientific hypothesis, dealing solely with phenomena, and invoking no unknowable agencies; and since there is no reason, in the nature of things, why it should not sooner or later be established or overthrown by some crucial experiment; there is nothing anomalous in the fact of two such thoroughly scientific evolutionists as Prof. Huxley and Dr. Bastian holding opposite opinions as to its merits. But it would not be in keeping for two scientific philosophers to wrangle over Leibnitz's doctrine of Pre-established Harmony, because that is a hypothesis which can never be proved or disproved. The data necessary for its verification do not exist, and therefore no system of philosophy, which would keep clear of metaphysics, can recognize it as a legitimate subject for investigation. Again, in the eighteenth century there were two rival theories of light. According to the theory of Newton, a ray of light is a linear series of material corpuscles, darted from the luminous object. According to the theory of Huyghens, a ray of light is a system of molecular undulations which move outward in ever-increasing concentric shells whose normals are radial, and which are set in motion by undulations among the molecules of the luminous object. At the beginning of the present century the corpuscular theory was submitted to a set of crucial investigations which overthrew it; and more recently the undulatory theory has been submitted to a course of crucial investigation which has finally established it. Both these theories were scientific in conception, and previous to the researches of Young and Fresnel a scientific philosopher might have consistently espoused either. Such are the controversies of science, which sooner or later have always led, and will always lead, to agreement and to knowledge. Far different is it with the disputes of metaphysics, which—conducted upon the subjective method, and dealing with unverifiable hypotheses—have never led, and can never lead, to anything but an endless renewal of dispute, *in sæcula sæculorum*.

In this condemnation of the subjective method, the Cosmic Philosophy here expounded is entirely in harmony with the Positive Philosophy, as set forth in Comte's first great work, and as held by M. Littré and Mr. Mill. Indeed there is probably nothing in the present chapter which might not be cited by the Positivist in confirmation of his opinions as to the limits of philosophical inquiry. The Positive Philosophy is based upon the assertion of the relativity of all knowledge; and, however fatally inadequate may have been its psychological interpretation of that doctrine, there is no ground for accusing it—as represented by Mr. Mill and M. Littré—of inconsistency in its adherence to the scientific method for which the doctrine of relativity supplies the justification. Since Bacon's time there have been few thinkers who have insisted more strenuously than Comte upon the necessity of distinguishing between legitimate and illegitimate hypotheses, or who have more clearly prescribed the conditions under which alone can any given hypothesis be regarded as legitimate. Unfortunately, by a strange and ironical fate, the writer who contributed so much toward the establishment of sound methods of philosophizing, lived to become a proficient in the subjective method, a pitiless scorner of crucial experiments, and a weaver of vagaries which might well be matched with those above cited from Plato and Hegel. The historical importance of this phenomenon is great enough to justify us in treating it at some length.

Though in Comte's earlier works a somewhat obtuse sense of the requirements of verification is now and then to be noticed; and though there is a tendency, which visibly increases toward the end of the "Philosophie Positive," to substitute intensely dogmatic *ex cathedrâ* dicta in the place of arguments; yet the necessity for strict obedience to the objective method is nowhere explicitly denied. It is insisted, with entire justice, that every hypothesis which does not admit of verification should be remorselessly discarded from philosophy; and that even a verifiable hypothesis should never be incorporated as a part of philosophy or science until it has been actually verified. Far different is the attitude taken by Comte in his later works, when he is attempting to reconstruct society. In the "Politique Positive" he begins by endeavouring to reinstate the subjective method; deluding himself, by a play upon words, into the belief that that method can be so reformed as to become available in the search for positive truths. "The subjective method," he tells us, "possesses striking advantages which can alone compensate for the inconveniences of the objective method." This unhappy sentence is of itself enough to show how far the writer had strayed from positive grounds. Here we see the necessity for constant verification characterized as an "inconvenience," and the liberty to string together premises and conclusions without ever stopping to test their conformity to facts is called a "striking advantage." Nothing could be more thoroughly metaphysical in temper. The "inconvenience" of the objective method is the inconvenience of being often obliged to stop and confess our ignorance of many things we should like to know, our lack of many data we should be glad to possess. The "striking advantage" of the subjective method is no other than the advantage enjoyed by the metaphysician of being permitted to persuade himself that he has arrived at complete knowledge because he has never stopped to confront the order of his conceptions with the order of phenomena. But let us continue with Comte: "Our logical system can be rendered complete and durable only by the intimate union of the two methods. History does not authorize us to regard them as radically irreconcilable, provided that both are systematically regenerated in accordance with their common function, intellectual and social. To yield to theology the exclusive privilege of using the subjective method is as unnecessary as to see in theology the only legitimate basis of religious feeling. If sociology may possess the latter, it may also possess the former, as the two are intimately connected. To this end it is enough that the subjective method, renouncing the vain search into efficient and final causes, should henceforth, like the objective method, be employed solely in the discovery of natural laws, whereby our social condition may be ameliorated." [1]

I do not know where one could find a passage, in the literature of modern philosophy, more lamentably confused in its ideas than this. The subjective method says that verification is not necessary; the objective method says that verification is necessary; and yet we are told that the two are not "radically irreconcilable!" It is proposed to "regenerate" the subjective method: yet there is no way of

[1] *Politique Positive*, tom. i. p. 455.

regenerating it save by forcing it to verify its premises and conclusions; and when this is done, it ceases to be the subjective and becomes the objective method. But Comte thinks this is not necessary; the subjective method may be used provided it be employed only upon scientific questions, only in ascertaining the laws of phenomena. That is to say, as long as you confine yourself to scientific questions, and leave theology and metaphysics alone, you may imagine some plausible hypothesis and then reason away until you have worked out a whole theory of natural phenomena, never stopping to observe or experiment, but dogmatically proclaiming your conclusions as infallible because they seem to flow logically from the premises! Can it be that we are here listening to the man who spent one half of his life in investigating the history of science,—the man whose labours did so much toward renovating inductive logic? The whole history of science proclaims the utter absurdity of the position taken by Comte. The subjective method has been employed, from the earliest times, upon purely scientific questions which took no note of causes, efficient or final; and its eternal impotence is illustrated upon every page of the annals of scientific error. In molar physics, it led to the doctrine that all motion is naturally circular; in astronomy it persuaded men that the sun and planets move in circular orbits about the central earth; in chemistry it instigated many generations of experimenters to the fruitless effort to convert lead or iron into gold; in physiology it suggested the notion that the arteries are air-vessels, and caused that notion to be held for centuries; in pathology it sanctioned the fallacy that fever is an unnatural exaltation of the powers of the organism,—a fallacy which has sacrificed many a valuable life to the lancet; in political economy it favoured the delusion, born of selfish instincts, that the commercial interests of each community are antagonistic to those of the communities with which it trades,—a delusion which is responsible for much foolish warfare, and which underlies the whole iniquitous system of so-called "protective" tariffs by which so many countries are even yet impoverished. Verily this illegitimate deduction, which verifies neither premise nor conclusion, but relies wholly on subjective coherence, has been tried quite long enough by the test which Comte recommends for it. Just so far as men have verified their hypotheses, either by direct observation, or by deduction based on observation, have they extended the boundaries of knowledge. Just so far as they have neglected such verification, have they gone astray amid the countless vagaries which have ever loved to encumber the path of scientific inquiry. To admit that we do not know what we have not verified requires rare self-denial, no doubt; a self-denial to which nothing, save the patient habit of scientific inquiry, can fully accustom us. This is the "inconvenience" of which Comte speaks, as attaching to the objective method. But mankind are fast reaching philosophic maturity; and we are already getting too thoroughly used to the requirements of science to be much longer content with the childish device of playing that whatever is in our ideas is in the facts. Whatever may be our failings in practice, we have become nearly unanimous in the declaration that before any hypothesis can be accepted it must be verified.

Strange that in the latter half of the nineteenth century these criticisms should still need to be made! Stranger still that they should be called forth by the writings of the great successor of Bacon and organizer of positive philosophy! Strangest of all that able men should still be found so imbued with the spirit of discipleship as to resort to all manner of logical subterfuges in order to destroy their force! Yet to show that I have by no means exaggerated the perversity of Comte's position, let me cite a page from Mr. Mill. "Among all the aberrations of scientific men, Comte thinks none greater than the pedantic anxiety they show for complete proof, and perfect rationalization of scientific processes. It ought to be enough that the doctrines afford an explanation of phenomena, consistent with itself and with known facts, and that the processes are justified by their fruits. This over-anxiety for proof, he complains, is breaking down by vain scruples the knowledge which seemed to have been obtained; witness the present state of chemistry [in 1854]. The demand of proof for what has been accepted by Humanity . . . . is a revolt against the traditions of the human race. So early had the new High Priest adopted the feelings and taken up the inheritance of the old." Mr. Mill goes on to remark upon the new sense in which he began to employ his famous aphorism that "the empire of the dead over the living continually increases." "As is not uncommon with him, he introduces the dictum in one sense and uses it in another. What he at first means by it is, that as civilization advances, the sum of our possessions, physical and intellectual, is due in a decreasing proportion to ourselves, and in an increasing one to our progenitors. The use he makes of it is, that we should submit ourselves more and more implicitly to the authority of previous generations, and suffer ourselves less and less to doubt their judgment, or test by our own reason the grounds of their opinions. The unwillingness of the human intellect and conscience, in their present state of 'anarchy,' to sign their own abdication, he calls 'the insurrection of the living against the dead.' To this complexion has positive philosophy come at last!"[1]

To realize the completeness of the break between Comte's earlier and later speculations, we have only to remember that the deepest of all the distinctions which he sought to establish between positive philosophy on the one hand and metaphysics and theology on the other, is the ineffaceable distinction of method: the one insists upon objective

[1] Mill, *Auguste Comte and Positivism*, p. 162.

verification, while the others are content with subjective congruity. Yet here we see Comte explicitly and with vehement dogmatism repudiating observation and experiment, and maintaining, as unreservedly as Hegel, that so long as our conceptions are systematic and mutually harmonious, it makes no difference whether they are verified or not!

It would be an interesting study to trace in detail the circumstances concerned in bringing about this singular aberration of a great scientific intellect. For while the proclamation of the subjective method, and its more or less consistent employment, by Descartes and Hegel, was logically based upon their erroneous psychological theories concerning the sources of knowledge; on the other hand, this metamorphosis in the opinions of Comte had no logical justification whatever, but was determined by circumstances of a purely personal character. It was due partly to what I may call the impatience of constructiveness,—the imperious mental demand for the erection of a system at whatever cost,—and partly upon the exaggerated over-estimate of self which is a symptom of incipient monomania.

In his youth Comte was an insatiable reader, and before he began the work of constructing the Positive Philosophy he had amassed vast stores of learning in almost every department of knowledge. There is no good reason for doubting that in 1830, when the publication of his great work began, he was, with a few serious exceptions, fully abreast of the best science of the times. But in the course of the twelve years during which the composition of this work went on, he found it desirable to alter his habits of study. Finding that constant attention to the progress of events interrupted the consecutive development of his thoughts, he began to abstain from all reading whatever, save in a few of his favourite poets. Still later in life he erected this practice into a general principle of action, and as a matter of conscience refused to take any note of the proceedings going on about him in the intellectual world. He utterly neglected not only newspapers, but also contemporary works on science, and even scientific periodicals, and devoted himself almost exclusively to music and to æsthetic or devotional literature, such as Homer, Dante, Thomas à Kempis, St. Augustine and Bossuet, Molière, Fielding and Lesage. This holding aloof from the course of contemporary speculation, he called "cerebral hygiene." It should rather be regarded as a source of mental one-sidedness than as a source of mental health. I have no intention of depreciating the vast amount of invaluable food for thought which is to be obtained from the study of such books as those just named. Without studying Homer and Dante and Molière and the rest, one can get but a very meagre notion of human history as concretely revealed in the thoughts of past generations. Nor can it be denied that there was much that was truly sensible in Comte's plan of leaving off study when about to write. The successful expositor of a system of thought is not the man who is always cramming, and who perhaps keeps but a few weeks in advance of the particular theme which he is expounding. It is the man who by long years of patient thinking has completely mastered the system, and has it so thoroughly elaborated in his mind that he can sit down and write it out of the fulness of his knowledge, without needing to look at books. And in such cases it is no doubt desirable to shut oneself up and allow nothing to distract the mind until the work is accomplished. So far, Comte was doubtless wise in doing as he did. But beyond this point, there is no wisdom in keeping aloof from contemporary matters. As soon as writing is done, reading should begin again; every conclusion should be carefully verified, and every statement revised in the light of the newest science. Otherwise room is left for the subjective method to enter, and opportunity is given the mind to tickle itself with the belief that it has reached finality on some points. There is no safety for the thinker who isolates himself, year after year, from the work which his contemporaries are doing. Such a proceeding, as Comte's experience is enough to show, is fraught with grave dangers, both intellectual and moral. The intellectual danger is that the thinker will be left hopelessly in the rear of the scientific movement of the age; will lose, from lack of the requisite stimulus supplied by open criticism and argument, the habit of bringing all his conclusions to the test of verification; and will thus gradually fall into the habit of reasoning upon his plausible hypotheses as if they were established. The moral danger is that which menaces all isolation, social or intellectual,—the danger of excessive egoism, of over-confidence in one's own conclusions, and undue respect for one's own achievements. It is well enough for a writer to be dogmatic, provided his dogmatism is sustained by vigorous argument. But the writer is past all hope who habitually thinks to make loud assertion do the duty of argument; and this is a habit into which every one is more or less liable to fall who is not constantly coming in contact with other thinkers, and forced continually to defend his conclusions by the objective appeal to universally admitted principles.

I believe these considerations will go far toward accounting for the unfortunate position taken by Comte toward the close of his life. Always of a warm and enthusiastic temperament, self-confident to an inordinate degree, and vain with more than a Frenchman's vanity, during his long period of isolation these traits and tendencies were unduly strengthened. The consciousness—to a certain extent well founded—of the grandeur of the task which he had accomplished, grew upon him apace; and not taking note of the serious defects and omissions which advancing science was constantly disclosing in that work, he became more and more settled in the conviction that it was final, so far as it had gone. Measuring all his newly-framed hypotheses solely by their congruity with the general system of his conceptions, he gradually lost the scientific habit. He ceased to take into account the fact that what seemed a necessary inference to him would not necessarily seem so to minds differently moulded, unless sustained by the requisite proofs Thus he emerged from the scientific into a pontifical state of mind, in which, just as with Plato in his old age, it was enough that an opinion seemed true to him for him straightway to proclaim it as binding on all men.[1] Moreover it is not improbable that his too exclusive intercourse with the devotional writers of the Middle Ages had much influence in generating that mystical tone which characterizes all his later writings. The "Imitation of Christ" is a noble work, which has been a comfort to many generations; but it is hardly a suitable book with which to nourish one's habits of scientific thought. By long contemplation of the many admirable features of mediæval civilization—features to which no previous writer had done such unstinted justice—Comte came at last to forget his relative point of view, and in his horror of revolutionary anarchy he began to imagine that certain points of medi-

[1] In its initial scientific attitude and in its final grotesque vagaries, the career of Plato's mind may be instructively compared with that of Comte's. In his earlier dialogues Plato professes to be, like Sokrates, a mere investigator of the methods by which trustworthy knowledge is obtained; just as Comte, in his first great work, is simply a co-ordinator of scientific methods and doctrines. In the Parmenides and Theaitetos, indeed, we may find, as strikingly presented as in any modern treatise, the antinomies or alternative impossibilities which, like the lions before Palace Beautiful, confront the pilgrim on either hand whenever he seeks to cross the barrier which divides the realm of science from that of metaphysics. But at a later period we find Plato, like Comte, renouncing the scientific attitude, and setting himself up as the founder of an ideal Community, in which the pervading tendencies which have shaped actual societies were to be ignored or overridden, and in which existence was to be made intolerable to all persons not built after the Platonic pattern. And finally we have seen Plato, in the Timaios, working out a system of the universe in accordance with his own subjective conceptions, and making a very sorry piece of work of it when compared with contemporary science as displayed in the writings of Hippokrates and Aristotle; just as Comte, in his latest years, began to write a "Subjective Synthesis" in which scientific truths are fearfully and wonderfully travestied. Historic parallelisms are often very misleading; but the parallel here indicated is one which I believe the most sedulous examination will justify.

ævalism might be again revived and engrafted upon our modern life. Thus by degrees he framed the conception of a sort of Neo-Catholicism, with power as unlimited and ceremonies as complicated as the old one, but with the science of 1830 substituted for evangelical theology, and with Comte installed as sovereign Pontiff. As a natural result of this new position, his self-confidence grew until it became even too great to be ludicrous. Literary history affords us no other example approaching to it, unless, as Mr. Mill suggests, in the case here and there of some "entirely self-taught thinker who has no high standard with which to compare himself." He habitually alludes to himself as the peer of Aristotle and St. Paul combined; or as the only really great philosopher, save Descartes and Leibnitz, who has been seen in modern times.

When in a future chapter we come to examine the system of polity which awakened in Comte such transcendent self-commendation, we shall find, as might be expected from the subjective method pursued, but little that is of value to reward our search; although there are detached speculations of great interest, serving to remind us that we are dealing with a mighty though fallen thinker, and not with an undisciplined pretender. For the purpose of the present chapter it will be enough to note some of his latest philosophic vagaries, in which, pushing the subjective method to the limits of self-refuting absurdity, he maintained that all science should be remodelled in conformity to the requirements of the imagination. Missing links in the geological series of plants and animals should be supplied by fictitious "constructions of the reason," so that our craving for symmetry may be appeased. Above all, science must be as far as possible deprived of its "dryness," and vivified by "sentiment." To this end it is well to accustom ourselves to the belief that all nature is alive, and that inorganic bodies, for instance, exert volition and feel what is done to them! Fetishism is, in express terms, restored, and we are invited to adore the Earth as the *Grand Fétiche.* This great fetish is supposed to have planned a shrewd system of shocks or explosions, by which to render its orbit less eccentric and the inclination of its axis better fitted for the requirements of the *Grand Être,* the Human Race. But even this is not enough to satisfy the demands of "*le cœur.*" We must adore whatever is useful to Humanity, and therefore must erect Space into a deity, and endow it with feeling, though not with intelligence. Not only physics but mathematics also must be made religious. And thus we reach the Comtist Trinity,—Humanity, the Grand Being; Earth, the Grand Fetish; and Space, the Grand Medium!!! Decimal numeration is to be abandoned in favour of a septimal system; because *seven* is a sacred number, and moreover a prime number, incapable of division, and therefore well adapted to impress us with a due sense of the weakness of the human mind and the limitations of thought! This is the wonderful philosophy which is thought worthy to take the place of the vain inquiries which scientific men still obstinately persist in making, into the motions of the stars, the undulations of atoms, and the development of organic life upon the globe!

Thus we might go on citing page after page of the most extravagant vagaries ever conceived outside of Bedlam; or, remembering the many valuable services for which mankind must ever be grateful to Comte, we might less harshly, and not less truly, call them the most mournful exhibition furnished by the annals of philosophy, of a great mind utterly shattered and ruined. Mr. Lewes rejects somewhat vehemently the suggestion of M. Littré, that these wild fancies are evidence of actual insanity.[1] For my own part, I do not see what there is unsound or uncharitable in M. Littré's suggestion. The only healthful activity of the mind is an

[1] *History of Philosophy,* 3rd edit. vol. ii. p. 583.

objective activity, in which there is as little brooding over self as possible. The less we think of ourselves, and the more we think of our work, the better. Dwelling on subjective fancies rarely fails to throw the mind out of balance; it is at the bottom of all religious melancholia and suicidal monomania, as well as of many other forms of cerebral disease. For a dozen or fifteen years, Comte's life was such as to make a man insane, if anything could; and we should not forget, whatever may be the physiological significance of the fact, that in his early manhood he had experienced a violent attack of acute mania. His astounding self-conceit was more akin to that which may be seen in lunatic asylums than to anything which is known to have been manifested by persons in a state of health. I am strongly inclined to believe that the harmonious activity of his brain never fully recovered from the shock given it by that first attack. Very likely that attack is partly responsible for the self-brooding tendency which led him to abandon the world, and lead a secluded life among his own unbridled fancies. And it is not improbable that this long-continued self-communion carried him on the road to chronic subacute monomania, until, when he wrote the "Synthèse Subjective," he had just overstepped the ill-defined limit which divides precarious cerebral health from pronounced cerebral disease. Nevertheless this hypothesis, though it seems most plausible, is perhaps not absolutely required by the facts. In this chapter we have seen how an exclusive reliance on the subjective method has bred in others, besides Comte, the most shocking extravagances. It may be, after all, that Comte's vagaries are not so very much wilder than those of Hegel and Plato; since Plato's absurdities are less in conflict with the scientific knowledge of the times in which they were conceived, and Hegel's are veiled by the dense obscurity of a pompous metaphysical terminology. When Hegel tells us that "*Seyn ist Seyn, und nicht Anders: Anders ist Anders, und nicht Seyn*" (Being is Being, and not

Otherwise: Otherwise is Otherwise, and not Being), we are overawed perhaps, but not immediately disgusted. There is an air of excessive profundity about the oracular dictum, and for a moment we think there may perhaps be something in it, which does not appear on the surface,—some occult verity which, as Hegelians tell us, fifty years more of enlightenment may enable us to realize. But Comte's thoughts are presented, not in the muddiest technical German, but in the clearest idiomatic French: when he makes the earth a fetish, and talks about a dance of the planets, the idea stands out in all its naked absurdity. In spite of all this, however, I am inclined to believe that Comte sounded a deeper depth of extravagance than either Plato or Hegel. Insanity is, after all, only the excessive lack of correspondence between the order of conceptions and the order of phenomena. That is what we mean when we characterize it as delusion or hallucination. And when we avowedly employ a method which never deigns to adapt the internal order to the external order, there is no foreseeing the depth of the ditch in which we may be landed. The difference between the delusion which we regard as compatible with sanity, and that which we commiserate as insane, is mainly a difference of degree. And whether we are to call Comte crazy or not, is to a great extent a question of terminology. Certain it is, that if Adelung had lived to witness Comte's latest speculations, he might have found in them the materials for a more wonderful chapter than any of those now contained in his voluminous "History of Human Error."

In these interesting vagaries we may find renewed evidence of the close kinship between the "dreams" of the ontologist, the fancies of the myth-maker, and the hallucinations of the insane, in so far as concerns the method employed. Nevertheless it would be highly unjust to hold the Positive Philosophy responsible for these inanities, or for those of the pseudo-positivists who would seem to set larger store by their master's personal shortcomings than by his permanently valuable contributions to philosophy. Not only the disciple, but also the impartial critic, may fairly urge that the Positive Philosophy is something greater than Comte, just as the differential calculus is something greater than Newton or Leibnitz. If Newton, in his old age, had become so far lost to all sense of scientific propriety as to apply his method of fluxions to the solution of physiological or ethical problems, much discredit would have attached to Newton, but none to the method of fluxions. Succeeding inquirers would have criticized him in the light of his own principles, and would have felt obliged to mourn the decadence of his godlike intellect, but the question would have been mainly a personal one, affecting in no way our estimate of the Newtonian mathematics. In like manner, when we characterize Comte's later speculations as vagaries hardly compatible with sanity, we cast no discredit upon the Positive Philosophy, since our whole argument implies that these speculations were conducted in utter disregard of those canons of research which it is the chief glory of the Positive Philosophy to have instituted. It is one of Comte's most legitimate claims to immortal remembrance that, with greater authority and far wider scientific resources than Bacon, he succeeded in introducing the objective method into departments of research where previously metaphysical interpretations had reigned supreme and unquestioned. For this he must ever be regarded as one of the worthiest among the "servants and interpreters of Nature." And it is mainly because of his pre-eminence as an inaugurator of scientific method that it has become customary to identify with Positivism every philosophy which, like the system expounded in this work, seeks to give synthetic expression to the ripest scientific thought of our age. If the question were only one of method, we might acquiesce in this identification. But, as I have already plainly indicated and shall presently show more fully our divergence from Positivism is so fundamental with regard to the deepest and gravest questions with which Philosophy is concerned, that, as Comte would unquestionably repudiate us as disciples, so do we unhesitatingly repudiate him as a master.

## CHAPTER VI.

### CAUSATION.

In the course of our examination of the Kantian doctrine of Necessary Truths, the origin and justification of our belief in the necessity of causation was incidentally discussed. We found that this belief can be explained and defended only as the product of a mental limitation due to absolute uniformity of experience. We believe that, under the requisite conditions fire burned before we were born, that it now burns in regions to which we have never had access, and that it will continue to burn as long as the world lasts, simply because we are incapable of forming conceptions of which the materials are not supplied by experience, and because experience has never presented to our consciousness an instance of fire which, under the requisite conditions for burning, did not burn. Or, in other words, we believe that in the absence of preventive conditions, fire must always and everywhere burn, because our concept of fire is the concept of a thing which burns, and this concept has been formed exclusively by our experience of fire. You may, like a mediæval sorcerer, envelope your hand in a soapy substance which will, for a few moments, check oxidation of the epidermis; or you may insert your hand in the blaze and withdraw it again so quickly that, since chemical action takes time, oxidation will not have a chance to begin, and your skin will escape;—these are disturbing conditions. But to say that, in the absence of such conditions, the blaze will not burn your inserted hand, is to state a proposition which is unthinkable,—a proposition of which the elements cannot be united in thought save by their mutual destruction. Why is this proposition unthinkable? It is because not only the material of our knowledge but our very mental structure itself, as I shall hereafter show, is due solely to that perpetual intercourse between subject and object which we call experience, so that, whatever verbal feats we may succeed in accomplishing, we can unite in thought no subject and predicate for the union of which experience has not in some way or other supplied the conditions. I do not mean to say that the proposition in question is not one which some ingenious person might stoutly maintain as a theory. We might, no doubt, hold the theory that Fire does not burn, just as we might espouse the doctrine that Triangles are circular, or that Matter is destructible. But as was sufficiently proved in the chapter on the Test of Truth, this shows only that it is possible for men to accept and defend propositions which they cannot truly conceive. It is easy to state the proposition that the Whole is equal to its Part; but it is none the less impossible to think the thought or no-thought, which the proposition seeks to express. We are under a mental compulsion to think of the whole as greater than its part, and to think of fire as a thing which burns, because the conditions of our thinking have been prescribed by that intercourse between our mind and environing agencies, which we call experience.

It is for the same reason that the mind is compelled to believe in the necessity of causation, and that the cultivated mind, which can realize all the essential conditions of the case, is compelled to believe in its universality. For what is the belief in the necessity and universality of causation? It is the belief that every event must be determined by some preceding event and must itself determine some succeeding event. And what is an event? It is a manifestation of force. The falling of a stone, the union of two gases, the blowing of a wind, the breaking of wood or glass, the vibration of a cord, the expansion of a heated body, the sprouting of a seed, the circulation of blood, the development of inflammation, the contracting of a muscle, the thinking of a thought, the excitement of an emotion,—all these are manifestations of force. To speak of an event which is not a manifestation of force, is to use language which is empty of significance. Therefore our belief in the necessity and universality of causation is the belief that every manifestation of force must be preceded and succeeded by some equivalent manifestation. Or, in an ultimate analysis, it is the belief that force, as manifested to our consciousness, can neither arise out of nothing nor lapse into nothing—can neither be created nor annihilated. And the negation of this belief is unthinkable; since to think it would be to perform the impossible task of establishing in thought an equation between something and nothing.

This, I suppose, is what Sir William Hamilton had in his mind when he asserted that our belief in the necessity and universality of causation is due to an original impotence of the conceptive faculty,—to our inability to conceive absolute beginning or absolute ending. In his examination of Hamilton's philosophy, Mr. Mill has made sad havoc of some of the crude and hasty statements, and yet more unfortunate theological illustrations, in which Hamilton couched this doctrine; but the doctrine itself he seems to have misunderstood rather than refuted. His favourite argument—that at one stage of philosophic culture we can conceive what at an earlier or later stage we could not conceive—rests upon a confusion of language which I trust has been sufficiently shown up in the course of the foregoing discussion. As I have already said, the only kind of inconceivability which we can admit as such is an impotence which results from the very constitution of the thinking process. As was shown in the first chapter on the Relativity of Knowledge, this is the case with our inability to conceive absolute beginning or absolute ending. We must therefore, to a certain extent, accept the Hamiltonian doctrine that our belief in the necessity and universality of causation is due to an original impotence of the conceptive faculty; save that an ultimate psychological analysis obliges us to regard this original impotence as simply the obverse of our inability to transcend our experience.

Here again we come upon a bit of common ground which underlies two opposing philosophies. For our last sentence, in its assertion and in its proviso, recognizes both aspects of the universal truth of which Kant and Hamilton on the one hand, and Hume and Mill on the other hand, have persisted in recognizing only one aspect. Here again we see exemplified what our sketch of the Newtonian discovery in the previous chapter taught us,—namely, the value of that objective method which, instead of ignoring an unexplained residuum, recognizes it as justifying further research. The unexplained residuum in the present case was the coexistence of an element of necessity in a given belief with an experiential origin for the belief. Following the subjective method, Hume denied the necessity, Kant denied the experiential origin. But the objective method, recognizing the coexistence of the two as a fact to be accounted for, and employing a psychological analysis inaccessible to Hume and Kant, discovers that the necessity of the belief and its experiential origin are but two sides of the same fundamental fact.

From the origin and justification of our belief in causation, let us now pass to the contents of the belief. Since there is nothing in the belief that has not been given in experience, let us endeavour to state what is and what is not given in our experience of an act of causation. In the first place *sequence* is clearly given in the phenomenon. "Even granting that an effect may commence simultaneously with its cause," this view is in no way practically invalidated. As Mr. Mill says, "Whether the cause and its effect be necessarily successive or not, the beginning of a phenomenon is what implies a cause, and causation is the law of the succession of phenomena. . . . I have no objection to define a cause, the assemblage of phenomena, which occurring, some phenomenon invariably commences, or has its origin Whether the effect coincides in point of time with, or immediately follows, the hindmost of its conditions, is immaterial. At all events it does not precede it; and when we are in doubt, between two coexistent phenomena, which is cause and which is effect, we rightly deem the question solved if we can ascertain which of them preceded the other."[1]

Secondly, *invariableness* of sequence is given in our experience of causation. Invariableness is the chief mark by which we distinguish those sequences which are causal from those sequences which are commonly termed accidental. The well-known fallacy of *post hoc, ergo propter hoc,* upon which are founded most of the current hygienic and therapeutic vagaries which claim to be upheld by experience, arises from the neglect of this essential distinction. It lumps together all kinds of sequence under the general head of causation. If drinking a cup of coffee is followed by headache, or if a troublesome fit of indigestion ends after taking a dose of patent medicine, it is rashly inferred that the coffee caused the headache, or that the medicine cured the indigestion. This is not legitimate induction. The sequence may be accidental and not causal. The headache may have been caused by eating hot risen biscuit, by inhaling carbonic oxide sent up from the furnace, by overwork, or by loss of sleep; or it may be the premonitory symptom of a typhoid fever due to imperfect drainage. The indigestion may have been cured by a ride on horseback, or by a walk

[1] Mill, *System of Logic,* 6th edit. vol. i. p. 384.

on a frosty morning, or by a piece of good news, or by a rhythmical increase in the rate of nutrition for which no definite external cause is assignable. It is the business of induction to eliminate, as far as possible, all these coexistent possible causes, so as to ascertain, after the elimination, whether the sequence between the presumed cause and the effect is invariable. If it turns out to be so, and, still better, if by reasoning deductively from the experimentally-ascertained action of the coffee or the medicine upon the organic tissues involved in the case, further proof of the invariableness of the given sequences can be obtained,—then we say that we have detected a case of true causation. When we have extended our inquiries in any case so far as to be able to predicate invariable sequence, then we predicate causation.

A moment's reflection, however, will show us that there are sequences which have been invariable throughout the whole course of human experience, but which are not regarded as causal sequences. Ever since there have been conscious minds to interpret phenomena, day has followed night, and night has followed day, and yet no one would say that day causes night, or that night causes day. In order to include such cases as this, we must limit still further our definition of causation. The sequence must be *unconditional* as well as invariable. This, as Mr. Mill observes, "is what writers mean when they say that the notion of cause involves the idea of necessity. If there be any meaning which confessedly belongs to the term 'necessity,' it is *unconditionalness.*[1] That which is necessary, that which *must* be, means that which will be, whatever supposition we may make in regard to all other things. The succession of day and night evidently is not necessary in this sense. It is conditional on the occurrence of other antecedents. That which will be followed by a given consequent when, and

[1] This, it will be seen, agrees with Mr. Lewes's admirable view of Necessity, cited above in Chapter III.

only when, some third circumstance also exists, is not the cause, even though no case should ever have occurred in which the phenomenon took place without it." Now, either day or night "might have existed for any length of time, and the other not have followed the sooner for its existence: day follows night only if certain other antecedents [the presence of the sun above the horizon, and the absence of any eclipsing opaque body from the direct path of the solar rays] exist; and where those antecedents existed, it would follow in any case. No one, probably, ever called night the cause of day; mankind must so soon have arrived at the very obvious generalization, that the state of general illumination which we call day would follow from the presence of a sufficiently luminous body, whether darkness had preceded or not."

Mr. Mill's further explanation of this point is so luminous that I prefer to cite it in his own words, rather than to abridge and dilute it. "To some," says Mr. Mill, "it may appear that the sequence between night and day being invariable in our experience, we have as much ground in this case as experience can give in any case, for recognizing the two phenomena as cause and effect; and that to say that more is necessary—to require a belief that the succession is unconditional, or in other words that it would be invariable under all changes of circumstances, is to acknowledge in causation an element of belief not derived from experience. The answer to this is, that it is experience itself which teaches us that one uniformity of sequence is conditional and another unconditional. When we judge that the succession of night and day is a derivative sequence, depending on something else, we proceed on grounds of experience. It is the evidence of experience which convinces us that day could equally exist without being followed by night, and that night could equally exist without being followed by day. To say that these beliefs 'are not generated by our mere observation of sequence,' is to forget that twice in every twenty-fou hours, when the sky is clear, we have an *experimentum crucis* that the cause of day is the sun. We have an experimental knowledge of the sun which justifies us on experimental grounds in concluding, that if the sun were always above the horizon there would be day, though there had been no night, and that if the sun were always below the horizon there would be night, though there had been no day. We thus know from experience that the succession of night and day is not unconditional. Let me add, that the antecedent which is only conditionally invariable, is not the invariable antecedent. Though a fact may, in experience, have always been followed by another fact, yet if the remainder of our experience teaches us that it might not always be so followed, or if the experience itself is such as leaves room for a possibility that the known cases may not correctly represent all possible cases, the hitherto invariable antecedent is not accounted the cause: but why? Because we are not sure that it *is* the invariable antecedent."

Furthermore let it be noted that "such cases of sequence as that of day and night not only do not contradict the doctrine which resolves causation into invariable sequence, but are necessarily implied in that doctrine. It is evident, that from a limited number of unconditional sequences, there will result a much greater number of conditional ones. Certain causes being given, that is, certain antecedents which are unconditionally followed by certain consequents; the mere coexistence of these causes will give rise to an unlimited number of additional uniformities. If two causes exist together, the effects of both will exist together; and if many causes coexist, these causes will give rise to new effects, accompanying or succeeding one another in some particular order, which order will be invariable while the causes continue to coexist, but no longer. The motion of the earth in a given orbit round the sun, is a series of changes which follow one another as antecedents and consequents, and will continue to do so while the sun's attraction, and the force with which the earth tends to advance in a direct line through space, continue to coexist in the same quantities as at present. But vary either of these causes, and the unvarying succession of motions would cease to take place. The series of the earth's motions, therefore, though a case of sequence invariable within the limits of human experience, is not a case of causation. It is not unconditional."[1] July does not cause August, though it invariably precedes it. For the sequence is conditioned by the coexistence of a given ratio between the solar gravitation and the earth's tangential momentum, with a given inclination of the earth's axis of rotation to the plane of its orbit. Vary either of these factors, which are the real causes of the seasons, and the hitherto invariable sequence between July and August will be altered.

Causation may therefore be defined as the unconditional invariable sequence of one event, or concurrence of events, upon another; and this is all that is given in the phenomenon. But metaphysics is not content with this conception of Cause. It prefers to regard causation as a kind of constraint by which the antecedent event obliges the consequent event to follow it. It postulates a hidden power, an *occulta vis*, in the cause, which operates as an invincible nexus between it and the effect. And it is by virtue of the exertion of this occult energy that cause, as formulated by metaphysics, is called Efficient Cause, in distinction from the only cause known to science,—the unconditional invariable antecedent, which may be termed Phenomenal Cause.

This explanation bears the distinctive marks of a metaphysical hypothesis, as enumerated in the preceding chapter. To the elements of sequence, invariableness and unconditionalness embraced in the scientific explanation, it superadds an *occulta vis*, an element which is not given in the pheno-

[1] Mill, *System of Logic*, 6th edit. vol. i. pp. 379–381.

menon. No one pretends that we can actually cognize this *occulta vis.* The deepest analysis of our experience of the act of causation will yield no such element. Viewed under its subjective aspect, our knowledge of causation amounts simply to this,—that an experience of certain invariable sequences among phenomena has wrought in us a set of corresponding indissolubly coherent sequences among our states of consciousness; so that whenever the state of consciousness answering to the cause arises, the state of consciousness answering to the effect inevitably follows. But answering to the *occulta vis* we have no state of consciousness whatever.

Moreover the hypothesis of an *occulta vis,* like so many other metaphysical hypotheses, straightway lands us in an impossibility of thought. The proposition that the cause constrains the effect to follow, is an unthinkable proposition; since it requires us to conceive the action of matter upon matter, which, as we saw in our first chapter, we can in nowise do. As was there pointed out, neither by the artifice of an intermolecular ether or of centres of attractive and repulsive force, nor by any other imaginable artifice, can we truly conceive one particle of matter acting upon another. What we do know is neither more nor less than what is given in consciousness, namely, that certain coexistences invariably precede or follow certain other coexistences. That matter as objectively existing may exert upon matter some constraining power which, as for ever unknowable by us, may be called an *occulta vis,* I readily grant. Thought is not the measure of things, and it was therefore unphilosophical in Hume to deny the existence of any such unknown power. Things may exist, in heaven and on earth, which are neither dreamt of in our philosophy nor conceivable by our intelligence. Respecting the external reality we say nothing: we only affirm that no such *occulta vis* is given in the *phenomenon* of causation. Any hypothesis which postulates such an unknown element as a means of explaining the phenomenon is unverifiable and, as such, science cannot admit it, nor can our Cosmic Philosophy admit it.

Nevertheless the belief that causation implies something more than mere invariability of sequence, has been a persistent belief; and as such, it is a fact which philosophy is required to account for. Its explanation will not be difficult if we look to the source from which our notion of Power is derived. That source is the peculiar class of states of consciousness which accompany our voluntary actions. Part of our notion of Power consists in our consciousness of an ability to generate certain muscular sequences by means of an act of volition; and this amounts to no more than an expectation that the antecedent, volition, will be followed by the consequent, muscular movement. But the other part of our notion of Power is derived from the sense of *effort* which invariably accompanies our muscular actions. Every such action "has to contend against resistance, either that of an outward object or the mere friction and weight of the moving organ; every voluntary motion is consequently attended by the muscular sensation of fatigue. Effort, considered as an accompaniment of action upon the outward world, means nothing to us but those muscular sensations."[1] Here, then, is the shape of our primitive conception of Power; the consciousness of volition, accompanied by the conscious sensation of effort overcoming resistance, and the conscious expectation of a consequent muscular movement. Now, by the very relativity of our thinking, as will be shown more fully in the next chapter, we are compelled to formulate our conception of the Power which is manifested in the sequence of external phenomena, in terms of that Power which is alone directly known to us in consciousness. Hence, when we see one object moved by another, we conceive the impelling object as putting forth effort and overcoming the inertia of the impelled object. Though we no longer, like some chil-

[1] Mill, *Examination of Hamilton's Philosophy*, vol. ii. p. 47.

dren and all savages, regard this as a conscious effort, attended by volition, we still conceive it as an effort attended by resistance. And from this anthropomorphism of thought are derived two closely related, though apparently incompatible, metaphysical theories; the theory that matter, regarded as a cause, is endowed with an *occulta vis;* and the theory that matter, regarded as an effect, can move only under constraint from without.

Such is the origin of our conception of power in causation. Yet that the conception, as thus formulated, cannot correspond to the external reality, is a truth so obvious, at the present stage of our discussion, as hardly to need pointing out. It is enough to remark that since effort, as known to us, is only an affection of our consciousness, we cannot conceive the wind which overturns a tree as exerting effort, unless we mentally endow the wind with consciousness. The primitive man did not scruple at this; to him the Wind was a superhuman person. We, who have outgrown fetishism, must take the other horn of the dilemma, and admit that whatever may be the force which the wind exerts, it cannot be the force which we know as effort. By this alternative difficulty we may recognize the fact that we have here again come face to face with the Unknowable. What the process of causation is in itself we cannot know. We can know it only as it is presented to our consciousness, as the unconditional invariable sequence of events.

Our account of causation would not be complete without some mention of an attempt which has again been made, of late years, to pass beyond the limits of intelligence, and cognize the external process in itself. This attempt, based upon an imperfect apprehension of the foregoing analysis, starts with the assertion that in our primitive consciousness of Power we have a true cognition of an Efficient Cause. According to this doctrine, the expectation that effort will overcome resistance and cause motion is a bit of *à priori* knowledge not given in experience. In our consciousness of effort we have direct knowledge of the causal nexus between the antecedent, volition, and the consequent, muscular contraction: volition is therefore known to us as an efficient cause of one kind of actions; and hence we must infer that it is the sole efficient cause of all kinds of actions. Matter is absolutely inert: it is inconceivable that matter should act upon matter, but it is conceivable that mind should act upon matter; and therefore all phenomena which are not the direct results of human or animal will, are the direct results of divine will. Such is the so-called Volitional Theory of Causation.

With the theistic implications of this doctrine I shall deal in a future chapter. At present we are concerned only with its psychological basis. And first we may observe that those who assert the action of mind upon matter to be conceivable, appear to have forgotten the great difficulty under which metaphysics laboured during the seventeenth century. To Leibnitz and the Cartesians the action of mind upon matter was the thing inconceivable above all others, to account for which two theories were framed, among the most remarkable in the annals of metaphysics. These are, the doctrine of Occasional Causes, expounded by the Cartesian Malebranche, and the doctrine of Pre-established Harmony, expounded by Leibnitz, who is said to have plagiarized it from Spinoza. The Cartesians held it to be inconceivable, and therefore (on the subjective method) impossible, that thoughts or feelings in the mind should produce movements in the body; and consequently they regarded the concurrence of mental and material facts "as mere Occasions on which the real agent, God, thought fit to exert his power as a Cause." So that, when you will to raise your arm, God interposes and lifts the arm for you; and he does this, not *as* a Being endowed with volition, but *as* an omnipotent Being, capable of working a miracle. To Leibnitz this seemed an unworthy view of divine action. He preferred to regard the entire series of volitions and the entire series of apparently consequent muscular motions as independent series, pre-established in harmony with each other by the contrivance of the Deity from a time preceding the commencement of the world. So that, when you will to raise your arm, the arm moves, because God in the past eternity constructed the series of your volitions and the series of your motions like two clocks which accurately correspond to each other in their rates of ticking.

Such theories as these can, of course, be neither proved nor disproved. They are cited as interesting specimens of the manner in which human speculation attempts to grapple with realities which lie beyond its reach; but, as being unverifiable, our philosophy cannot recognize them as legitimate hypotheses. Coupling them with the Volitional Theory, the result is mutual destruction. In point of fact, we are no more directly cognizant of the action of mind upon matter than we are directly cognizant of the action of matter upon matter. "Our will causes our bodily actions in the same sense (and in no other) in which cold causes ice, or a spark causes an explosion of gunpowder." The antecedent, volition, and the subsequent, muscular movement, are subjects of consciousness. But the relation of invariable sequence between them is known by experience, just as we know any other relation of sequence. As Mr. Mill observes, it cannot be admitted "that our consciousness of the volition contains in itself any *à priori* knowledge that the muscular motion will follow. If our nerves of motion were paralyzed, or our muscles stiff and inflexible, and had been so all our lives, there is no ground for supposing that we should ever (unless by information from other people) have known anything of volition as a physical power, or been conscious of any tendency in feelings of our mind to produce motions of our body, or of other bodies."[1] In such case we might still have had a sensation, like that which we now term the

[1] *System of Logic*, 6th edit. vol. i. p. 391.

"consciousness of effort," but we should have known it merely as "a feeling of uneasiness, accompanying our feelings of desire." As Sir William Hamilton acutely observes, the Volitional Theory "is refuted by the consideration, that between the overt act of corporeal movement of which we are cognizant, and the internal act of mental determination of which we are also cognizant, there intervenes a numerous series of intermediate agencies of which we have no [direct] knowledge; and, consequently, that we can have no consciousness of any causal connection between the extreme links of this chain, the volition to move and the limb moving, as this hypothesis asserts. No one is immediately conscious, for example, of moving his arm through his volition. Previously to this ultimate movement, muscles, nerves, a multitude of solid and fluid parts, must be set in motion by the will, but of this motion, we know, from consciousness, absolutely nothing. A person struck with paralysis is conscious of no inability in his limb to fulfil the determinations of his will; and it is only after having willed, and finding that his limbs do not obey his volition, that he learns by this experience, that the external movement does not follow the internal act. But as the paralytic learns after the volition that his limbs do not obey his mind, so it is only after volition that the man in health learns that his limbs do obey the mandates of his will."[1]

To this crushing refutation it may be added that even if volition were the efficient cause of our own movements, as we admit it to be the phenomenal cause, it would not follow that it is the cause of anything else. As the passage just cited from Hamilton shows, the only direct effect which volition can be known to produce, is nervo-muscular action,—a very exceptional, peculiarly animal, phenomenon. And yet, "because this is the only cause of which we are conscious, being the

[1] *Lectures on Metaphysics*, Lect. 39; see also *Dissertations to Reid*, pp. 866, 867.

only one of which in the nature of the case we *can* be conscious, since it is the only one which exists within ourselves,"—we are asked to assume, without further evidence, that throughout the infinitely multitudinous and heterogeneous phenomena of nature, no other kind of cause exists! A more amazing example of the audacity of the subjective method could hardly be found. In Mr. Mill's forcible language, "the supporters of the Volition Theory ask us to infer that volition causes everything, for no reason except that it causes one particular thing; although that one phenomenon, far from being a type of all natural phenomena, is eminently peculiar; its laws bearing scarcely any resemblance to those of any other phenomenon, whether of inorganic or of organic nature."

Thus ends in signal failure the last of the many attempts which have been made to invalidate the principle of the Relativity of Knowledge. Start from what point we may, we must sooner or later reach the periphery of the circle which includes all that is knowable. Every attempt to overstep this periphery, and gain a sure foothold in the dark region beyond, must result in utter discomfiture. The inquiry into the origin and contents of our belief in Causation reveals, more clearly than ever, our impotence to deal with objective powers and existences. The attempt to detect the *occulta vis* or hidden energy in the act of causation, is but the fruitless attempt to bind in the chains of some thinkable formula that universal Protean Power, of whose multitudinous effects we are cognizant in the sequence of phenomena, but which in its secret nature must ever mockingly elude our grasp.

## CHAPTER VII.

### ANTHROPOMORPHISM AND COSMISM.

The body of philosophic truth contained in the six foregoing chapters can in nowise claim Auguste Comte as its originator. The doctrine of the relativity of knowledge has, as we have seen, been accepted more or less unreservedly by most of the thinkers of the last two centuries; and has, indeed, never been wholly lost sight of in philosophic speculation since the time of Protagoras. Nevertheless the doctrine has been variously interpreted by different philosophers; and we have seen that the Positivist interpretation of it, propounded by Littré and Mill, is essentially different from the interpretation given by Mr. Spencer, and here adopted. Again, the doctrine that all knowledge is the product of the intercourse between the sentient organism and its environment is a doctrine which has been held by more than half the philosophic world since the time of Locke. The doctrine that causation, as cognizable by us, is merely unconditional invariable sequence was the doctrine of Hume, Brown, and James Mill; and for its further defence and elucidation we are indebted, not to Comte, but to John Stuart Mill. The test of truth, as stated in the third chapter of this work, was just as much or just as little postulated by Comte as by preceding thinkers: it was first definitely propounded by Mr. Spencer, and its validity has been repeatedly challenged by

Mr. Mill,—the most eminent psychologist who has yet declared his assent to all the fundamental doctrines of Positivism. Nor was Comte the first to insist upon the exclusive use of the objective method in all departments of research; for Bacon, as we have seen, had enunciated this precept with equal vigour and impressiveness, though with less commanding scientific authority. It is to be regretted, moreover, that we cannot even accredit Comte with unflinching loyalty to this principle. Not only have we seen him openly disavowing it, but we have been called upon to contemplate, in his "Subjective Synthesis," the most lamentable instance afforded by history of the wonderful extent of aberration possible to the *intellectus sibi permissus.*

All the above truths, then, so far as they were understood by Comte, were accepted by him as he found them. He did not originate them, nor did he place them, from the psychological point of view, upon any surer footing than they had occupied before. That psychological analysis, in the light of which they have been here exhibited, and by which alone they can be securely established, Comte unreservedly and disdainfully repudiated. Asserting as he did that all direct observation and comparison of states of consciousness is vain and nugatory, Comte could only accept the doctrine of the relativity of knowledge and its corollaries as empirical doctrines. We shall frequently have occasion to remark upon the vulnerable condition in which the Positive Philosophy is left, owing to this disregard of psychology. Here indeed was Comte's weak point, as it is Mr. Spencer's strong point. As an observer and interpreter of states of consciousness Comte was below mediocrity—hardly fit to be ranked with Cousin or Dugald Stewart; while, in power of psychological analysis, Herbert Spencer has been surpassed by no thinker that ever lived, and has been rivalled only by Aristotle, Berkeley, and Kant. And it is accordingly not Comte, but Spencer, who has wrought the truths above enumerated into an organized body of doctrine resting upon an indestructible basis in consciousness.

Since, then, the foundations of the scientific philosophy here expounded were laid down by Bacon, Locke, Hume, and Kant, and since that philosophy has first been presented as a coherent body of universal truth by Herbert Spencer, it is clear that there exists a very considerable body of philosophic doctrine, which is not metaphysical or theological, and which, nevertheless, does not owe its existence to Comte. It is clear that we cannot concede to Comte such a monopoly of the scientific method of philosophizing that all scientific philosophy must be designated as Positivism. It does not yet appear, from the foregoing summary, that scientific philosophy owes anything whatever to Comte. Yet if we were to rest in any such conclusion as this, we should be seriously in error. It is not to be gainsaid that the speculations of Comte have played a most conspicuous and important part in directing the course of philosophic inquiry in the nineteenth century. A thinker of Comte's calibre does not live and write to no purpose. And while it will appear, in the course of the following discussion, that the peculiar theories of Comte are such as philosophy cannot possibly adopt, it will also appear that these theories, besides containing a germ of truth, are instructive even in their erroneousness Even while demonstrating that we cannot, without grievously retrograding, consider ourselves followers of Comte or advocates of the Positive Philosophy, we must at the same time freely admit our indebtedness to Comte for sundry suggestions of the highest importance. We must not refuse to Comte the meed of acknowledgment which we should have no hesitation in giving to Kant, or Spinoza, or even to Hegel, if occasion were to be offered. Least of all can we acquiesce in Prof. Huxley's opinion that there is nothing whatever of any value in the philosophy of Comte which is not also to be found in the philosophy of Hume. The point is one of such importance in itself, and is so narrowly implicated with much of the following discussion, that I must devote a few moments to the elucidation of it, before entering upon the special subject of this chapter.

In spite of his feebleness as a psychologist, and his numerous unphilosophic idiosyncrasies of temperament, Comte was possessed of one mental endowment, most brilliant at any time, and most useful to a thinker living in the first half of the nineteenth century. It is by virtue of this mental endowment that Comte is chiefly distinguished from the thinkers of the eighteenth century; and it was by dint of this that he succeeded in making himself, more conspicuously than any of those thinkers, the herald, though not the inaugurator, of modern philosophy. I refer to that historic sense,—that almost unique power of investing himself, so to speak, with the mental habits of bygone generations, and of entering into the very spirit which dictated past events and obsolete modes of thinking,—which makes the fifth volume of Comte's great work one of the most valuable and suggestive treatises ever written concerning the concrete phenomena of history. Many thinkers before Comte had conceived the idea of a philosophy of history—such were Machiavelli, Vico, Montesquieu, Voltaire, Turgot, and Condorcet; but none of these great men possessed in so high a degree the historic sense necessary for the realization of such a project. It is the influence of this historic sense of Comte, more or less consciously felt, which lends a great part of their value to many of the most striking historical treatises of our time,—to the colossal works of Grote and Mommsen, as well as to the monographs of Mr. Bryce, Dr. Bridges, M. Taine, M. Renan, and the author of "Ecce Homo." It was the lack of such a historic sense, and the adherence to the old disposition to examine past events through the refracting medium of recently acquired habits of thought, which constituted Mr. Buckle's chief source of failure as a philosophic historian.

Now I say it was by dint of this rare historic sense that Comte succeeded in taking a step which was not only an important advance, but in many respects a veritable revolution in philosophy. It was Comte who first brought into prominence the idea of a philosophy of history which should also be the history of philosophy. The thinkers of the eighteenth century, with Hume at their head, had studied systems of philosophy, much as anatomists before Cuvier had studied animal and vegetal organisms, as detached independent existences, without regard to their past or future. But to Comte is due the grand and luminous conception of a historic development of thought, from the earliest to the latest ages of human speculative activity. Just as Cuvier proclaimed it irrational to study existing organisms without constant reference to extinct organisms, Comte pronounced it irrational to coordinate existing opinions, save in their relation to past opinions. He grasped, as it had not before been grasped, the truth that each body of doctrines has its root in some ancestral body of doctrines; that throughout the whole of man's speculative career there has been going on an Evolution of Philosophy, of which the thorough recognition of the relativity of knowledge must be the inevitable outcome. Herein lay the originality of Comte; an originality of which it is hardly correct to say that Prof. Huxley disparages it, since he passes over it in silence and does not appear to have discerned it. Yet as to the originality of this conception, there can be no question whatever. Neither Hume nor any other thinker of the eighteenth century had compassed it. Lessing, indeed,—a man far in advance of his age,—had, in his work entitled "The Education of the Human Race," sketched a theory of the evolution of speculative ideas; but it was only imperfectly, if at all, that he comprehended the nature and direction of that evolution. He may be regarded as a forerunner, but not as an anticipator, of Comte.

As to the importance of Comte's conception there can be no more question than as to its originality. It constituted a revolution in philosophy as thorough and wide-reaching as the revolution which Cuvier, by fusing together the studies of comparative anatomy and palæontology, brought about in biology. In working out the details of his conception, Comte, like Cuvier, fell into many grave errors: but the great thing was, to have framed the conception. As Mr. Spencer wisely and wittily observes, "Inquiring into the pedigree of an idea is not a bad means of estimating its value." Comte's conception of the evolution of philosophy obliges us henceforth to test ideas by their pedigree,—to trace their origin in the employment of the subjective or of the objective method. Surely it was no small achievement to bring together the truths which Locke and Hume and others had laboriously detected, and to exhibit them as the necessary outcome of twenty-five centuries of speculative activity. For by this proceeding the truths in question were at least historically justified. And although the psychological justification of them had to be left for Mr. Spencer, although it can be amply proved that Comte, in his ignorance of psychology, seriously misinterpreted the import of these truths, that is no reason why we should hesitate to acknowledge the greatness of his achievement. The doctrine of which Cuvier was the most eminent upholder—the doctrine of fixity of species—is one which modern biology rejects, just as modern philosophy rejects the doctrines especially characteristic of Comte's system. Nevertheless, as we admit of Cuvier, that his innovation, in studying all existing organisms with reference to past organisms, amounted to a revolution in the attitude of biology; so we must admit of Comte, that his innovation, in studying all phases of thought with reference to preceding phases of thought, amounted to a revolution in the attitude of philosophy. Yet the latter admission no more makes us followers of Comte than the former admission makes us followers of Cuvier.

The significance of this illustration will become still more apparent as we proceed to examine the attempt of Comte to describe the course of philosophic evolution as actually shown in history. According to Comte there are three modes of philosophizing—the Theological, the Metaphysical, and the Positive. The first two modes are characterized by the attempt to formulate the unknowable Cause or causes of phenomena; but Positivism, recognizing the futility of all such attempts, ignores the unknowable Cause or causes of phenomena. Positivism limits itself to ascertaining uniformities of coexistence and sequence among phenomena. Metaphysics and Theology superadd investigations concerning the nature of the hidden efficient cause of the phenomena; but Metaphysics regards this cause as a mere abstract entity, while Theology regards it as endowed with volition and intelligence. There are three successive stages of theology; Fetishism, in which phenomena, being not yet generalized, are regarded each as endowed with a volition of its own; Polytheism, in which generalized groups of phenomena are regarded each as under the control of a presiding deity endowed with volition; and Monotheism, which arises when men have gained the conception of a Universe, and have generalized the causes of phenomena until they have arrived at the notion of a single First Cause. According to Comte, philosophy began in fetishism; as science progressively arranged phenomena in groups of wider and wider generality, philosophy passed through polytheism into monotheism; and as with its increasing generality, the primitive anthropomorphic conception of cause faded away, becoming replaced by the conception of an unknowable Cause manifested in phenomena, philosophy became metaphysical: finally, when the unknowable Cause is wholly ignored, and no account is taken of anything beyond the immediate content of observed facts, philosophy becomes positive. For while Comte did not follow Hume and Berkeley to the extent of explicitly or implicitly denying the independent existence of a Power manifested in phenomena; while he would, if consistent with his own principles, have regarded such a denial as an overstepping of the limits within which positive speculation should be confined; it is none the less true that he ignored the existence of any such Power as completely as if he had held the extreme idealist doctrine which pronounces it a mere figment of the imagination. So utterly foreign to Positivism is Mr. Spencer's doctrine of the Unknowable, that M. Littré, who is of all living men the most thoroughly and consistently a Positivist, condemns it as a baseless metaphysical speculation.

Such is the celebrated "Law of the Three Stages," which is regarded by Positivists as one of the greatest achievements of the human mind, and which impartial criticism must regard as an achievement of sufficient importance to have wrought a complete revolution in the attitude of modern philosophy. That it also contains a large amount of truth, as a concise generalization of historical facts, can be denied by no competent student of history But, while freely conceding all this, it will appear, on a closer examination, that the doctrine in question is rather a foreshadowing of the true statement than the true statement itself; and that in one all-important particular it is utterly inadmissible. Let us begin by inquiring how far the progress of human thought, with reference to the unknown Cause or causes of phenomena, can be regarded as divisible into stages, and in what sense Comte really intended to assert that there are three stages. It is important that both these points should be determined, in order that our conception of the character of the speculative development may be rendered sufficiently precise, and in order to ascertain how far Comte understood that character.

Upon this point, as upon many others, Comte has left on record assertions which, if literally interpreted, simply cancel each other. At the beginning of the "Philosophie Positive," he tells us that "the mind employs successively in each of its researches three methods of philosophizing, of which the character is essentially different and even radically opposed —first the theological method, then the metaphysical, lastly the positive. The theological system arrives at the highest perfection of which it is susceptible, when it has substituted the providential action of a single Being for the capricious play of the innumerable independent deities which were primitively imagined. Likewise the perfection of the metaphysical system consists in conceiving, instead of many particular entities, one grand entity, Nature, as the source of all phenomena. Finally the perfection of the positive system would be to represent all observable phenomena as particular cases of a single general fact." And hence, says Comte, "these three general systems of conceptions concerning the ensemble of phenomena mutually exclude each other." Now Comte elsewhere maintains that, so far from mutually excluding each other, the three methods of philosophizing have coexisted with each other since the dawn of speculation; and that, in particular, the metaphysical method is merely a modification of the theological method.

The truth is, however, that the so-called "Law of the Three Stages" was an empirical generalization from the facts of history, and that, with his customary indifference to psychological interpretations, Comte did not concern himself with the character of the mental processes involved in the speculative progression which he sought to formulate. What Comte really saw was, that men, when they first began to speculate upon the phenomena of nature, imagined behind every phenomenon, save possibly a few of the most familiar ones, an impelling will, like the human will; that, as the anthropomorphic character of this conception slowly faded away, it left the conception of a hidden Power or powers, to ascertain the nature of which was long supposed to be the legitimate business of philosophy; and that, lastly, with the further progress of thought, philosophy must give up the attempt to ascertain the nature of this hidden Power or powers, and concern itself solely with coexistences and sequences among phenomena. All this is true so far as it goes, its confirmation being written on every page of history Nevertheless, all this is but one side of the truth. The truth has another side, which Comte never saw, and which no writer of the Positivist school has ever given any evidence of discerning. What Comte did not see was, that from first to last there is no change in the nature of the psychological process; and that, even at the last, the hidden Power underlying and sustaining the world of phenomena can no more be ignored than at the beginning. Let us examine both these points, and note well their significance.

In the first place there is no change in the nature of the mental processes concerned in the development. From first to last, whether we give a theological, a metaphysical, or a scientific explanation of any phenomenon, we are interpreting it in terms of consciousness. To recur to our old illustration; on seeing a tree blown down by the wind, the primitive man concludes that the wind possesses intelligence and exerts volition: he calls it Hermes, or Boreas, or Orpheus, and erects to it a temple, wherein by prayer and sacrifice he may avert its displeasure. In a later age the wind is no longer regarded as endowed with conscious volition; but it is still regarded as exerting effort, and overcoming the forces which tend to keep the tree in its place. Obviously this is at bottom the same conception as its predecessor, save that it is less crudely anthropomorphic. Now in the scientific explanation, we omit also the conception of a specific *nisus* or effort, and regard the falling of the tree as an event invariably consequent upon the blowing of the wind with a given momentum. Here, perhaps, it may seem that we quite get rid of every subjective or anthropomorphic element. But this is a mistake. The use of the word "momentum" shows how we are compelled to conceive the event as a manifestation of force. We may abolish the figment of a specific *occulta vis;* but, strive as we will, we cannot mentally represent the event otherwise than as a differential result of the excess of one quantum of force over another quantum of force. And what do we mean by force? Our conception of force is nothing but a generalized abstraction from our sensations of muscular resistance. That such a conception is merely symbolic, that it does not truly represent the real force objectively existing, I have already shown. Nevertheless, from the relativity of our thought, such is the only conception which we can frame. Therefore, I repeat, from first to last, whether we give a theological, a metaphysical, or a scientific explanation of any phenomenon, we alike interpret it in terms of consciousness. Whether we frame the crude conception of an arbitrary volition, or the refined conception of a uniformly conditioned force, we must equally admit that our subjective feelings are the only materials with which the conception can be framed. The consciousness of force remains dominant from first to last, and can be abolished only by abolishing consciousness itself.

But now, in the second place, this final scientific conception of a uniformly conditioned force cannot even be framed save by postulating an unconditioned Power existing independently of consciousness, to which no limit is conceivable in time or space, and of which all phenomena, as known to us, are the manifestations. It was demonstrated above, in the fourth chapter, that without postulating such an Absolute Existence, we can frame no theory whatever, either of external or of internal phenomena, even our proof of the relativity of knowledge immediately becoming nonsense in such case. It was shown that the existence of such a Power independent of us is an element involved in our consciousness of our own existence—is, in short, the "obverse of our self-consciousness." Thus the three stages disappear entirely, and the three terminal conceptions which are alleged as distinctively characteristic of the stages are seen to be identical. The God of the monotheist, the Nature of the metaphysician, and the Absolute Being which science is compelled to postulate, differ only as symbols differ which stand for the same eternal fact. If there be any confusion still left regarding this point, it will be dispelled by the following citation from Mr. Spencer:—

"The progress of our conceptions, and of each branch of knowledge, is from beginning to end intrinsically alike. There are not three methods of philosophizing radically opposed; but one method of philosophizing which remains, in essence, the same. At first, and to the last, the conceived causal agencies of phenomena have a degree of generality corresponding to the width of the generalizations which experiences have determined; and they change just as gradually as experiences accumulate. The integration of causal agencies, originally thought of as multitudinous and local, but finally believed to be one and universal, is a process which involves the passing through all intermediate steps between these extremes; and any appearance of stages can be but superficial. Supposed concrete and individual causal agencies coalesce in the mind as fast as groups of phenomena are assimilated, or seen to be similarly caused. Along with their coalescence, comes a greater extension of their individualities, and a concomitant loss of distinctness in their individualities. Gradually, by continuance of such coalescences, causal agencies become, in thought, diffused and indefinite. And eventually, without any change in the nature of the process, there is reached the consciousness of a universal causal agency, which cannot be conceived.

"As the progress of thought is one, so is the end one. There are not three possible terminal conceptions; but only a single terminal conception. When the theological idea of the providential action of one Being is developed to its ultimate form, by the absorption of all independent secondary agencies, it becomes the conception of a Being immanent in all phenomena; and the reduction of it to this state implies the fading-away, in thought, of all those anthropomorphic attributes by which the aboriginal idea was distinguished. The alleged last term of the metaphysical system—the conception of a single great general entity, *Nature*, as the source of all phenomena—is a conception identical with the previous one: the consciousness of a single source which, in coming to be regarded as universal, ceases to be regarded as conceivable, differs in nothing but name from the consciousness of one Being manifested in all phenomena. And similarly, that which is described as the ideal state of science—the power to represent all observable phenomena as particular cases of a single general fact—implies the postulating of some ultimate Existence of which this single fact is alleged; and the postulating of this ultimate Existence involves a state of consciousness indistinguishable from the other two."[1]

This completely unanswerable statement exhibits Mr. Spencer's unrivalled power of psychologic analysis in striking contrast to the weakness under which Comte laboured from his neglect of such analysis. And it shows that Comte's conception of the order of philosophic evolution was entirely inadequate, and in the most important point entirely erroneous. It shows that the fundamental characteristic of Positive Philosophy, as asserted by Comte and as admitted by his followers, is the non-recognition of the absolute and infinite Power which is manifested in phenomena. Or, to use Mr. Spencer's words, the essential principle of Comte's philosophy is "an avowed ignoring of Cause altogether. For if it is not, *what becomes of his alleged distinction between the perfection of the positive system and the perfection of the metaphysical system?*" According to Comte's own definition,

[1] Spencer: *Recent Discussions*, p. 124.

the terminal conception of the metaphysical system is that of a single great Entity or Existence as the source of all phenomena; and since we have here shown that this very conception is the final conception in which science also must rest, the only possible step in advance which can be taken by Positivism is the elimination of this conception altogether. Prof. Huxley is thoroughly justified, therefore, in describing the name Positivism as implying a system of thought which recognizes nothing beyond the observed contents of phenomena: this description would be acknowledged as strictly accurate by M. Littré, and indeed expresses neither more nor less than that which Comte sought to express when he defined the perfection of the positive system to be the contemplation of all observable phenomena as particular cases of a single general fact, and omitted to add that this single fact must be alleged of some Existence of which all observable phenomena are manifestations. The "positive" stage of philosophizing is, therefore, something which never did exist and which never will exist. The "positive" method of philosophizing is simply an impossibility. The fundamental principle upon which the Positive Philosophy rests is the refusal to affirm that of which the affirmation is the fundamental principle of all knowledge, of all science, and of that Cosmic Philosophy which is the summing up of science.

Thus, since Comte's positive stage must be set aside altogether, and since his metaphysical stage and his theological stage alike end in positing Absolute Existence as the source of phenomenal existence, this being also the fundamental postulate made by science, the three stages vanish altogether. As we saw, in our second chapter, that from lowest to highest the process of knowing is essentially one and the same, we now see that from beginning to end the progress of that kind of knowledge which we call philosophy is one and the same. There are not three successive or superposed processes. There is one continuous process, which (if I may be allowed to invent a rather formidable word in imitation of Coleridge) is best described as a continuous process of *deanthropomorphization*, or the stripping off of the anthropomorphic attributes with which primeval philosophy clothed the unknown Power which is manifested in phenomena. Or, to be still more accurate, we may describe the process of philosophic evolution as a continuous integration, in thought, of causal agencies; of which process the gradual deanthropomorphization of these agencies is the necessary symptom and result,—until, as the end of the process, when all causal agencies have become integrated in the conception of a single Causal Agency, the tendency to ascribe anthropomorphic attributes to this Agency has reached its minimum.

We may now consider this process somewhat more in detail, as it has been concretely exemplified in history. And in doing this it will become apparent that, in spite of its vagueness, its inadequacy, and the fundamental error which vitiates it, the Comtean conception undeniably contained an adumbration of the truth. It recognized the process of deanthropomorphization as historically displayed, though it did not interpret it psychologically. And in several of its minor statements, we can have no hesitation in admitting Comte's generalization to be thoroughly valid. It is, for example, a historical fact that monotheism was preceded by polytheism, and that polytheism was preceded by fetishism; as indeed it was a psychological necessity that it should be so. Nor need we have any scruples about grouping these various forms of anthropomorphism under the general title of theology; or about employing the term "metaphysics" to designate that imperfect phase of science in which the necessity for verification is not yet recognized, and in which the limits to philosophic inquiry are as yet undetermined. It was in this sense that the term was defined in our fifth chapter, and it was in this sense that Newton used it in his famous objurgation, "O, Physics, beware of Metaphysics!" The term, as thus defined, as well as the term "theology," belongs to the general vocabulary of modern philosophy; and in using the two, we in nowise tacitly commit ourselves to the untenable hypothesis of the "Three Stages," while at the same time we are thereby enabled the better to sum up the facts which seemed to Comte to justify his generalization.

Premising this, we may proceed to gather our illustrations of the deanthropomorphizing process. And first let us note that theology, metaphysics, and science all have their common starting-point in mythology. It is worthy of remark that at about the same time when Comte first announced his theory of the primeval origin of philosophy in fetishism, the greatest of modern scholars, Jacob Grimm, was beginning those profound inductive researches which ended in demonstrating the fetishistic origin of myths. The myths of antiquity and of modern savagery constitute philosophy in its most primitive form, and embody whatever wisdom fetishism has to offer as the result of its meditations upon the life of man and the life of nature. Primitive men, like modern savages, had no systematic theology; they possessed no symbolic conception of God as an infinite unity; they were astray amid an endless multitude of unexplained and apparently unconnected phenomena, and could therefore form no generalized or abstract notions of divinity. But they were "oppressed with a *sensus numinis*, a feeling that invisible, powerful agencies were at work around them, who, as they willed, could help or hurt them." They naturally took it for granted that all kinds of activity must resemble the one kind with which they were directly acquainted—their own volition. Seeing activity, life and motion everywhere, it was impossible to avoid the inference that intelligent volition must be everywhere. Even after centuries of philosophizing, we can hardly refrain from imagining an anthropomorphic effort, or *nisus*, as constituting the necessary link between cause and effect. Yet in our minds, in so far at least as our overt utterances are concerned, fetishism has been very nearly destroyed by the long contemplation of the unvarying uniformity of the processes of nature. In the mind of the primitive man there were no such checks. The crude inference had its own way unopposed; and every action was believed to have its volition behind it. There was a volition for sunrise, and another for sunset; and for the flood of rain and the lightning there was a mighty conflict of volitions, a genuine battle of *manitous,* or superior beings, whenever—in mythic phrase—the great black shaggy ram, lifting audaciously his moist fleece against the sky, was slain and annihilated by the golden, poison-tipped, unerring shafts of Bellerophon.[1]

Thus we may safely assert, with Comte, that the earliest attitude assumed by the mind in interpreting nature was a fetishistic attitude. That chaos which the oldest traditions and the latest science alike recognize as the primordial state of the material universe must also have characterized the infancy of the human intellect. Until phenomena had been partially generalized, they could only have been considered the manifestations of arbitrary powers, not only unallied, but even in conflict with each other. And psychology tells us

[1] Thus, as I have observed in another work, "a myth is an explanation, by the uncivilized mind, of some natural phenomenon; not an allegory, not an esoteric symbol,—for the ingenuity is wasted which strives to detect in myths the remnants of a refined primeval science,—but an explanation. Primitive men had no profound science to perpetuate by means of allegory, nor were they such sorry pedants as to talk in riddles when plain language would serve their purpose. Their minds, we may be sure, worked like our own, and when they spoke of the far-darting sun-god, they meant just what they said, save that where we propound a scientific theorem, they constructed a myth. A thing is said to be explained when it is classified with other things with which we are already acquainted. That is the only kind of explanation of which the highest science is capable. We explain the origin, progress, and ending of a thunder-storm, when we classify the phenomena presented by it along with other more familiar phenomena of vaporization and condensation. But the primitive man explained the same thing to his own satisfaction when he had classified it along with the well-known phenomena of human volition, by constructing a theory of a great black dragon pierced by the unerring arrows of a heavenly archer."—*Myths and Myth-Makers,* p. 21.

that the fetishistic hypothesis was the only possible one,—that these powers must have been supposed to effect their purposes by means of volition. As we have seen, all interpretation of phenomena is an interpretation in terms of likeness and unlikeness. We know an object only as this thing or that thing, only as classifiable with this or that other object; and the extent of our knowledge may be measured by the accuracy and exhaustiveness of our classification. To adopt a familiar expression of Plato, we are ever carrying on a process of dichotomy; or, in the more precise language of modern psychology, we are continually segregating similar objects and similar relations of objects into groups, apart from those which they do not resemble. If we fail to detect the resemblances which really exist, or if we have imagined resemblances which do not exist, our interpretation is so far inaccurate and untrustworthy, but not therefore necessarily useless. Some theory is needful as a basis for further observation. Wrong classification is the indispensable prelude to right classification. The mind cannot go alone till it has for awhile groped and stumbled. Nature, the hoary Sphinx, sternly propounds a riddle; and many a luckless guesser gets devoured before an Oidipous arrives with the true solution.

In the primitive hypothesis, therefore, the forces of nature must have been likened to human volition, because there was nothing else with which to compare them. Man felt within himself a source of power, and did not yet surmise that power could have any other source than one like that which he knew. Seeing activity everywhere manifested, and knowing no activity but will, he identified the one with the other; and thus the same mighty power of imagination which now, restrained and guided by scientific methods, leads us to discoveries and inventions, then wildly ran riot in mythologic fictions whereby to explain the phenomena of nature.

The advance from this primeval fetishism through polytheism to monotheism was determined by the gradual attainment of physical knowledge, or, in other words, by the detection of certain uniformities in the processes of nature. The discovery of natural laws is the segregation of phenomena into groups according to their relations of likeness and unlikeness, attended by the disclosure of community of causation for the phenomena constituting each group. After this process has continued for a time, it is perceived that there are different modes of causation. Phenomena, in the production of which the human will is not implicated, are seen to differ from those in which it is concerned, by exhibiting a more conspicuous and readily detected regularity of sequence. Consequently, in considering them, the conception of arbitrary or capricious will is gradually excluded, and is replaced by the conception of a uniform force, whose actions may be foreseen, and whose effects, if harmful, may be avoided. This having occurred in the case of the more familiar phenomena, the same result eventually follows in the case of those which are more remote. The ultimate phase of this process characterized by the complete extrusion of volitional agencies and the universal substitution of the conception of invariable sequence, becomes possible only after an immense development of physical science. Volitional agencies, therefore, were not at once extruded, but were only generalized more and more, and gradually separated further and further from the phenomena which they were supposed to produce. A great step was taken in philosophy when the Titan dynasty was dethroned, and the celestial and terrestrial provinces of phenomena partitioned between Zeus and Poseidon. A still greater step was taken when God, considered as an arbitrary volitional agency, was entirely separated from the universe of tolerably uniform sequences, interposing with his will only on rare occasions. This is the cruder form of monotheism, and in it the metaphysical mode of thought is very conspicuous. In place of the innumerable volitional agents of the older theosophy, we have now innumerable *occultæ vires*, inherent virtues, vital principles, essential properties, and abstract entities; at the bottom of all the universal occult entity Nature, which is regarded as producing phenomena with considerable uniformity, save when the Volition behind sees fit to interpose and temporarily modify the natural order. Finally, when physical generalization has advanced so far as to include all, or nearly all, orders of phenomena, the theory of miraculous interposition vanishes, or remains only as a lifeless formula, verbally assented to, but not really believed in, while the presiding Volition is thrust back to the beginning of things, being retained only as a convenient and apparently necessary postulate by which to account for the origin of the universe and the harmonious cooperation of phenomena. This most refined form of theology will be thoroughly discussed in a future chapter. We have now only to note that further progress in deanthropomorphization involves the extrusion of the notion of a volitional Cause altogether, and leaves us with the conception of a Cause manifested throughout the entire world of phenomena, which is an indestructible element of consciousness, and which, equally with the anthropomorphic conceptions which have preceded it, is the proper object of religious feeling, but concerning the nature of which—in itself, and apart from its phenomenal manifestations—the human mind can frame no verifiable hypothesis.

We have seen that this terminal phase of the deanthropomorphizing process is radically distinct from Positivism, in which the Cause manifested in the world of phenomena is entirely ignored. It need hardly be added that it is equally distinct from Atheism and Pantheism, in which no place is left for a Cause distinct from phenomena themselves. How shall we characterize this terminal phase of the long process of philosophic development which we have just passed in rapid survey? An answer will be forthcoming if we pause to consider the common characteristics of the theological phases of thought which, in this terminal phase, are assumed to be outgrown and superseded. Let us premise that the word "Cosmos" is, by virtue of its etymology and of strict scientific usage, the antithetical correlative to the word "Chaos." It *denotes* the entire phenomenal universe; it *connotes* the orderly uniformity of nature, and the negation of miracle or extraneous disturbance of any kind. Now it is a common characteristic of the theologico-metaphysical phases of philosophy above passed in review, that while they have sought to explain the universe of phenomena, their explanations have been not purely cosmic, but to a greater or less extent anthropomorphic. Instead of restricting themselves to the interpretation of the uniformities of coexistence and sequence discovered by science, they have had recourse to unverifiable hypotheses concerning supernatural beings and occult entities, and have thus complicated the conception of the Cosmos with that of anthropomorphic agencies that are extra-cosmic. We have seen that the process of scientific generalization, which underlies the evolution of philosophy from epoch to epoch, is characterized not by the elimination of these agencies, but by their integration into a single Agency, from which the anthropomorphic attributes are stripped, and which is regarded as revealed in and through the Cosmos. Manifestly, then, while it is impossible to define this process as a development from Anthropomorphism to Positivism, it is on the other hand strictly accurate and entirely appropriate to define it as a development from Anthropomorphism to Cosmism. I do not know where we could find, for our purpose, a pair of terms more happily contrasted. For besides the connotations just described, there is also involved in this terminology the recognition of the fact that, at the outset, men interpreted the Cosmos in terms of human feeling and volition; while, on the other hand, as the newest result of scientific generalization, we now find them beginning to interpret human feeling and volition in terms obtained from the objective study of the Cosmos.

Let it be noted also, that, along with this group of happy contrasts, there is an equally happy lack of antagonism between our pair of terms. For while, on the one hand, all past philosophies have been Cosmic, in so far as the interpretation of the universe has been their aim; on the other hand, it will never be possible to get entirely rid of every trace of Anthropomorphism. For, as was proved in the fourth chapter, there is anthropomorphism even in speaking of the unknown Cause as *single;* and, as has been proved in the present chapter, there is anthropomorphism even in speaking of the unknown Cause as a *Power* manifested in phenomena. Yet we must either use such language or remain silent; we must either symbolize the unknown Cause or ignore it,—and as the latter alternative is impossible, we must accept the former.

Thus is exhibited in strong relief the peculiar excellence both of our theory of deanthropomorphization, and of the terms in which it is stated. For whereas the Atheistic Philosophy current in the eighteenth century, sought to break entirely with the past, scornfully setting aside its time-honoured beliefs as so much quackery and delusion; and whereas the Positive Philosophy, in spite of its sympathetic attitude toward the past, consequent upon its announcing itself as the terminal phase of a long development, nevertheless was obliged tacitly to break with the past, in so far as it ignored that which in earlier stages had always been taken for granted; on the other hand, the Cosmic Philosophy, in announcing itself as the most recent phase of a long development, recognizes no break anywhere in the course of that development. While Atheism scoffed at religion, and denied that the religious sentiment needed satisfaction; while Positivism, leaving no place in its scheme for religion to occupy, was compelled by an afterthought to proclaim that the religious sentiment finds its legitimate satisfaction in the service of an idealized Humanity; Cosmism, on the contrary, assigns to religion the same place which it has always occupied, and affirms that the religious sentiment must find satisfaction in the future, as in the past, in the recognition of a Power which is beyond Humanity, and upon which Humanity depends. The existence of God —denied by Atheism and ignored by Positivism—is the fundamental postulate upon which Cosmism bases its synthesis of scientific truths. The infinite and absolute Power, which Anthropomorphism has in countless ways sought to define and limit by metaphysical formulas, thereby rendering it finite and relative, is the Power which Cosmism refrains from defining and limiting by metaphysical formulas, thereby acknowledging so far as the exigencies of human speaking and thinking will allow—that it is infinite and absolute. Thus in the progress from Anthropomorphism to Cosmism the religious attitude remains unchanged from the beginning to the end. And thus the apparent antagonism between Science and Religion, which is the abiding terror of timid or superficial minds, and which the Positive Philosophy did comparatively little to remove, is in the Cosmic Philosophy utterly and for ever swept away.

The further elucidation of these views must be postponed until we come to treat in detail of the relations of science to theism and religion. With this preliminary indication of a theory to be hereafter more fully unfolded, the present chapter might be brought to a close, were it not that our conclusions have been elicited through a criticism of the theory of Comte, and that, at the beginning of our discussion, certain expectations were held out which the close of the discussion may seem to have belied. Conformity to the requirements of sound criticism demands that something more should be said upon this point.

We started in the belief that we were about to trace the outlines of some grand achievement whereby the claims of Comte to philosophic originality might be vindicated. We expressed entire dissent from Prof. Huxley's opinion that there is nothing of any value in the Positive Philosophy save that which it has borrowed from Hume. And we went so far as to assert that Comte's generalization of the historic order of speculative development inaugurated nothing less than a veritable revolution in the attitude of philosophy. Yet we have ended by regarding that generalization as wholly erroneous in one fundamental point, and as more or less inadequate in nearly all its points. And, more than this, we have noted that the very weakness of Comte's position consisted in his inability to advance one step in psychology beyond the point reached by Hume.

In spite of all this, however, the essential importance of the step taken by Comte is in no way invalidated. It is one thing to show that a doctrine is not wholly true; it is quite another thing to show that it contains no truth whatever. When Copernicus, for example, asserted that the planets revolve about the sun in circular orbits, he made a statement which is false; yet it is by virtue of his making this statement that we regard him as the inaugurator of the modern movement in astronomy. It was false that the planets revolve in circular orbits, but it was true that they revolve about the sun; and this was the part of the statement which turned men's thoughts into a new channel. Now, while I do not believe that Comte will ever be regarded by posterity as the Kepler or the Newton of modern philosophy, it is not at all unlikely that he will be pronounced its Copernicus. Though he was wrong in asserting that in the course of speculative evolution there are three radically distinct stages, and wrong also in assuming that the consciousness of Absolute Existence can ever be abolished; he was right in asserting that there has been a definite course of speculative evolution, of which deanthropomorphization is an essential feature, and which must end in the complete rejection of ontology. And this—though Prof. Huxley has not remarked it—was the part of his statement which called attention to the fact that a new era in speculation was commencing. I cannot, therefore, unreservedly endorse Mr. Spencer's assertion that Comte, while accepting the doctrine of the relativity of knowledge and kindred doctrines of modern scientific philosophy, nevertheless did nothing toward placing these doctrines upon a firmer ground than they had hitherto occupied. Comte indeed contributed nothing whatever to the psychological justification or elucidation of these doctrines; yet with his keen historic sense, he did much toward justifying them historically. To Hume's partial demonstration of the relativity of knowledge, Comte added incalculable weight by showing that toward the assertion of that doctrine tended the enormous momentum of twenty-five centuries of speculative activity. It is true that he proved this point only by an empirical induction from the facts of history; and it is true that he only half understood and stated incorrectly the doctrine which he thus empirically confirmed. Nevertheless even this incomplete achievement was partly the symptom and partly the cause of a philosophic revolution, the character of which we shall more fully appreciate when we come in our final chapter to compare the critical attitude assumed by philosophy in our age with that which it assumed in the age of Rousseau and the *Encyclopédistes.* When we recollect how slow is the education of the human race, and how few are they who can serve efficiently as its teachers, we shall be inclined to admit the justice of the principle that great thinkers should be estimated rather according to what they have accomplished than according to what they have failed to accomplish. Historic criticism is at last beginning to learn this important lesson. And just as we freely admit that in those very speculations of Berkeley and Hume and Kant which we now reject, the point which riveted the attention of their authors was a valuable truth, though not the truth which they supposed they saw; in like manner we must admit that in that theory of Comte's which I have here adversely criticized, there was contained a fruitful germ of truth.

## CHAPTER VIII

### ORGANIZATION OF THE SCIENCES.

THE results obtained in the course of the preceding inquiry have added depth and precision to our conception of the Scope of Philosophy. In coming to look upon all phenomena as manifestations of a Power unknowable in itself, yet knowable in the order of its phenomenal manifestations, we have virtually come to declare that the true business of philosophy is the determination of the order of the phenomena in which this omnipresent Power is manifested. And thus we arrive by another road at the very same definition of Philosophy which was previously given ; and we see that the progress of deanthropomorphization, while leaving the religious attitude of philosophy entirely unchanged, has at the same time precisely limited its scope in making it the Synthesis of the general truths of science into a system of universal truth. We have next to inquire—as preliminary to the construction of such a Synthesis—into the manner in which the different orders of scientific truths are to be grouped for the purposes of our philosophic construction. In short, we are brought face to face with the problem which also occupied Comte next in order after the question of deanthropomorphization: we have to deal with the classification of the sciences. And, as in the preceding chapter, we shall endeavour, while adversely criticizing the Comtean theory, to elicit results which are both true and available for our subsequent inquiries.

Comte begins by distinguishing two kinds of natural sciences; the one kind abstract and general, having for their object the discovery of the laws to which the various orders of phenomena conform, in all conceivable cases; the other kind concrete, special, descriptive, consisting in the application of general laws to the natural history of the various objects actually existing in the present or past. There is nothing difficult, or even novel, in this distinction, since it corresponds very nearly with that which is ordinarily drawn in scientific treatises between dogmatic physics and natural history. We shall see the difference very clearly by comparing general physiology, on the one hand, with zoology and botany on the other. The one formulates the general laws of life, whether considered in equilibrium or in the process of development; the other merely enumerates the conditions and mode of existence of each particular species of living bodies. Similar is the contrast between chemistry and mineralogy, of which the latter science is evidently founded upon the former. In chemistry we consider all possible combinations of heterogeneous molecules, in all imaginable circumstances; in mineralogy we consider only the particular combinations which are found realized in the actual past or present constitution of the terrestrial globe, under the influence of special sets of conditions. A circumstance which well illustrates the difference between the chemical and the mineralogical point of view, although the two sciences deal with the same objects, is, that a large proportion of the facts contemplated in chemistry have only an artificial or experimental existence. So that, for example, a body like chlorine or potassium may possess great importance in chemistry by reason of the extent and energy of its reactions and its affinities; while in mineralogy, on the other hand, it may be of little importance, because it is but seldom concerned in producing the natural rearrangements of molecules which it is the business of mineralogy to explain. And conversely, some such compound as granite or feldspar, which fills a great place in mineralogy, may be of little interest from the chemical point of view.

Of these two kinds of sciences, according to Comte, manifestly it is the first kind which first needs to be classified and systematically studied in its doctrines and methods. The scientific study of concrete physics presupposes the scientific study of abstract physics. For example, the study of the geologic development of the earth, when prosecuted in the most comprehensive manner, requires not only the previous study of physics and chemistry, but also some previous knowledge of astronomy and physiology. And similarly the scientific study of oceanic and atmospheric currents,—which, in the present chaotic state of our nomenclature, we characterize variously as meteorology, or climatology, or include under physical geography,—demands a preliminary acquaintance not only with mechanics, chemistry, and all the branches of molecular physics, but also with astronomy, since climatic rhythms depend upon the inclination of the earth's axis to the plane of the ecliptic, and more remotely upon the variations in that inclination known as precession and nutation. It is for this reason that concrete physics has made so little progress down to the present day, since it could begin to be rationally studied only after all the branches of abstract physics had assumed a distinctively scientific character. While, conversely, as soon as abstract physics has been completely organized, the study of concrete physics becomes merely the detailed application of general principles already established.

From these considerations Comte concluded that his Positive Philosophy might be founded upon a thorough organization of the doctrines and methods of the abstract sciences alone. The problem first in order was to arrange these sciences in a natural series. The end to be kept in view, in this encyclopædic labour, is to arrange the sciences in the order of their natural succession and mutual interdependence; so that we may study and expound them one after the other, without ever being led into a zigzag or circular course of study and exposition. It should be mentioned here at the outset, that Comte did not regard such an end as strictly attainable, in all its rigorous precision. He tells us expressly that however natural and however logically serviceable such a classification may be, it must always and necessarily contain something that is arbitrary, or at least artificial, in its arrangements. This, as he clearly saw, must ever result from the very richness and complexity of Nature, which refuses to be analyzed and partitioned off into distinct provinces, save provisionally for convenience of study. In his Introduction he reminds us that so few as six fundamental sciences will admit of seven hundred and twenty different arrangements; and that in behalf of each of these arrangements very likely something might be said, since even in the various classifications already proposed, the same science which one places at the beginning of the scale is by another placed at the end.[1] Nevertheless there is one series which is clearly indicated by the decreasing generality and simplicity of the phenomena with which the respective sciences are concerned. And this is the order which Comte adopts, primarily on account of its logical convenience. He begins with the most simple and general phenomena, to proceed step by step to those which are most complex and special.

Proceeding upon this principle, we are confronted at once by two grand divisions of phenomena, inorganic and organic. There is no difficulty in deciding which of these to study first. The more general and simple phenomena of weight, heat, light, electricity, and chemism, are manifested alike by

[1] Later in life Comte, no doubt, came to look upon his classification as complete and final. And so it appears to be regarded by his disciples, who are deaf to all the considerations which impeach it.

not-living and by living bodies; whereas the more special and complex phenomena of life are manifested, of course, only by the latter. Therefore the science of inorganic phenomena must precede the other. We can study thermal radiations and chemical reactions without taking vital forces into the account; but we cannot study living organisms without appealing to physics and chemistry at every step.

In the science of inorganic phenomena a somewhat less obvious principle of division next presents itself. Inorganic physics may be divided into celestial and terrestrial physics; of which the first treats only of gravitative force as manifested in the relatively simple phenomena of the mutual attractions of the heavenly bodies; while the second treats not only of gravitative force as manifested throughout relatively complex terrestrial phenomena, but also of the molecular forces, cohesion and chemism, and of the modes of undulatory motion called sound, heat, light, magnetism, and electricity. This second division may be again subdivided into physics proper and chemistry. The first treats of those changes in which the relative positions of the molecules of matter are altered homogeneously, resulting in increase or decrease of volume, or other change of physical state; while the second treats of those changes in which the relative positions of molecules are altered heterogeneously, resulting in the production of new compounds and new affinities. Of these two sciences, manifestly physics should be first studied. We can to a certain extent generalize the laws of reflection and refraction, condensation and rarefaction, without help from chemistry; but we cannot proceed a step in chemistry without appealing to physics.

Turning now to organic phenomena, we perceive that living beings may be studied either individually or collectively. In the first case we generalize the laws of nutrition and reproduction, of muscular contractility and nervous sensibility. This is the province of biology, a science which according to Comte, is of itself competent to include all the phenomena presented by vegetables and by the lower animals, as well as all those presented by individual man. But in the case of man, the aggregation of individuals gives rise to an entirely new class of phenomena produced by the reaction of individuals upon each other. To generalize the laws of this class of phenomena is the business of sociology, which is thus manifestly the most complex and special of the sciences.

According to Comte, this disposes of all the fundamental abstract sciences, except mathematics. This science he places first of all, the phenomena of number and form being universal, and capable of generalization without reference to other phenomena.

Thus we have the hierarchy of the positive sciences arranged in the following order:—

I. Mathematics.
II. Astronomy.
III. Physics.
IV. Chemistry.
V. Biology.
VI. Sociology.

In each of these sciences, there are several subdivisions which Comte endeavours to arrange, wherever it is possible, according to the same general principle of convenience. In mathematics, he places algebra before geometry, on the ground that we can study number by itself, but in order to study form we must make use of sundry laws of number; and for a similar reason, mechanics, which involves time and motion, is placed subsequent to the other two. In physics, barology, or the general doctrine of weight and pressure, is placed first, as nearest akin to astronomy; and electrology is placed last, as nearest akin to chemistry. The intermediate branches, acoustics, optics, and thermology, would now be ranked in the order in which I have named them; but

Comte ranked thermology first, probably because of the enthusiasm aroused in him by his friend Fourier's achievement in bringing the general doctrine of thermal expansion and contraction so thoroughly under the sway of mathematical analysis. In biology, anatomy, or the study of structure, is placed before physiology, or the study of function; and the study of the vegetal or nutritive functions precedes that of the animal or nervo-muscular functions. In sociology, the study of equilibrium, or the conditions essential to order, is ranked before the study of the laws of progress as generalized from history.[1]

It will be observed that in this scheme no special place is assigned to psychology. This is an omission quite in keeping with Comte's general conception of the scope of philosophic inquiry, from which the observation and analysis of states of consciousness are purposely omitted altogether. This omission will best be criticized and characterized later on, when in the course of our philosophic synthesis we shall have arrived at the discussion of the relations of the phenomena of mind to the phenomena of life.[2] Meanwhile, merely noting this serious omission, we may observe that the classification just sketched is so fascinating in its simplicity, and so manifestly convenient for many practical purposes of research, that at first it seems almost a pity for criticism to invalidate it. Its leading features appear to speak for themselves, to carry their own recommendation with them, to characterize this classification as the best which, with our present resources, it is possible to frame. And, indeed, if we compare it with some of the most ambitious preceding classifications, such as those of Oken and Hegel; or even with

[1] In a future chapter, it will appear that the proper arrangement is just the reverse of this, no sound theory of social equilibrium being attainable until the laws of progress have been generalized from history, with the aid of biology and psychology. Here, as in many other cases, Comte's error was due to his imperfect comprehension of the principle of Evolution.

[2] See below, part ii. chap. xiv.

the less pretentious but more useful systems of D'Alembert, Stewart, Ampère, Geoffroy St. Hilaire, and Cournot; its superiority is at once apparent. The arrangement seems so natural and obvious that it has not unfrequently been characterized by able critics as "just the sort of classification that would naturally arise in any reflecting mind on a review of the subject." We should not forget, however, that it never had arisen in any of the reflecting minds which reviewed the subject previous to Comte.

But Comte, who viewed everything in a historical light, intended that his classification should be something more than a convenient plan for arriving at philosophic generality through the study of the separate abstract sciences. He regarded it also as a kind of philosophic tableau or conspectus of the progress of the human mind from anthropomorphic toward scientific conceptions of natural phenomena. According to him, the order in which he arranged the sciences was the order in which they had respectively been constituted as sciences,—in which they had passed from the theological or metaphysical into the scientific stage. Thus mathematics, he tells us, has been a science, in the strict sense of the word, from time immemorial; but he omits to tell us that pure mathematics, dealing solely with number and form, and not involving conceptions of force, *could* never have been in the theological stage. It was only the phenomena of force which to primitive men must have seemed to require an anthropomorphic explanation. The action of the human will, by the analogy of which external events were explained, may be a mechanical, but it is not a geometrical or algebraic phenomenon. When we come to mechanics, there is room to construct volitional explanations. Nevertheless in mechanics there are so few traces of such explanations, since the dawn of history, that Comte thinks it may have always been a positive science; and he quotes approvingly Adam Smith's remark that nowhere do we ever hear of a god of Weight.

Such a god, however, had there ever been one, would have been a generalized deity, belonging to a comparatively advanced system of polytheism; and though we are entitled to infer from this that the earliest generalization of the phenomena of weight was a scientific and not a theological generalization, we are not entitled to infer that in the primeval fetishistic period, before the phenomena had been generalized at all, they were not supposed to be due to volition. It is one of the unfortunate results of Comte's use of the term "theological," to characterize this primitive philosophy, that we are apt to think it necessary to seek for signs of a deity when examining the so-called theologic epoch. The idea of a god distinct from the phenomenon was, however, a polytheistic, not a fetishistic idea: it was the result of much abstraction and generalization. Fetishism endowed the particular object itself with volition. And, such being the case, I am inclined to believe that many even of the simplest mechanical phenomena may have been originally explained as due to the free will of the objects concerned.[1] However this may be, there can be no doubt that mechanical conceptions ceased to be anthropomorphic at a very early date, and that statics, one branch of mechanics, is the oldest of the sciences, outside of pure mathematics.

If now we consider the three great branches of inorganic physics, we find abundant records of a time when the heavenly bodies were supposed to be intelligent creatures, and were worshipped as such. Even in the enlightened age of Perikles, and in the most advanced community then existing, Anaxagoras came near losing his life for asserting that the moon was a mass of rocks and not a goddess. Long after monotheism had overthrown these crude interpretations, the planets were still supposed to be the abode of controlling

[1] See *Myths and Myth-Makers,* chap. vii., "The Primeval Ghost World.

archangels. Even Kepler himself, early in the seventeenth century, was inclined to countenance this opinion, as may be seen from a remarkable passage in his "Harmonices Mundi" (p. 252). It was not until Newton that dynamical astronomy became a positive science. Similarly with the phenomena of terrestrial physics. The electric phenomena of storms, the thermal phenomena of congelation, the optical phenomena of the rainbow and the mirage, have, within the period known to history, been explained anthropomorphically; and, as late as the time of Cardan, echoes were by the unlearned interpreted as the voices of mocking demons, and *ignes fatui* were regarded as malign spirits inhabiting marshes. While in chemistry, both the Arabian alchemists and their European successors, in manipulating some of the more powerful reagents, and especially in the use of explosive or highly combustible materials, believed themselves to be forcing unwilling supernatural agents to execute their purposes. Probably the name "spirits," as employed in modern pharmacy, has had some such anthropomorphic origin.

Inorganic physics has by this time become almost entirely free from anthropomorphic conceptions. In the sciences which deal with organic phenomena, however, purely scientific conceptions do not yet reign supreme. Biology and sociology are still infected with metaphysical, and even to a certain extent with theological, notions. In biology, for instance, we have the anthropomorphic conception of an *archæus* or vital principle, distinct from the organism, and controlling its molecular processes. Though such a theory would not, at the present day, be defended by any authoritative writer upon this subject, it is nevertheless vaguely present in the popular mind, and exerts a clandestine influence even upon scientific speculations. The metaphysical doctrine of stimulus, so ably criticized by Dr. Anstie in his treatise on "Stimulants and Narcotics,"—the doctrine that stimulus is, not an increase in the rate of nutrition of the nerves, but a goading of the organism, sure to be followed by a depressive reaction,—is founded mainly upon this antiquated *à priori* conception of a vital principle. To take another instance, colds, fevers, and other diseases are commonly spoken of as entities which "get into the system," and are to be driven out; and imperfectly educated physicians are often heard reasoning upon this mythological assumption; whereas a disease of any kind, scientifically considered, is not an entity, but a disturbance of equilibrium among the interacting functions of the organism. A cancer, for instance, is a modification of structure resulting from a disturbance in the general process of nutrition. Molecules which should normally be deposited here and there throughout the various tissues begin to aggregate over a single limited area, forming a new abnormal tissue, of low vitality; and this new tissue grows at the expense of the organism until death ensues from exhaustion, or, if the wall of a large bloodvessel happens to get encroached upon and disintegrated, death ensues from hemorrhage. So an ordinary fever, in which blood-poisoning does not occur, is the result of an ill-understood alteration in the molecular properties of the blood, one of the chief symptoms of which is the adherence of the blood-corpuscles to the walls of the capillaries. Yet so prevalent still is the personifying habit of thought, that cancers and fevers are spoken of and reasoned about as occult entities, as ugly Things which somehow or other "get into" the blood.

It is hardly necessary to insist upon the prevalence of the metaphysical habit in sociology, where final causes are still sought after, where the doctrine of the "freedom of the will" (or, as it might better be termed, of the "lawlessness of volition") still maintains a precarious footing, and where practical conclusions are constantly based upon the *à priori* doctrine of inherent "rights." Here, too, as well as in biology, even the theological point of view not unfrequently appears. The late war between France and Germany was doubtless the occasion of many prayers to the "God of Battles." The same persons who, in the regular recurrence of the seasons, in the expansion of heated bodies, in the explosion of fulminating compounds, in the darkness caused by an eclipse, in short throughout the entire realm of inorganic phenomena, see nothing but the operations of uniform forces, nevertheless explain diseases, famines, and political revolutions, upon the hypothesis of an overruling Providence extraneous to the Cosmos; announcing, perhaps, the doctrine of a divine judgment upon sin,—which is indeed not a fiction, but the mythologic version of a scientific truth.

Not only (according to Comte) has deanthropomorphization proceeded more rapidly in the simpler sciences than in the more complex ones, but the generalization of causal agencies, of which deanthropomorphization is the result, took place earlier in the former than in the latter. This is to be seen by comparing the dates at which the sciences respectively ceased to be mere aggregations of empirical knowledge, and became founded as sciences, in the strict sense of the word. Thus astronomy, at least in its statical department, was a science in the days of Hipparchos. Physics became a science when Galileo discovered the law of falling bodies. Chemistry became a science, about a hundred and seventy years later, when Lavoisier overthrew the doctrine of phlogiston, and detected the true principles of combustion. Biology did not become a science until the very end of the eighteenth century, when Bichat pointed out the relations between the functions of organs and the properties of tissues. Finally sociology has hardly yet become a science; and many educated persons still regard historical events as happening in no determinate sequence, and stigmatize, as not only chimerical but even impious, any attempt to formulate the order of such events.

Here it becomes desirable to pass from simple exposition to criticism. In the Comtean views above set forth we must of course recognize a large amount of historic truth. There can be no doubt that anthropomorphic conceptions soonest disappear from those departments of science which are earliest constituted and most rapidly developed. Nor can there be any doubt that in a vague and general way the Comtean arrangement represents, or at any rate suggests, the historic order of progression. No doubt mathematics is the oldest of the sciences—as indeed its name curiously hints to us—and sociology the youngest. No doubt the movements of masses, of which astronomy and physics treat, were correctly formulated sooner than the combinations of heterogeneous molecules, which form the subject-matter of chemistry. And no doubt the science of inorganic phenomena as a whole is more complete than the science of organic phenomena. All this must be admitted. Yet if we examine more closely into the matter, we shall discover grave errors in this classification which looked so fair to us on a cursory inspection. We shall notice first that in many points of fundamental importance it does not faithfully represent the order of historic progression; and when we come to inquire into the reason of this failure, we shall find that the classification errs from its very simplicity, that the facts to be arranged are too complex and heterogeneous to admit of any such facile linear arrangement.

In the first place the historical relations between astronomy and physics have been mis-stated by Comte, and he has marked out the province of physics after a fashion that is, at the present day, completely indefensible. To class together the science which treats of weight and pressure, and the sciences which treat of light, heat, and electricity, and to refer to the whole under the general appellation of Physics, is to prepare the way for statements which are too general to be accurate. In contrasting physics with astronomy, however, Comte is careful to let us know that he intends to designate that physics which deals with the phenomena of moving masses; for he tells us that while astronomy has been a science since the time of Hipparchos, physics first became a science in the days of Galileo. The slightest consideration will show us that this apparent confirmation of Comte's views rests upon a verbal ambiguity. For what portion of astronomical phenomena had been generalized as early as the time of Hipparchos? Simply the statical or geometrical portion, namely, the apparent motions of the planets, the great achievement of Hipparchos having been the construction of the theory of epicycles and eccentrics, whereby to formulate these motions. It is needless to add that all the geometrical data used in making this generalization had been obtained from the previous observation of terrestrial phenomena. And what portion of physics was it which was not generalized till the time of Galileo? It was the dynamical portion, since statics had been erected into a science by Archimedes, who lived just a century before Hipparchos. By comparing the statical part of astronomy with the dynamical part of physics, Comte finds it quite easy to establish the precedence of the former. Unfortunately, such precedence is not what the argument requires, though it is all that can be established. If we compare like orders of phenomena, we shall see at once that it was physics which preceded astronomy. Dynamical astronomy became a science only with the discovery of the law of gravitation; and this law was not discovered, nor could it have been discovered, until after the leading generalizations of terrestrial dynamics had been established. For, as Mr. Spencer observes, "What were the laws made use of by Newton in working out his grand discovery? The law of falling bodies, disclosed by Galileo; that of the composition of forces, also disclosed by Galileo; and that of centrifugal force, found out by Huyghens—all of them generalizations of terrestrial physics. . . . Had M. Comte confined his attention to the things and disregarded the words, he would have seen that before mankind scientifically coordinated *any one class of* phenomena displayed in the heavens, they had previously coordinated *a parallel class of phenomena* displayed upon the surface of the earth." [1]

This criticism is a very incisive one. It destroys this part of Comte's classification not only from the historical, but also from the logical point of view. It shows that the study of astronomy depends upon that of terrestrial physics, and should therefore come after, and not before it. In fact the whole science of astronomy, as at present constituted, consists of two portions,—the theory of gravitation and the theory of nebular evolution. The first of these, as we have just seen, is a mere extension to celestial phenomena of certain laws of terrestrial physics. The second depends upon the study of terrestrial phenomena in a yet greater degree, since it involves the knowledge not only of gravitation, but also of radiant heat, and of the conditions of equilibrium of gases and liquids.[2]

If now we compare physics with chemistry, we shall find a similar ambiguity in Comte's results. It is easy to say that chemistry was not organized into a science until toward the close of the eighteenth century, while physics was organized at the beginning of the seventeenth: but what do we now mean by physics? If we mean merely the science which generalizes the phenomena of weight, our proposition is indisputable; but unfortunately it is of little use in supporting the Comtean classification. For Comte, as we have seen, includes under the general head of physics, not

[1] Spencer's *Essays*, 1st series, p. 179.

[2] I leave this as it stood five years ago, when this chapter was written. The numerous and wonderful disclosures of spectrum-analysis, not only giving us unlooked-for information concerning the physical constitution of the stars, but even throwing new light on their movements, make it desirable, perhaps to enlarge the scope assigned to astronomy in the text. But such a modification of the form of statement would show only the more forcibly how closely the study of astronomy depends on the study of terrestrial phenomena. The greatest step recently taken in science is thus an additional argument against the validity of Comte's conception.

only the science of weight, but also the sciences of heat, light, electricity and magnetism, to say nothing of sound. It was incumbent on Comte to show that this whole group of phenomena became scientifically coordinated at an earlier date than the phenomena of chemical composition and decomposition. This, however, it would have been impossible to show. Electric phenomena, the most backward of the group, were not scientifically coordinated until the close of the last century, when Coulomb generalized the laws of electric equilibrium. Strictly speaking, there was no general science of Physics even when Comte wrote the "Philosophie Positive;" and in linking together the allied departments of optics, thermology, acoustics and electrology, he made up what was then an incongruous group, about which it was unsafe to make general statements. In 1842—the year in which Comte's work was finished—Mr. Grove, by showing that the different allied manifestations of physical force are modes of motion which are convertible into each other, laid the foundations of a general science of Molecular Physics, regarded as a science of vibrations. And in 1843 Mr. Joule, by discovering the mechanical equivalent of heat, gave to the new science a quantitative character. These were the great epoch-making steps, like the steps taken by Newton in astronomy, which founded the science.

It is thus evident that Comte was far from successful in this part of his classification; and considering the state of science forty years ago, it appears impossible that he should have succeeded. He united phenomena which should have been kept separate, and separated phenomena which should have been united. We are now in a position to see that Comte's grand division of inorganic science must be subdivided into Molar Physics, which treats of the movements of masses; Molecular Physics, which treats of the movements of molecules and of the laws of aggregation of homogeneous molecules; and Chemistry, which treats of the laws of aggregation of heterogeneous molecules. And we see, moreover, that astronomy is merely the application of the principles of molar physics (and, in its latest researches, of molecular physics and chemistry also) to the study of a special class of concrete phenomena. Such is the logical arrangement; and the only historical parallelism to be found is the fact that theorems relating to masses were reached sooner than theorems relating to molecules.

It would not be difficult to cite other instances in which the Comtean classification is at variance not only with the order of the phenomena classified but also with the order of historic progression. But I prefer to quote from Mr. Spencer a remarkable passage which strikes immediately at the vital point of the theory. Comte's fundamental error was in not recognizing "the constant effect of progress in each class upon *all* other classes; but only on the class succeeding it in his hierarchical scale. He leaves the impression that, with trifling exceptions, the sciences aid each other only in the order of their alleged succession. But in fact there has been a continuous helping of each division by all the others, and of all by each. Every particular class of inquirers has, as it were, secreted its own particular order of truths from the general mass of material which observation accumulates; and all other classes of inquirers have made use of these truths as fast as they were elaborated, with the effect of enabling them the better to elaborate each its own order of truths. It was thus with the application of Huyghens's optical discovery to astronomical observation by Galileo. It was thus with the application of the isochronism of the pendulum to the making of instruments for the measuring of intervals, astronomical and other. It was thus when the discovery that the refraction and dispersion of light did not follow the same law of variation, affected both astronomy and physiology by giving us achromatic telescopes and microscopes. It was thus when Bradley's discovery of the aberration of light enabled him to make the first step towards ascertaining the motions of the stars. It was thus when Cavendish's torsion-balance experiment determined the specific gravity of the earth, and so gave a datum for calculating the specific gravities of the sun and planets. It was thus when tables of atmospheric refraction enabled observers to write down the real places of the heavenly bodies instead of their apparent places. It was thus when the discovery of the different expansibilities of metals by heat, gave us the means of correcting our chronometrical measurements of astronomical periods. It was thus when the lines of the prismatic spectrum were used to distinguish the heavenly bodies that are of like nature with the sun from those which are not. It was thus when, as recently, an electro-telegraphic instrument was invented for the more accurate registration of meridional transits. It was thus when the difference in the rates of a clock at the equator and nearer the poles, gave data for calculating the oblateness of the earth, and accounting for the precession of the equinoxes. It was thus—but it is needless to continue. We have already named ten cases in which the single science of astronomy has owed its advance to sciences coming after it in Comte's series. Not only its secondary steps, but its greatest revolutions have been thus determined. Kepler could not have discovered his celebrated laws, had it not been for Tycho Brahe's accurate observations; and it was only after some progress in physical and chemical science that the improved instruments with which those observations were made, became possible. The heliocentric theory of the solar system had to wait until the invention of the telescope before it could be finally established. Nay, even the grand discovery of all—the law of gravitation—depended for its proof upon an operation of physical science, the measurement of a degree upon the earth's surface. Now this constant intercommunion, here illustrated in the case of one science only, has been taking place with all the sciences

. . . . Let us look at a few cases. The theoretic law of the velocity of sound, enunciated by Newton on purely mechanical considerations, was found wrong by one-sixth. The error remained unaccounted for until the time of Laplace, who, suspecting that the heat disengaged by the compression of the undulating strata of the air, gave additional elasticity and so produced the difference, made the needful calculations and found he was right. Thus acoustics was arrested until thermology overtook and aided it. When Boyle and Mariotte had discovered the relation between the density of gases and the pressures they are subject to; and when it thus became possible to calculate the rate of decreasing density in the upper parts of the atmosphere; it also became possible to make approximate tables of the atmospheric refraction of light. Thus optics, and with it astronomy, advanced with barology . . . . When Fourier had determined the laws of conduction of heat, and when the earth's temperature had been found to increase below the surface one degree in every forty yards, there were data for inferring the past condition of our globe; the vast period it has taken it to cool down to its present state; and the immense age of the solar system —a purely astronomical consideration. Chemistry having advanced sufficiently to supply the needful materials, and a physiological experiment having furnished the requisite hint, there came the discovery of galvanic electricity. Galvanism reacting on chemistry disclosed the metallic bases of the alkalies, and inaugurated the electro-chemical theory; in the hands of Oersted and Ampère it led to the laws of magnetic action; and by its aid Faraday detected significant facts relative to the constitution of light. Brewster's discoveries respecting double refraction and dipolarization proved the essential truth of the classification of crystalline forms according to the number of axes, by showing that the molecular constitution depends upon the axes. In these, and in numerous other cases, the mutual influence of the sciences has been quite independent of any supposed hierarchical order. Often, too, their interactions are more complex than as thus instanced—involve more sciences than two . . . . So complete in recent days has become this *consensus* among the sciences, caused either by the natural entanglement of their phenomena, or by analogies in the relations of their phenomena, that scarcely any considerable discovery concerning one order of facts now takes place without very shortly leading to discoveries concerning other orders."[1]

Mr. Spencer goes on to describe the infinitely complex manner in which the various sciences act upon the advancement of the arts, and are reacted upon by that advancement. He enumerates the vast multitude of arts, involving the knowledge of many distinct sciences, which enter into the economical production of such an apparently simple article as a child's calico frock. He shows that the various sciences by turns stand in the relation of arts to each other; and that often the mere process of observation in any one science requires the aid of half a dozen other sciences. But it is needless for me to go on quoting from an essay which is easily accessible, and which should be read from beginning to end by everyone who wishes to understand the true character of scientific progress. I prefer to add an illustration or two, suggested by the progress of science during the nineteen years that have elapsed since that essay was published; and to observe how Kirchhoff's discoveries in spectrum-analysis—rendered possible only through a great advance in chemical knowledge — have reacted upon astronomy, enabling Mr. Huggins to determine the proper motion of Sirius, and consequently, by putting it in our power to ascertain the motions of all those stars which, moving directly towards or away from us, yield no parallax, have laid the foundations for a general theory of sidereal dynamics, to be further elaborated in the future. Or to take

[1] Spencer's *Essays*, 1st series, pp. 181—183, 214, 215.

a still more striking instance, let us remember how Adam Smith's elucidation of the principle of "division of labour," in sociology, suggested to Goethe the conception of a "division of labour" in biology, and thus heralded Von Baer's magnificent discovery that organic development is a progressive change from homogeneity to heterogeneity of structure. And let us note how this discovery in biology has lately reacted upon all preceding departments of investigation, strengthening the nebular theory in astronomy and the theory of the progressionists in geology; and thus ultimately reacting upon our philosophy by giving us, for the first time, a scientific doctrine of the evolution of the physical universe.

Enough has been alleged to prove that the Comtean view of the progress of science fails to account for more than a limited portion of the facts of that progress. Instead of the sciences aiding each other, with few and unimportant exceptions, only in the hierarchical order in which Comte has placed them, we perceive that they have continually been aiding each other in all directions at once. The more complex sciences have all along been assisting the simpler ones, and these have often been delayed in their progress for want of the assistance which the former have ultimately furnished. There has, therefore, been no such thing as a progressive evolution of the sciences in a linear order; but there has been a consentaneous evolution, in which the advance of each science has been a necessary condition of the advance of all the others.

It thus appears that Comte unduly simplified the problem. His classification well enough expresses the order of development of the sciences, in so far as their development has depended merely on the relative simplicity or complexity of the phenomena with which they have had to deal. It rests upon the assumption that, with few and unimportant exceptions, the progress of generalization has been from the simple to the complex. Now this is not the case. The progress of generalization has indeed been partly determined by the relative simplicity or complexity of the phenomena to be generalized (and this fact accounts for the considerable amount of truth which the Comtean doctrine contains); but it has been also determined by several other circumstances. In the chapter on "Laws in General" to be found in the first edition of "First Principles," but omitted in the revised edition, Mr. Spencer has called attention to some of these circumstances. He reminds us that not only are phenomena early generalized in proportion as they are *simple*, but also in proportion as they are *conspicuous* or obtrusive. "Hence it happened that after the establishment of those very manifest sequences constituting a lunation, and those less manifest ones marking a year, and those still less manifest ones marking the planetary periods, astronomy occupied itself with such inconspicuous sequences as those displayed in the repeating cycle of lunar eclipses, and those which suggested the theory of epicycles and eccentrics; while modern astronomy deals with still more inconspicuous sequences, some of which, as the planetary rotations, are nevertheless the simplest which the heavens present." The solution of the problem of specific gravity by Archimedes, and the discovery of atmospheric pressure, nearly nineteen hundred years later, by Torricelli, involved mechanical relations of exactly the same kind; but the connection between antecedent and consequent was much more conspicuous in the former case than in the latter. The effect produced by the air in decomposing soil is a phenomenon just as simple as the rusting of iron or the burning of wood; but it is far less conspicuous, and accordingly chemistry generalized the one long before the other. Finally, if, remembering the enormous advance in science due to the telescope and microscope, and bearing in mind the equally astonishing results which are likely to arise from the use of the lately-invented spectroscope, we ask what is the character of the service rendered us by these instruments; the reply is that they enable us to generalize phenomena which before were too inconspicuous to be generalized.

Again, other things equal, phenomena that are *frequent* have been scientifically explained sooner than unusual phenomena. "Rainbows and comets do not differ greatly in conspicuousness, and a rainbow is intrinsically the more involved phenomenon; but chiefly because of their far greater commonness, rainbows were perceived to have a direct dependence on sun and rain while yet comets were regarded as supernatural appearances."

In like manner the more *concrete* relations have been formulated before those that are more abstract. If we were to adhere rigorously to Comte's principle of decreasing generality, we should have to place the infinitesimal calculus before algebra, and algebra before arithmetic. But the order of development has been just the reverse,—from arithmetic, the least abstract department, to calculus, the most abstract.

Lastly I would suggest a circumstance, not mentioned by Mr. Spencer, namely that, other things equal, the sciences must advance according to the ratio between the complexity of the phenomena with which they deal and the multiplicity of our means for investigating those phenomena. I shall presently describe our three chief implements for extorting the secrets of Nature—observation, experiment and comparison; showing that in general, as phenomena become more and more complicated, our ability to make use of these implements increases. In astronomy we have only observation to help us; but astronomic phenomena are comparatively simple, so that here we have a highly-developed science. In biology we can use all three implements; and so, in spite of the complexity of vital phenomena, we have here a tolerably well-organized science. But in meteorology, we have to deal with very complex phenomena, and still have no resource save in steadfast observation. Hence meteorology is still a very backward science,—more backward even than sociology, of which the phenomena are far more complex.

According to Mr. Spencer, phenomena are also generalized early in proportion as they directly affect human welfare. But this circumstance would appear to have far less potency than the others above enumerated. There is, of course, no doubt that men will earliest study those subjects which most obviously concern them; but whether their study will be fruitful or not depends, as it seems to me, upon the other factors in the case, above enumerated. I doubt if there is any instance in which this factor has actually overruled the other factors, as these have continually overruled each other. Sociology is the science which, more than all others, would seem to have direct practical bearings upon human welfare; yet, although men have studied social phenomena since the days of Plato, they have but lately arrived at any scientific generalizations concerning them. The daily changes of weather are more obviously concerned with human interests than the geological succession of extinct animals and vegetables; yet our scientific knowledge of palæontology, though unsatisfactory enough, is yet far more advanced than our scientific knowledge of meteorology. No doubt men will soonest endeavour to understand the phenomena which most intimately concern them; but the order in which they will come to understand them will depend upon the simplicity, the concreteness, the conspicuousness, and the frequency of the phenomena, and upon the number and perfection of the implements of investigation which are at command. Indeed, from one point of view, it may be urged that direct complicity with human interests is often a hindrance to the scientific investigation of phenomena. Doubtless the disinterested calmness with which remote mathematical and physical inquiries are prosecuted is one secret of their success. As Hobbes remarked, with keen sarcasm, "even the axioms of geometry would be disputed if men's passions

P 2

were concerned with them." And does not daily experience teach us the difficulty of getting our legislators to accept the simplest and most completely established principles of political economy?

Thus there are at least five separate factors determining the order and rate at which knowledge progresses; and it is the interaction of these factors which has made the actual order of scientific development too complex to be embraced in any linear formula, like that proposed by Comte. It is because it recognizes only one of these factors that the Comtean classification fails to represent the historic order in its true complexity. It makes a straight line where it ought to make a system of inosculating spirals.

Returning now from the historical to the logical point of view, we have to note a still more fundamental error in the Comtean classification. That classification rests primarily upon the distinction, above explained, between the abstract and the concrete sciences. That there is such a distinction cannot be questioned; but it will not be difficult to show that Comte has made the division incorrectly. When Comte contrasts chemistry with mineralogy, because the one formulates the abstract laws of the aggregation of heterogeneous molecules, while the other applies these laws to concrete instances actually realized in nature, under the influence of particular sets of conditions,—the distinction must be admitted as valid. But when he similarly contrasts biology with zoology and botany, because the one formulates the general laws of life, while the others merely study the conditions of existence of particular genera and species, the distinction cannot be admitted as valid. In so far as zoology and botany are restricted to the mere description and enumeration of organic forms, they cannot strictly be called sciences at all, but only branches of natural history. In so far as they are anything more than this, they are a constituent part of biology. For in biology, it is the study of the concrete conditions of existence of living organisms which lies at the bottom of the whole. The laws of nutrition, reproduction and innervation are not abstract laws, considered apart from the conditions in which they are realized, like the law of inertia in physics, or the law of definite proportions in chemistry. They are realized in each concrete instance just as much as certain chemical and physical laws are realized in each concrete instance of mineralogy. Or, in other words, the laws of biology are derivative uniformities, while the laws of physics and chemistry are original uniformities. Given the general laws of molecular combination and decombination, and given also a certain definite organization placed in a given environment, and the laws of nutrition, reproduction and innervation follow. Take away the definite organization, and you have nothing left but the laws of molecular rearrangement, which are the subjects of physics and chemistry. This is not identifying biology with physics and chemistry. The fact of organization remains, by the study of which biology is an independent science. But it is a concrete science, since it can study organization only as actually exemplified in particular organisms. The same is true of sociology, which is simply an extension of the principles of biology and psychology to the complex phenomena furnished by the mutual reactions of intelligent organisms upon each other. There is no abstract science of sociology which leaves out of sight the special complications arising from the interaction of concrete, actually-existing communities. Any such abstract science is a mere figment of the imagination, born of Comte's excessive passion for systematizing. The science of sociology is the generalization of the concrete phenomena of society, as recorded in history; and, in the widest sense, the laws of sociology are the laws of history. And, travelling back to the other end of the series, a similar criticism must be made upon astronomy. This science is an application of molar physics (and latterly, in some degree, of molecular physics and chemistry) to the concrete phenomena presented by the heavenly bodies. The universal law of gravitation is indeed an abstract law; it formulates a property of bodies. But it holds good of terrestrial as well as of celestial phenomena: and its application to either class of phenomena, in their actual complications, constitutes a concrete science.

These are the considerations which irretrievably demolish the Comtean classification, considered as an expression of the true relations between the sciences. It appears that Comte has intermingled three abstract sciences,—mathematics, physics, and chemistry,—with three concrete sciences,—astronomy, biology, and sociology. He was led into this confusion by confounding the *general* with the *abstract*. But, as Mr. Spencer has pointed out, these terms have different meanings. "Abstractness means *detachment from* the incidents of particular cases; generality means *manifestation in* numerous cases. On the one hand the essential nature of some phenomenon is considered, apart from the phenomena which disguise it. On the other hand, the frequency of recurrence of the phenomenon, with or without various disguising phenomena, is the thing considered. An abstract truth is rarely if ever realized to perception in any one case of which it is asserted. A general truth may be realized to perception in all of the cases of which it is asserted. . . . In other words, a general truth colligates a number of particular truths; while an abstract truth colligates no particular truths, but formulates a truth which certain phenomena all involve, though it may be actually seen in none of them." [1]

Now there can be no question that if we were to substitute the words *general* and *special* for the words *abstract* and *concrete*, in the Comtean classification, that classification would express, to a certain extent, a true distinction. No doubt chemistry and biology are general sciences, while

[1] Spencer, *Classification of the Sciences*, 1864, pp. 7—9.

mineralogy, zoology and botany are more or less special sciences. But the distinction between abstract and concrete is by far the deeper distinction, and because the Comtean classification incorrectly formulates it, there is no alternative but to regard that classification as incurably faulty.

The above criticism, however, supplies us with materials for making a better one. As the case now stands, we have three abstract sciences,—mathematics, physics, and chemistry. Yet a distinction in degree of abstractness arises between mathematics and the other two. All three were originally obtained by generalization from concrete phenomena. All mathematical analysis starts from numeration, as all geometry starts from measuring. Nevertheless, mathematics has utterly outgrown the processes of concrete observation, and is a purely deductive science, dealing merely with number and figure, or what may be called the blank forms of phenomena. It thus becomes more nearly allied to logic than to the physical sciences; and indeed the chief difference between the two is that logic deals with qualitative relations only, while mathematics deals with relations that are quantitative. On the other hand, molar physics, molecular physics, and chemistry, dealing with abstract laws of motion and force that are gained from experience of concrete phenomena, and appealing at every step to the concrete processes of observation and experiment, may be distinguished as abstract-concrete sciences. These sciences analyze concrete phenomena, in order to formulate the working of their factors. "In every case it is the aim to decompose the phenomenon, and formulate its components apart from one another; or some two or three apart from the rest." The problem is to ascertain the laws of molar motion, or molecular vibration, or atomic rearrangement, not as these laws are actually realized to perception in any concrete example, "but as they would be displayed in the absence of those minute interferences which cannot be altogether avoided." Conversely, when we come to the concrete sciences,—astronomy, geology, biology, psychology, and sociology,—our business is no longer analysis but synthesis. "Not to formulate the factors of phenomena is now the object; but to formulate the phenomena resulting from these factors under the various conditions which the Universe presents."

Thus we have distinguished three orders of sciences,—the abstract, the abstract-concrete, and the concrete. Our task is next to arrange the concrete sciences in some convenient and justifiable order. Mr. Spencer has constructed an elaborate tableau of these sciences, which is at once elegant and accurate, but which, for ordinary purposes, may profitably be abridged and condensed. Our principle of abridgment shall be a simple one. Since, in the concrete sciences, our object is to interpret the various orders of phenomena synthetically, as actually manifested throughout that portion of the universe which is accessible to our researches,—we cannot do better than arrange these sciences in the order in which their subject-phenomena have begun to be manifested in the course of universal Evolution.[1] First in order come the astronomical phenomena presented by the genesis of the solar system from a cooling and contracting mass of vapour, and the resulting rotatory motions of its members. Next come the geological phenomena presented by each cooling and contracting planet, but completely accessible to us only in the case of the earth. With the origin of life upon the earth, already considerably advanced in its development, biological phenomena begin to be presented. Still later, with the appearance of animals possessing comparatively complex nervous systems, begin the phenomena of consciousness, constituting the subject-matter of psychology. Finally, with

[1] See, in this connection, a very interesting letter by the distinguished geologist M. Cotta, in *La Philosophie Positive*, mai-juin, 1869; tom. iv. p. 186.

the advent of creatures sufficiently intelligent to congregate for mutual assistance in permanent family-groups, and by the aid of language to transmit their organized experience from generation to generation, there begin the phenomena of sociology.

The logical correctness of this threefold division of the sciences is shown by the fact that the several sciences which we have arranged together in each group cohere strongly among themselves, while they do not strongly cohere with the sciences arranged in either of the other groups. The concrete sciences, for example, all agree in having for their subject-matter the study of the *aggregates* of sensible existences, or of the relations and forces which sensible existences manifest in the state of aggregation. Sidereal Astronomy deals with stellar aggregates scattered through space just as we find them. "Planetary Astronomy, cutting out of this all-including aggregate that relatively minute part constituting the solar system, deals with this as a whole." Out of the number of aggregates which make up the whole with which planetary astronomy thus deals, Geology selects the one most easily accessible, and studies that one in detail. Again, among the many rearrangements of matter and motion which go on upon the earth's surface, there are found a number of small aggregates which Biology distinguishes as vital, and accordingly selects as constituting its own special subject-matter. Among the many functions which, taken together, make up the life of these organic aggregates, there are sundry "specialized aggregates of functions which adjust the actions of organisms to the complex activities surrounding them"; and these specialized aggregates of functions form the subject-matter of Psychology. Lastly Sociology "considers each tribe and nation as an aggregate presenting multitudinous phenomena, simultaneous and successive, that are held together as parts of one combination." So that, from first to last, the object of the concrete sciences is to describe the history and formulate the modes of action of actually existing *aggregates*, from the time when they begin to exist as aggregates down to the time when they cease to exist as aggregates.

It is quite otherwise with the abstract-concrete sciences. By all these sciences, actually existing aggregates are implicitly ignored; "and a *property*, or a connected set of properties, exclusively occupies attention." It matters not to Molar Physics "whether the moving mass it considers is a planet or molecule, a dead stick thrown into the river or the living dog that leaps after it: in any case the curve described by the moving mass conforms to the same laws." So when Molecular Physics investigates "the relation between the changing bulk of matter and the changing quantity of molecular motion it contains," constant account is taken of connected sets of properties, but no account whatever is taken of particular aggregates of matter. The conclusions reached apply equally to Chimborazo and to a tea-kettle, to the solidification of the earth's crust and to the cracking of a pipe by frozen water. Similarly in Chemistry, while "ascertaining the affinities and atomic equivalence of carbon, the chemist has nothing to do with any aggregate. He deals with carbon in the abstract, as something considered apart from quantity, form, or appearance, or temporary state of combination; and conceives it as the possessor of powers or properties, whence the special phenomena he describes result; the ascertaining of all these powers or properties being his sole aim." So that, from first to last, the object of the abstract-concrete sciences is to give an account "of some order of *properties*, general or special; not caring about the other traits of an aggregate displaying them, and not recognizing aggregates at all further than is implied by discussion of the particular order of properties."

Finally, the abstract sciences deal solely with *relations* among aggregates or among properties, or with the relations between aggregates and properties, or with relations among relations; but take no further account of aggregates or of properties than is implied in the discussion of a particular order of relations. For example, "the same Logical formula applies equally well, whether its terms are men and their deaths, crystals and their planes of cleavage, or letters and their sounds. And how entirely Mathematics concerns itself with relations, we see on remembering that it has just the same expression for the characters of an infinitesimal triangle, as for those of the triangle which has Sirius for its apex and the diameter of the earth's orbit for its base."[1]

Since then, "these three groups of sciences are, respectively, accounts of *aggregates*, accounts of *properties*, accounts of *relations*, it is manifest that the divisions between them are not simply perfectly clear, but that the chasms between them are absolute." Thus we arrive at the following

*Classification of the Sciences.*

| | | |
|---|---|---|
| ABSTRACT SCIENCES, dealing with *relations*, that are | qualitative; | Logic. |
| | quantitative; | Mathematics. |
| ABSTRACT-CONCRETE SCIENCES, dealing with *properties*, that are manifested | in movements of masses; | Molar Physics. |
| | in movements of molecules; *and* in aggregations of molecules that are homogeneous; | Molecular Physics. |
| | in aggregations of molecules that are heterogeneous; | Chemistry. |
| CONCRETE SCIENCES, dealing with *aggregates* (with their properties and relations), as actually exemplified | in stellar and planetary systems; | Astronomy. |
| | in the earth; | Geology. |
| | in living organisms; | Biology. |
| | in the functions which adjust organic actions to specific relations in the environment; | Psychology. |
| | in the mutual relations of living organisms grouped into communities; | Sociology |

[1] Spencer, *Recent Discussions*, pp. 107—110.

It remains to add that each of the five concrete sciences may, for the purposes of our philosophic synthesis, be advantageously regarded as consisting of two portions. In the first place, we have Astronomy—in the time-honoured sense of the word—which deals with the motions of stellar and planetary masses in their present state of moving equilibrium; and Astrogeny, as it is now frequently termed, which seeks to ascertain the genesis of these masses and of their motions.

Geology admits of a similar division. The general laws of the redistribution of gases and liquids over the earth's surface, which we commonly call meteorology, and the general laws of the formation of solid compounds, which we call mineralogy, unite to furnish us with a general doctrine of the massive and molecular motions going on at any given epoch and under any given geographic condition of the earth's surface. But geology has another clearly-defined province; which is to formulate the general order of sequence among terrestrial epochs; to ascertain the genesis of the various molar and molecular redistributions going on at any given period, by regarding them as consequent upon the relations between a cooling rotating spheroid and a neighbouring sun which imparts to it thermal, luminous, and actinic undulations. This part of the science is already currently known as Geogeny. And here we touch upon the essential point of difference between geology and astronomy, regarded as sciences of development, which it seems to me that M. Wyrouboff, in his interesting essay upon this subject, has quite lost sight of. Both astrogeny and geogeny are concerned with the phenomena presented by a cooling and contracting body, of the figure known as a spheroid of rotation. In the one case this body is the sun, which once more than filled the orbit of Neptune; in the other case it is the earth, which at first more than filled the moon's orbit. But together with this point of community between the two sciences, there is a fundamental difference between them. While astrogeny contemplates the contracting spheroid chiefly as a generator of other spheroids, which are from time to time formed from its equatorial belt, detached as often as the centrifugal force at its equator begins to exceed the force of gravitation at the same place; on the other hand, geogeny contemplates the contracting spheroid only with reference to the redistributions of matter and motion going on within itself, and partly consequent upon its cooling. Partly consequent, I say, for there is one further point of difference between the two sciences. Astrogeny contemplates its spheroid as a radiator of heat, but neglects, as not affecting its own peculiar problems, the heat which the spheroid may receive by radiation from other masses. But geogeny not only studies its spheroid as a radiator of heat, but includes, as of the highest importance, the heat which it receives from an external source.

In Biology also the twofold point of view is obvious, according as we study structures and functions in mobile equilibrium at any particular epoch, or on the other hand the process of adaptation which structures and functions undergo as the conditions of existence change from epoch to epoch. The first of these studies gives rise to the sciences of anatomy and physiology, as well as to the subsidiary science of pathology. On the other hand Biogeny comprises embryology, morphology, and questions relating to the origin of species. Psychology too admits of a similar division, into the department which embraces the laws of association, as generalized by James Mill and further illustrated by Mr. Bain; and Psychogeny, which endeavours to interpret the genesis of intellectual faculties and emotional feelings in the race, and their slow modifications throughout countless generations.

Finally in Sociology this principle of twofold division is so manifest that for the past thirty years the distinction has been currently, though too vaguely, drawn between "social statics" and "social dynamics." Obviously we may either study the phenomena arising from social aggregation, as they are manifested under any given set of conditions; or we may study the phenomena of progress manifested in the relations of each epoch to preceding and succeeding epochs. In the first case, we have the sub-sciences of political economy, ethics, jurisprudence, etc.; in the second case we have Sociogeny, or the so-called "science of history."

In each of the five concrete sciences, therefore, there is a sub-science which deals with the genesis or evolution of the phenomena which form the subject-matter of the science; and it is with these sciences of genesis that we shall chiefly be concerned throughout the second part of this work. It is of little consequence, however, whether the symmetrical nomenclature here used be adopted or not. Excessive symmetry in naming is a mark of pedantry rather than of accuracy; and questions of terminology become important only when differences of opinion are involved. In reasoning about the Test of Truth, it makes a great difference whether we use the term "incredible" or the term "inconceivable." In the present discussion, it makes a great difference whether we speak of biology as an "abstract" or as a "concrete" science. But provided we bear in mind the twofold character of the problems which it is the office of biology to solve, it makes little difference whether or not we employ such a term as "biogeny"; and such expressions will be used, in the present work, only when it is desirable to avoid tedious circumlocution.

If now we proceed to inquire whether our revised classification can be made to afford us a bird's-eye view of the historic progression of the respective sciences, we shall find that it cannot be made to do so. The classification has been made upon purely logical grounds; and no attempt has been made to express the order of historic progression, simply because, as I have already shown, that order cannot be expressed by any linear series. If we were to represent the respective rates of progress in the different sciences by a device familiar to statisticians; denoting the sciences by a series of curves, starting from the same point, and constructed with reference to a common abscissa; marking off the abscissa into equal sections and sub-sections answering to centuries and decades; and expressing the progress of each science at each decade by the length of the ordinate erected at the corresponding sub-section; we should see these curves from first to last intersecting each other in the most complicated and apparently capricious manner. Probably the only conspicuously persistent relation would be that between the entire set of curves representing the concrete organic sciences, and all the rest of the curves taken together; of which two sets the former would, on the whole, have the shorter ordinates.

But on sufficiently close inspection, we should detect, between the sets of curves representing the abstract, the abstract-concrete, and the concrete sciences, a relation equally constant, and far more interesting, though less conspicuous. We should observe that all along the progress of the concrete sciences has determined that of the abstract-concrete and abstract sciences, and has been determined by it; that, from first to last, synthesis and analysis have gone hand in hand. Such has been the complex order of progression. Men have begun by grouping concrete phenomena empirically. When the groups have become wide enough to allow the disclosure of some mode of force uniformly manifested in them, the operations of this force have begun to be experimentally or deductively studied, all disturbing conditions being as far as possible eliminated or left out of the account; and thus have arisen the analytic or abstract-concrete sciences. And finally, as fast as the laws of the various manifestations of force have been generalized, the synthetical interpretation of phenomena has advanced by the aid of the knowledge of these laws. As Mr. Spencer well expresses it: "there has all along been higher specialization, that there might be a larger generalization; and a deeper analysis, that there might be a better synthesis. Each larger generalization has lifted sundry specializations still higher; and each better synthesis has prepared the way for still deeper analysis." Long before Archimedes founded statics, the earliest branch of abstract-concrete science, empirical generalizations had been made in every one of the concrete sciences. Astronomy had accomplished the preliminary task of classifying stars according to their times of rising and setting, of tracing the apparent courses of the planets, of determining the order of recurrence of lunar eclipses, and of constructing chronological cycles. In geology some scanty progress had been made, in classifying the physical features of the earth's surface, and in ascertaining the properties of a limited number of minerals. In biology, classification had been carried sufficiently far to enable an acute observer, like Aristotle, to distinguish between the selachians, or shark-tribe, and the bony fishes; and a considerable amount of anatomical and physiological knowledge had been acquired, as may be seen in the works of Hippokrates. Even in psychology there had been made a crude classification of the intellectual and emotional functions; and the "Politics" of Aristotle show us the statical division of sociology already empirically organized. To such a point had the synthetic concrete sciences arrived in antiquity; and this point they did not pass until the analytic abstract-concrete sciences had furnished them with factors with which to work. Astronomy must still remain in the empirical stage until molar physics had generalized the abstract laws of falling bodies, of the composition of forces, and of tangential momentum. Geology could not advance until molecular physics had supplied the general principles of thermal radiation and conduction, of evaporation and precipitation, condensation and rarefaction. Biology was obliged to wait until chemistry had thrown light upon the molecular constitution of the various tissues and anatomical elements, and had furnished the means of explaining synthetically such organic processes as digestion and assimilation. But, as we have already seen, the obligation has not been all on one side. The services rendered by the analytic to the synthetic sciences have been all along repaid by services no less essential. Thus the great principle of molar physics—the law of gravitation—could not be generalized from terrestrial phenomena alone, but had to wait until astronomic observations had revealed the true forms of the planetary orbits and the rates of their velocities. Thus molecular physics has received important hints from mineralogy, the properties of crystals having rendered indispensable aid in the discoveries of polarization and double refraction, and therefore in the final verification of the undulatory theory. And thus also in late years the researches of Dumas, Laurent, Gerhardt, and Williamson on the structure of organic molecules have reacted upon the whole domain of inorganic chemistry, regenerating the doctrine of types, supplying the fundamental conceptions of atomicity and quantivalence, replacing the dualistic theory of Berzelius by the theory of saturation and substitution, and inaugurating a radical revolution in chemical nomenclature. I may note in passing that this great revolution, which has rendered the science of only half-a-generation ago completely antiquated, and has obliged so many of us to unlearn the chemistry which we learned at college, furnishes a crucial disproof of the Comtean theory of the way in which a scientific revolution should occur. We see that the chemistry of inorganic bodies was not placed upon its true foundation until the study of organic chemistry had supplied to the whole science its fundamental principles; in spite of Comte, who always scouted at organic chemistry as an illegitimate science, and predicted the speedy extension of the dualistic theory to organic compounds.

Space permitting, I might go on and point out more minutely how the allied sciences in each grand division have continually reacted upon each other; how synthesis has directly aided synthesis, and how analysis has directly aided analysis; how the analytic and the simpler synthetic sciences have from time to time furnished new hints to mathematics; and how all the other sciences, in all the divisions, from mathematics to sociology, have aided the progress of logic, supplying it with new methods of investigation and fresh canons of proof. But such a detailed survey is not needful for the purposes of this work. Let us rather return for a moment to our criticism of Comte, and, having already examined his organization of the sciences both from the historical and from the logical point of view, let us endeavour to render an impartial verdict as to the philosophic value of his achievement.

If tried by its conformity to the ideal standard of perfection furnished by the scientific and philosophical knowledge of the present day, the Comtean classification of the sciences must undoubtedly be pronounced, in nearly all essential respects, a failure. As a representation of the historic order of progression among the different sciences, it must be regarded as the imperfect expression of an inadequately comprehended set of truths. We have seen that this order of progression depends upon at least five interacting factors; upon the simplicity, the concreteness, the conspicuousness, and the frequency of the phenomena investigated, and upon the comparative number and perfection of the implements of investigation. Of these five factors, the Comtean series takes into account only the first, or at the utmost only the first and the last. For this reason it unduly simplifies the order of progression. Doubtless it is correct to say that, other things equal, the simpler and more general phenomena have been interpreted earlier than the more complex and special phenomena; but the other things have not been equal. And consequently scientific evolution has not proceeded uniformly, in a straight line, but rhythmically, in a plexus of curved lines.

As a representation of the logical order of subordination among the different sciences, the Comtean series is equally faulty. While it correctly formulates sundry of the minor relations of dependence, as well as one relation of great importance,—that of the dependence of organic upon inorganic science,—it incorrectly formulates the grand distinction of all,—the distinction between abstract and concrete, between analytic and synthetic, science. It mixes together sciences formed by the analysis and synthesis of concrete phenomena, and a science which is purely abstract. It strives to represent, by a linear series, relations which are so complex that they can be adequately represented only in space of three dimensions.

It is therefore indisputable that the Comtean classification, viewed absolutely, is a failure. The advance of science has refuted instead of confirming it. It has become rather an encumbrance than a help to the understanding of the true relations among the sciences. Shall we then, with Prof. Huxley, say that the classification, and with it the whole Comtean philosophy of science, is "absolutely worthless?"[1] I think not. We might say as much of Oken or Hegel, but hardly of Stewart or Ampère; far less of Comte. Mr. Spencer speaks more justly of his great antagonist when he says: "Let it by no means be supposed from all I have said, that I do not regard M. Comte's speculations as of great value. True or untrue, his system as a whole has doubtless produced important and salutary revolutions of thought in many minds; and will doubtless do so in many more. Doubtless, too, not a few of those who dissent from his general views have been healthfully stimulated by the consideration of them. *The presentation of scientific knowledge and method as a whole, whether rightly or wrongly coordinated,*

[1] Huxley, *Lay Sermons*, p. 172.

*cannot have failed greatly to widen the conceptions of most of his readers.* And he has done especial service by familiarizing men with the idea of a social science based on the other sciences. Beyond which benefits resulting from the general character and scope of his philosophy, I believe that there are scattered through his pages many large ideas that are valuable not only as stimuli, but for their actual truth."

This passage comes so near to appreciating Comte's true philosophic position, that one is surprised to find Mr. Spencer, after all, stating that position inadequately. Though he sees clearly that, whether rightly or wrongly coordinated, the presentation of scientific knowledge and method *as a whole*, must greatly have widened people's conceptions; he does not explicitly recognize that this presentation of scientific knowledge and method as a whole was, in spite of the wrong coordination, a step sufficient of itself to change and renovate the entire attitude of philosophy. He tells us that persons like Prof. Huxley, Prof. Tyndall, and himself, stand substantially in the same position in which they would have stood had Comte never written; that, "declining his reorganization of scientific doctrine, they possess this scientific doctrine in its pre-existing state, as the common heritage bequeathed by the past to the present." And elsewhere he tells us that Comte "designated by the term 'Positive Philosophy' all that definitely-established knowledge which men of science have been gradually organizing into a coherent body of doctrine." It seems to me, on the other hand, that the coherent body of doctrine was the very thing which no scientific thinker had ever so much as attempted to construct, though Bacon, no doubt, foresaw the necessity of some such construction. M. Littré may well inquire what is meant by the great scientific minds whose traditions Comte is said to have followed. "Does it mean the philosophers? Why, they have one and all belonged to theology or metaphysics, and it is not their tradition which Comte has followed. Does it mean those who have illustrated particular sciences? Well, since they have not philosophized, Comte can hardly have received his philosophy from them. That which is recent in the Positive Philosophy, that which is Comte's invention, is the conception and construction of a philosophy, by drawing from particular sciences, and from the teaching of great scientific minds, such groups of truths as could be coördinated on the positive method."

That the mode in which Comte effected this coordination was imperfect, may affect our estimate of the amount of his achievements, but it cannot affect our estimate of their character. The former is a merely personal question, interesting chiefly to disciples; the latter is a general question, interesting to all of us who are students of philosophy. For the purposes of impartial criticism, the great point is, not that the attempt was a complete success, but that the attempt was made. When knowledge is advancing with such giant strides as at present, it is hardly possible to construct a general doctrine which forty years of further inquiry and criticism will not considerably modify and partially invalidate. It is now forty years since Comte framed his philosophy of science; and during that period there is not a single department of knowledge, outside of pure mathematics, which has not undergone a veritable revolution. Molecular physics has been revolutionized by the discovery of the correlation of forces; and the deduction of that principle, as well as of the principle of virtual velocities, from the law of the persistence of force, has placed molar physics also upon a new basis. Chemistry, as we have seen, has undergone changes nearly as sweeping as those brought about by Lavoisier; changes which have thoroughly renovated our conceptions of the phenomenal constitution of matter. Sidereal astronomy has been brought into existence as a science; and we have learned how to make a ray of light, journeying toward us from the remotest regions of space, tell us of the molecular constitution of the matter from which it started. Geology has been robbed of its cataclysms, and periods of universal extinction; while both astrogeny and geogeny have assumed a new character through the wide extension of the theory of nebular genesis. There is not a truth in biology which has not been shown up in a new light by the victory of the cell-doctrine; the discovery of natural selection has entirely remodelled our conceptions of organic development; and the dynamical theory of stimulus has wrought great changes, which are but the beginning of greater changes, in pathology, in hygiene, and in the treatment of disease. Psychology, in both its branches, has received a scientific constitution by the establishment of the primary laws of association, and the fundamental law of the growth of intelligence. And sociology, both statical and dynamical, has undergone changes equally important, as we shall see when we come to treat specially of that subject. All this makes up an aggregate of scientific achievement such as the world has never before witnessed in anything like an equally short interval. So enormous is the accumulated effect of all these discoveries upon the general habits of thought, that the men of the present day who have fully kept pace with the scientific movement, are separated from the men whose education ended in 1830, by an immeasurably wider gulf than has ever before divided one progressive generation of men from their predecessors. And when we add that both the history of science and the general principles upon which discoveries are made have been, during this interval and largely through the impulse given by Comte himself, more thoroughly studied than ever before,—we may begin to realize how far the resources which we possess for constructing a synthesis of the sciences, exceed the resources which were at his disposal. We shall realize that Comte—at least where physical science is concerned—has come to be almost an ancient; and we shall see that there may easily be injustice in criticizing him as if he were a contemporary. We shall find the legitimate ground for wonder to be, not that he did so little, but that he did so much. And estimating him, as we estimate Bacon, from a purely historical point of view, we shall feel obliged to admit that the grand characteristic of the modern movement in philosophy—the continuous organization of scientific truths into a coherent body of doctrine—found in Comte its earliest, though by no means an adequate, exponent. Previous to him, as M. Littré is right in reminding us, the field of general speculation belonged to metaphysics or theology, while science dealt only with specialities. It was owing to an impulse of which Comte is the earliest representative, that the tables were turned. The field of general speculation is now the property of science, while metaphysics and theology are presented as particular transitory phases of human thought.[1] Whatever, therefore, may be the case with Mr. Spencer—whose entire originality cannot for a moment be questioned—it is not true of the great body of scientific thinkers, that they stand in essentially the same position in which they would have stood had Comte never written. The course of speculative inquiry during the past forty years would no more have been what it is, without Comte, than the course of speculative inquiry during the past two centuries would have been what it is, without Bacon. And, indeed, in Mr. Spencer's own case,—as he is himself disposed to admit,—there are several instances in which his very antagonism to Comte has led him to state certain important truths more clearly and more definitely than he would otherwise have been likely to state them. The theory of deanthropomorphization, set forth in the preceding chapter, was presented in a much more vivid light than would have been possible had it not been reached through an adverse criticism of the Comtean doctrine of the "Three Stages." The condemnation of Atheism

[1] Littré, *Auguste Comte*, p. 99.

involved in our statement of that theory, is redoubled in emphasis when Positivism is by the same reasoning condemned; and our dissent from Hume is all the more strongly accented, when it is seen to be so complete as to include dissent from Comte also. So, too, the conclusions reached in the present chapter concerning the organization of the sciences are undeniably far more precise and satisfactory than they would have been if presented without reference to the earlier and necessarily cruder views of Comte. Indeed, in the very sense of incompleteness which would justly have attached itself to our exposition, had no mention been made of the Comtean theory, we may find fresh illustration of the fact that the errors of great minds are often no less instructive than the permanent truths which they have succeeded in detecting. And consequently, so far from decrying the Positive Philosophy or seeking to ignore it, we shall much better fulfil our duty as critics if we frankly acknowledge that the speculative progress of the nineteenth century would have been incomplete without it. Holding these views, and for these reasons, we may freely admit the justice of much that Prof. Huxley urges against Comte; that his rejection of psychology was unphilosophical, and his acceptance of phrenology puerile; that his acquaintance with science was bookish and unpractical, and that his efforts to found a social polity were the very madness of utopian speculation. Had he committed twice as many such blunders, his general conception of philosophy and his contributions to the logic of science would have remained substantially unaffected in value. Had Bacon enrolled himself among the followers of Copernicus instead of adhering to the exploded theories of Ptolemaios, that fact would not by itself affect our estimate of the value of the "Novum Organon." And Comte's philosophic position, as I have here sought to define it, is no more shaken by his numerous scientific blunders than Bacon's position is shaken by the fact that he repudiated the Copernican astronomy and refused to profit by the physical discoveries of Gilbert.

But the allusion to the Logic of Science may here serve to remind us that, before we can thoroughly understand Comte's general conception of philosophy, there is another point of view from which his system of the sciences must be criticized; a point of view too little dwelt upon by Mr. Spencer, since by the due consideration of it we shall arrive at the deepest of the differences between the Comtean organization of the sciences and the Spencerian organization which is here adopted. In order fairly to bring out this point, let us devote a chapter to considering the masterly enumeration of scientific methods, and the survey of the resources which the mind has at its disposal for the investigation of phenomena, which Comte has made a part of his general philosophy of the sciences; withholding, until the sequel, the application which is to be made of the discussion.

## CHAPTER IX.

### PHILOSOPHY AS AN ORGANON.

THE absence of Logic, as a distinct science, from the Comtean classification, has by most critics been rightly regarded as a serious defect. Nevertheless, before we can intelligently find fault with Comte, we must make sure that we understand his grounds for assigning to Logic no independent position. The explanation is more deeply implicated with his fundamental conception of the Scope of Philosophy than has generally been suspected. But let us begin by considering the more obvious aspects of the case.

The science of logic consists of two portions,—the doctrine of the syllogism, and the general theory of induction, the latter comprising a codification on the one hand of the methods of research, and on the other hand of the laws of evidence. But this twofold province of logic can hardly be said to have been clearly indicated until the publication of Mr. Mill's treatise. From the days of Aristotle down to the time when Comte wrote the "Philosophie Positive," the logic officially recognized and taught as such consisted almost exclusively of the doctrine of the syllogism. Besides this there was nothing save the Baconian logic, containing indeed many valuable hints for inquirers, but not organized into a coherent system. Now Comte held in small esteem the syllogistic logic. He held, and justly, that something besides the scholastic quibbling over *Baroco, Camestres* and *Barbara,* was needed in prosecuting the search after new truths. To attempt, by prolonged dealing in these dialectic subtleties, to acquire the art of correct reasoning, was, in his opinion, much like trying to learn the art of correct speaking by prolonged study of the rules of grammar. Men do not learn to swim, to fence, or to hunt, by reading elaborate treatises on gymnastics and sportsmanship. The study of rhetoric, however thorough, careful and systematic, will never of itself enable us to write a clear and forcible style. We may know all the commandments of ethics by heart, and be able to utter the soundest judgment upon the comparative merits of the utilitarian and the intuitional theories, and yet be unable to lead upright lives. And similarly we may go on stringing together majors and minors until we are grey, and yet after all be unable to make an accurate observation, or perform a legitimate induction. Therefore, according to Comte, logic is not so much a science as an art, indispensable in the prosecution of all the sciences, but to be learned only by practice. As philosophy, regarded as a general conception of the universe, has hitherto, like the mistletoe, had its roots in the air, but has now been brought down and securely planted in the fertile soil of scientific knowledge, so let us no longer permit logic to remain in isolation, feeding upon airy nothings, but let us bring it down and nourish it with scientific methods. As we learn to live rightly, not by dogmatic instruction, but by the assiduous practice of right living, as we learn to speak properly and to write forcibly by practice and not by theory, so let us gain control of the various instruments for investigating Nature by the study of the several sciences in which those instruments come into play. To become skilful in the use of deduction, let us study mathematics, especially in its direct applications to the solution of problems in astronomy and physics. If we would become accurate observers, and would enable ourselves properly to estimate the value of experimental reasoning, let us study those inductive sciences which exhibit practically the essential requisites of an accurate observation or a conclusive experiment. Even so, if we would attain literary excellence, let us not fritter away our time in puerile attempts to imitate the favourite modes of expression of admired writers, but let us rather aim at directly expressing the thoughts that are in us, the result of our own observation and reflection, admitting no phrase which does not assist the exposition of the thought. If, as Buffon said, the style is the man, so also is the habit of thinking the man, save that in the one case as in the other, if it possess any merit, it is the man as modified and cultivated by a complex intercourse with phenomena.

Such is Comte's opinion of logic,—an opinion common enough at the present day, but sufficiently novel to be revolutionary forty years ago. That the above views are in the main perfectly sound will now be questioned by no one, nor can it be doubted that they are of the highest importance. When put into practical operation, they are destined to work changes of fundamental importance in our methods of education. Nevertheless, though sound enough as far as they go, these arguments are far from exhibiting the whole truth. Admitting unreservedly that, to become proficient in observation and reasoning, we must learn logic, as we learn grammar and rhetoric, by practical experience; it must still be maintained that there is need of a general doctrine of logic, as indeed there is also need of a general doctrine of grammar and rhetoric. Though a man may write an excellent style without having studied rhetoric systematically, yet it will be no injury, but rather an important help to him to understand theoretically the general principles on which a sentence should be constructed. In the fine arts, which afford an excellent test for judging this point, the superiority imparted by systematic instruction is quite incontestable. Doubtless it is by long-continued practice that men learn to paint pictures, to mould statues, and to compose oratorios or symphonies. But it is none the less probable that Mozart and Beethoven would have accomplished comparatively little without the profound study of harmony; and in painting and sculpture the "originality of untaught geniuses" is, not unjustly, made a subject for sarcasm. It is therefore useless for Macaulay to remind us that men reasoned correctly long before Bacon had drawn up his elaborate canons of induction; or for Comte to appeal to rhetoric, grammar, and æsthetic art in support of the opinion that we need no general doctrine of logic.

To take a concrete example,—if, as in Borda's experiment, you make a simple pendulum oscillate thirty hours in an exhausted receiver, by diminishing the friction at the point of support, and proceed to infer that with the total abolition of friction and atmospheric resistance the pendulum would oscillate for ever, it may not be essential to the validity of your inference that you should understand the character of the particular logical method which you are employing. Nevertheless it cannot but be of advantage to you to know that you are using the "method of concomitant variations," and to understand on general principles the conditions under which this method may be employed and the precautions required in order to make it valid. For want of such general knowledge of method, even trained physicists not unfrequently make grave errors of inference, applying some powerful implement of research in cases where interfering circumstances, not sufficiently taken into account, render it powerless. Thus the method just alluded to, of varying the cause in order to observe and note the concomitant variations of the effect, is a very powerful instrument of induction; but in order to use it effectively, we need to bear in mind two things. First, we need to know the quantitative relation between the variation of the cause and that of the effect; and secondly, we need to know that the intermixture of circumstances will not, after a certain point, alter the order of the variations. In the case of the pendulum, just cited, we know both of these points. We know that the only factors in the case are the momentum of the pendulum, acting in concert with gravity, the friction at the point of support, and the friction and resistance of the atmosphere; and as we progressively diminish these latter retarding factors, we can calculate the exact ratio at which the retardation diminishes. We are therefore perfectly justified in concluding that if the friction and resistance could be utterly abolished, the momentum of the pendulum, acting in concert with gravity, would carry it backward and forward for ever. But because the abstraction of heat causes the molecules of a body to approach each other, it is not safe to infer that, if all the heat were abstracted, the molecules would be in complete contact. This is a more or less plausible guess, not a true induction. "For since we neither know how much heat there is in any body, nor what is the real distance between any two of its particles, we cannot judge whether the contraction of the distance does or does not follow the diminution of the quantity of heat according to such a numerical relation that the two quantities would vanish simultaneously."[1] In similar wise, from the fact that in alcoholic intoxication the severity of the narcotic symptoms varies according to the size of the dose, it is not legitimate to infer that a very small dose will cause slight narcotic symptoms or even a tendency to the production of such symptoms. For we can neither ascertain the quantitative ratio between the variation in the dose and the variation in the narcosis, nor in the case of such a complex aggregate as the human organism can we assert the absence of interfering conditions which, after a certain point, will entirely change the order of

[1] Mill, *System of Logic*, 6th edition, vol. i. p. 447.

the two variations. In point of fact there are such interfering conditions, due partly to the control exercised by the sympathetic nerve over the contraction and dilatation of the cerebral blood-vessels, and partly to other circumstances too complicated to be here mentioned.

Now it is the business of logic to codify, upon abstract principles, the rules of scientific investigation; to determine what shall be admitted as trustworthy evidence, and what shall not be so admitted; to point out the class of problems which each implement of research is best fitted to solve; and to enumerate the precautions which must be taken in order to use each implement with skill and success. Logic is therefore a science which contributes to all the others, and to which all the others contribute. Though we may, and indeed must, acquire familiarity with its methods by direct practice in the study of the various sciences, yet the advantage of understanding the general theory of those methods, as a science by itself, cannot well be questioned after the foregoing explanation. To become familiar with the values of different kinds of evidence, and with the processes by which evidence is procured, a lawyer must practise in court; yet every lawyer thinks it necessary to master the general theory of evidence as presented in special treatises. Logic is to the philosopher and the scientific inquirer what the law of evidence is to the lawyer; and the need for its theoretical study rests upon the admitted principle that, in all branches of human activity, rational knowledge is better than empirical knowledge. In order to be always sure that we are generalizing correctly, we must make the generalizing process itself a subject of generalization.

But although Comte did not dignify logic with the rank of an independent science, he more than atoned for the omission by his contributions to the study of logic. Since the era of Bacon and Descartes, no book had appeared containing such profound views of scientific method as the "Philosophie

Positive." It has since been surpassed and superseded in many respects by Mr. Mill's "System of Logic;" but Mr. Mill would be the first to admit that, but for the work of Comte, his own work would have been by no means what it is.[1]

Comte's most important innovation consisted in comprehensively assigning to each class of phenomena its appropriate method of investigation, and in clearly marking out the limits within which each method is applicable. It is this which gives to the first three volumes of the "Philosophie Positive" the character of a general treatise on scientific method, and which makes them still interesting and profitable reading, even in those chapters on physics, chemistry and biology, which in nearly all other respects the recent revolutions in science have rendered thoroughly antiquated. Comte intended this portion of his work especially for a new Organon of scientific research, which should influence educational methods in the future, as well as assist in determining the general conception of the universe. He calls attention to the futility of approaching the most complicated phenomena, such as those of life, individual or social, without having previously, by the study of the simpler sciences, learned what a law of nature is, what a scientific conception is, what is involved in making an accurate observation, what is requisite to a sound generalization, what are the various means of verifying conclusions obtained by deduction. Continually we witness the spectacle of scientific specialists, justly eminent in their own department of research, who do not scruple to utter the most childish nonsense upon topics with which they are but slightly acquainted. The reason is that they have learned to think correctly after some particular fashion, but know too little of the general principles on which thinking should be conducted. In such a condition—owing to the discredit which the manifest failure of metaphysics has for the time being cast upon philosophy in

[1] This is perhaps too strongly stated. See Mill's *Autobiography*, pp. 207–213, 245.

general—are too many of our scientific *savants* of the present century; whose narrowness of mind, in dealing with philosophic questions, Comte was never weary of pointing out and tracing to its true source in the defective mastery of logical methods. The cure for this narrowness is to be found in a philosophic education which shall ensure familiarity with all logical methods by studying each in connection with that order of phenomena with which it is most especially fitted to deal.

According to Comte, the resources which the mind has at its disposal for the inductive investigation of phenomena are three in number,—namely, Observation, Experiment, and Comparison. Strictly speaking, experiment and comparison are only more elaborate modes of observation; but they are nevertheless sufficiently distinct from simple observation to make it desirable, for practical purposes, to rank them as separate processes. Concisely stated, the difference is as follows. In simple observation, we merely collate the phenomena, as they are presented to us. In experiment, we follow the Baconian rule of artificially varying the circumstances. In comparison, we watch the circumstances as they are varied for us on a great scale by Nature.

Answering to the two processes of observation and experiment, as Mr. Mill has shown, there are two inductive methods,—the Method of Agreement and the Method of Difference. The former compares different instances of a phenomenon, to ascertain in what respects they agree, while the latter compares an instance of the occurrence of a phenomenon with an instance of its non-occurrence, to ascertain in what respects they differ. To cite from Mr. Mill's "System of Logic" a pair of examples:—"When a man is shot through the heart, it is by the method of difference we know that it was the gun-shot which killed him; for he was in the fulness of life immediately before, all circumstances being the same except the wound." On the other hand, in inquiring into the cause of crystallization, we employ the method of agreement as follows. "We compare instances in which bodies are known to assume crystalline structure, but which have no other point of agreement; and we find them to have one, and as far as we can observe, only one, antecedent in common,—the deposition of a solid matter from a liquid state, either a state of fusion or of solution. We conclude, therefore, that the solidification of a substance from a liquid state is an invariable antecedent of its crystallization." In this particular case we may say that it is not only the invariable antecedent, but the unconditional invariable antecedent, or cause; since, having detected the antecedent, we may produce it artificially, and find that the effect follows it. It was thus in Sir James Hall's splendid experiment, in which "he produced artificial marble by the cooling of its materials from fusion under immense pressure." And it was thus when Dr. Wollaston, "by keeping a vial of water charged with siliceous particles undisturbed for years, succeeded in obtaining crystals of quartz."

Manifestly, however, unless we can artificially produce the antecedent, and so reason back from cause to effect, our method of agreement is not exhaustively conclusive. Unless we can be sure that the observed antecedent is the only one common to all the instances, the sequence may turn out to be only a derivative sequence, like that of day and night. And unless the phenomena are very simple, we cannot be sure that the observed common antecedent is the only one. It is otherwise with the method of difference. Whenever we can bring that method to bear upon the phenomena, its results are finally conclusive; since it is the very essence of that method to compare two instances which are exactly alike in every respect save in the presence or absence of the given antecedent. Unfortunately, in the operations of nature these requisites are seldom fulfilled. So that the method of difference "is more particularly a method of artificial experiment; while that of agreement is more especially the resource employed where experimentation is impossible."

Now in astronomy we can employ only simple observation. The magnitude and the inaccessibility of the phenomena render it impossible for us to vary the circumstances, so that experiment is out of the question. Nevertheless, here the phenomena are so simple that the method of agreement alone carries us far toward certainty; and accordingly in astronomy the art of observation has been brought to such a pitch of perfection, and the conditions of an accurate observation are so thoroughly understood, that it is here that the use of this implement of induction must be studied.

In physics, both molar and molecular, and in chemistry, the phenomena become far more complicated. Yet here we become able to vary the phenomena almost indefinitely; and accordingly physics and chemistry are the inductive sciences *par excellence*, in which experiment, the great engine of induction, is employed most successfully, and in which, therefore, is especially to be studied the proper use of the method of difference.

When we come to biology, we are met by a still greater complication of phenomena; but according to the luminous principle, first suggested by Comte, that in general our means of investigation increase with the complexity of the phenomena, we have here an additional weapon of investigation. We still retain the ability to experiment; although such is the intricacy of the circumstances, and such the subtlety of the causes in operation, that we can seldom apply the potent method of difference. We can seldom be sure that the two instances compared agree in everything save in the presence or absence of the circumstance we are studying.[1] In experimenting upon live animals, we are liable to cause a patho-

[1] A striking illustration of this truth is furnished by the controversy now going on concerning archebiosis or "spontaneous generation." See below, part ii. chap. viii.

logical state, and set in motion a whole series of phenomena which obscure those which we wish to observe. It is instructive, and often amusing, to read some treatise on experimental physiology, like those of Magendie and Claude Bernard, and see how easy it is for equally careful investigators to arrive at totally irreconcilable results. It is not to be denied that experiment is of vast importance in biology, and has already achieved wonders. Nevertheless, the practical study of experimentation should never be begun in biology, but in chemistry or physics, where the conditions are simpler. Having learned from these sciences the general theory of sound experimenting, we may afterward safely proceed to apply the same method to vital phenomena.

The additional implement possessed by the organic sciences is comparison, to which corresponds the Method of Concomitant Variations, already described. It is true we can also employ this method to a large extent in the simpler sciences, but it is in biology that it attains its maximum efficiency. Here we have a series of instances already prepared for us by Nature, in which certain antecedents and consequents vary together. We have a vast hierarchy of organisms, each exhibiting some organ and the corresponding function more or less developed than it is in the others. To trace the functions of the nervous system, or to follow the process of digestion, in its increasing complication, from the star-fish up to man, is to employ the logical method of comparison. And if any one wishes to realize the immense power of this method, let him reflect upon the revolution which was wrought in the science of biology when Lamarck and Cuvier began the work of comparison upon a large scale.

Hence, it is that biology is eminently the science of classification; and if skill in the use of this powerful auxiliary of thought is to be acquired, it must be sought in the comparative study of the vegetable and animal kingdoms. Theoretical logic may divide and subdivide as much as it likes; but genera and species are dull and lifeless things, when contemplated merely in their places upon a logical chart. To become correct reasoners, it is not enough that we should know what classes and sub-classes are; we should also be able skilfully to make them. I conclude with a citation from Mr. Mill:—"Although the scientific arrangements of organic nature afford as yet the only complete example of the true principles of rational classification, whether as to the formation of groups or of series, those principles are applicable to all cases in which mankind are called upon to bring the various parts of any extensive subject into mental coordination. They are as much to the point when objects are to be classed for purposes of art or business, as for those of science. The proper arrangement, for example, of a code of laws depends on the same scientific conditions as the classifications in natural history; nor could there be a better preparatory discipline for that important function, than the study of the principles of a natural arrangement, not only in the abstract, but in their actual application to the class of phenomena for which they were first elaborated, and which are still the best school for learning their use. Of this, the great authority on codification, Bentham, was perfectly aware; and his early 'Fragment on Government,' the admirable introduction to a series of writings unequalled in their department, contains clear and just views (as far as they go) on the meaning of a natural arrangement, such as could scarcely have occurred to anyone who lived anterior to the age of Linnæus and Bernard de Jussieu."[1]

These illustrations will serve to give the reader some idea of Comte's brilliant and happy contributions to the logic of scientific inquiry. I am aware that scanty justice is done to the subject by the condensed and abridged mode of treatment to which I have felt obliged to resort. But an exhaustive exposition and criticism of the details of the Comtean

[1] *System of Logic*, 6th edit., vol. ii. p. 288.

philosophy of method does not come within the scope of the present work. The object of the preceding sketch is to enable the reader to realize the significance of Comte's omission of Logic from the scheme of the sciences. *That omission,* as we may now see, *was due to the fact that Comte merged Philosophy in Logic.* Or, in other words, *from his point of view, Philosophy is not a Synthesis, but an Organon.* Nowhere in that portion of the "Philosophie Positive" which treats of the organization of the sciences, do we catch any glimpse of that Cosmic conception of the scope of philosophy which was set forth and illustrated in the second chapter of these Prolegomena. For according to that conception, we have seen that philosophy is an all-comprehensive Synthesis of the doctrines and methods of science; a coherent body of theorems concerning the Cosmos, and concerning Man in his relations to the Cosmos of which he is part. Now, though Comte enriched mankind with a new conception of the aim, the methods, and the spirit of philosophy, he never even attempted to construct any such coherent body of theorems. He constructed a classification of the sciences and a general theory of scientific methods; but he did not extract from each science that quota of general doctrines which it might be made to contribute toward a universal doctrine, and then proceed to fuse these general doctrines into such a universal doctrine. From first to last, so far as the integration of science is concerned, his work was logical rather than philosophical. And here we shall do well to note an apparent confusion between these two points of view, which occurs in Mr. Mill's essay on Comte. "The philosophy of science," says Mr. Mill, "consists of two principal parts; the methods of investigation, and the requisites of proof. The one points out the roads by which the human intellect arrives at conclusions; the other, the mode of testing their evidence. The former, if complete, would be an Organon of Discovery; the latter, of Proof." Now I call this an admirable definition; but it is not the definition of Philosophy, it is the definition of Logic. If we were to accept it as a definition of philosophy, we might admit that Comte constructed a philosophy; as it is, we can only admit that he constructed a logic, or general theory of methods. In the present chapter we have seen how valuable were his contributions to the logic of induction. We may admit, with Mr. Mill, that he treats this subject "with a degree of perfection hitherto unrivalled,"—save (I should say) by Mr. Mill himself. But an Organon of Methods is one thing, and a Synthesis of Doctrines is another thing; and a system of philosophy which is to be regarded as a comprehensive theory of the universe must include both. Yet Comte never attempted any other synthesis than that wretched travesty which, with reference to the method employed in it, is aptly entitled "Synthèse Subjective."

Not only does Comte thus practically ignore the conception of philosophy as a Synthesis of the most general truths of science into a body of universal truths relating to the Cosmos as a whole, but there is reason to believe that had such a conception been distinctly brought before his mind, he would have explicitly condemned it as chimerical. In illustration of this I shall, at the risk of apparent digression, cite one of his conspicuous shortcomings which is peculiarly interesting, not only as throwing light upon his intellectual habits, but also as exemplifying the radical erroneousness of his views concerning the limits of philosophic inquiry. Prof. Huxley calls attention to Comte's scornful repudiation of what is known as the "cell-doctrine" in anatomy and physiology. Comte characterized this doctrine as a melancholy instance of the abuse of microscopic investigation, a chimerical attempt to refer all tissues to a single primordial tissue, "formed by the unintelligible assemblage of a sort of organic monads, which are supposed to be the ultimate units of every living body." Now this "chimerical doctrine" is at the present day one of the fundamental doctrines of biology. Other instances are at hand, which Prof. Huxley has not cited. For example, Comte condemned as vain and useless all inquiries into the origin of the human race, although, with an inconsistency not unusual with him, he was a warm advocate of that nebular hypothesis which seeks to account for the origin of the solar system. As these two orders of inquiry are philosophically precisely on a level with each other, the former being indeed the one for which we have now the more abundant material, the attempted distinction is proof of the vagueness with which Comte conceived the limits of philosophic inquiry.[1] But what shall we say when we find him asserting the impossibility of a science of stellar astronomy? He tells us that we have not even the first datum for such a science, and in all probability shall never obtain that datum. Until we have ascertained the distance, and cal-

[1] It is interesting to note that disciples of Comte are still to be found, so incapable of realizing that the arbitrary dicta of their master did not constitute the final utterance of human science, that they oppose the Doctrine of Evolution upon no other ground than the assumed incapacity of the human mind for dealing with origins! In a discussion held in New York some two years since on the subject of "Darwinism," a certain disciple of Comte observed that it was useless for man to pretend to know how he originated, when he could not ascertain the origin of anything! Nevertheless, since we do find ourselves able to point out the origin of many things, from a myth or a social observance to a freshet or the fall of an avalanche, it appears that our Comtist was playing upon words after the scholastic or Platonic fashion, and confounding proximate "origin," which is a subject for science, with ultimate "origin," which must be relegated to metaphysics. Had Comte carried out this principle consistently, he would never have written his Philosophy of History, since the explanation of the social phenomena existing in any age is the determination of their mode of origin from the social phenomena of the preceding age. But if with the aid of historic data we may go back three thousand years, there is no reason why, with the aid of geologic, astronomic, and chemical data, we should not go back, if necessary, a thousand billion years, and investigate the origin of the earth from the solar nebula, or the origin of life from aggregations of colloidal matter. In either case, the problem is one, not of ultimate origin, but of evolution. In neither case do we seek to account for the origin of the matter and motion which constitute the phenomenal universe, but only to discover a formula which shall express the common characteristics of certain observed or inferred redistributions of the matter and motion already existing. The latter attempt is as clearly within the limits of a scientific philosophy as the former is clearly beyond them.

culated the proper motion, of at least one or two fixed stars, we cannot be certain even that the law of gravitation holds in these distant regions. And the distance of a star we shall probably never be able even approximately to estimate. Thus wrote Comte in 1835. But events, with almost malicious rapidity, falsified his words. In less than four years, Bessel had measured the parallax of the star 61 Cygni,—the first of a brilliant series of discoveries which by this time have made the starry heavens comparatively familiar ground to us. What would Comte's scorn have been, had it been suggested to him that within a third of a century we should possess many of the data for a science of stellar chemistry; that we should be able to say, for instance, that Aldebaran contains sodium, magnesium, calcium, iron, bismuth, and antimony, or that all the stars hitherto observed with the spectroscope contain hydrogen, save $\beta$ Pegasi and $\alpha$ Orionis, which apparently do not! Or what would he have said, had it been told him that, by the aid of the same instrument which now enables us to make with perfect confidence these audacious assertions, we should be able to determine the proper motions of stars which present no parallax! No example could more forcibly illustrate the rashness of prophetically setting limits to the possible future advance of science. Here are truths which, within the memory of young men, seemed wholly out of the reach of observation, but which are already familiar, and will soon become an old story.

I believe it was Comte's neglect of psychological analysis which caused him to be thus over-conservative in accepting new discoveries, and over-confident in setting limits to scientific achievement. He did not clearly distinguish between the rashness of metaphysics and the well-founded boldness of science. He was deeply impressed with the futility of wasting time and mental energy in constructing unverifiable hypotheses; but he did not sufficiently distinguish between hypotheses which are temporarily unverifiable from present lack of the means of observation, and those which are permanently unverifiable from the very nature of the knowing process. There is no ground for supposing that Comte ever thoroughly understood *why* we cannot know the Absolute and the Infinite. He knew, as a matter of historical fact, that all attempts to obtain such knowledge had miserably failed, or ended in nothing better than vain verbal wranglings; but his ignorance of psychology was so great that he probably never knew, or cared to know, why it must necessarily be so. Had he ever once arrived at the knowledge that the process of knowing involves the cognition of likeness, difference, and relation, and that the Absolute, as presenting none of these elements, is trebly unknowable, he would never have confounded purely metaphysical hypotheses with those which are only premature but are nevertheless scientific. He would have seen, for instance, that our inability to say positively whether there are or are not living beings on Saturn results merely from our lack of sufficient data for a complete induction; whereas our inability to frame a tenable hypothesis concerning matter *per se* results from the eternal fact that we can know nothing save under the conditions prescribed by our mental structure. Could we contrive a telescope powerful enough to detect life, or the products of art, upon a distant planet, there is nothing in the constitution of our minds to prevent our appropriating such knowledge; but no patience of observation or cunning of experiment can ever enable us to know the merest pebble as it exists out of relation to our consciousness. Simple and obvious as this distinction appears, there is much reason to believe that Comte never understood it. He inveighs against inquiries into the proximate origin of organic life in exactly the same terms in which he condemns inquiries into the ultimate origin of the universe. He could not have done this had he perceived that the latter question is for ever insoluble because it involves absolute beginning; whereas the former is merely a question of a particular combination of molecules, which we cannot solve at present only because we have not yet obtained the requisite knowledge of the interactions of molecular forces, and of the past physical condition of the earth's surface. In short, he would have seen that, while the human mind is utterly impotent in the presence of noumena, it is well-nigh omnipotent in the presence of phenomena. In science we may be said to advance by geometrical progression. Here, in the forty years which have elapsed since Comte wrote on physical science, it is hardly extravagant to say that the progress has been as great as during the seventeen hundred years between Hipparchos and Galileo. If then, in the three or four thousand years which have elapsed since Europe began to emerge from utter barbarism, we have reached a point at which we can begin to describe the chemical constitution of a heavenly body seventy thousand million miles distant, what may not science be destined to achieve in the next four thousand, or forty thousand, years? We may rest assured that the tale, if we could only read it, would far excel in strangeness anything in the "Arabian Nights" or in the mystic pages of the Bollandists.

But Comte did not understand all this. He, the great overthrower and superseder of metaphysics, did not really apprehend the distinction between metaphysics and science. Hence every hypothesis which went a little way beyond the limited science of his day he wrongly stigmatized as "metaphysical." Hence he heaped contumely upon the cell-doctrine, only three years before Schwann and Schleiden finally established it. And hence, when he had occasion to observe that certain facts were not yet known, he generally added, "and probably they never will be,"—though his prophecy was not seldom confuted, while yet warm from the press.

Toward the close of his life, after he had become sacerdotally inclined, this tendency assumed a moral aspect. These remote and audacious inquiries into the movements of stars, and the development of cellular tissue, and the origin of species should not only be pronounced fruitless, but should be frowned upon and discountenanced by public opinion, as a pernicious waste of time and energy, which might better be devoted to nearer and more practical objects. It is a curious illustration of the effects of discipleship upon the mind, that several of Comte's disciples—Dr. Bridges among others less distinguished—maintain this same opinion, for no earthly reason, I imagine, save that Comte held it. It is certainly a strange opinion for a philosopher to hold. It bears an unlovely resemblance to the prejudice of the Philistines, that all speculation is foolish and empty which does not speedily end in bread-and-butter knowledge. Who can decide what is useful and what is useless? We are told first that we shall never know the distance to a star, and secondly that even if we could know it, the knowledge would be useless, since human interests are at the uttermost bounded by the solar system. Three years suffice to disprove the first part of the prediction. In a little while the second part may also be disproved. We are told by Comte that it makes no difference to us whether organic species are fixed or variable; and yet, as the Darwinian controversy has shown, the decision of this question must affect from beginning to end our general conception of physiology, of psychology, and of history, as well as our estimate of theology. If it were not universally felt to be of practical consequence, it would be argued calmly, and not with the weapons of ridicule and the *odium theologicum*. But this position—the least defensible one which Comte ever occupied—may best be refuted by his own words, written in a healthier frame of mind. "The most important practical results continually flow from theories formed purely with scientific intent, and which have sometimes been pursued for ages without any practical result. A remarkable example is furnished by the beautiful researches of the Greek geometers upon conic sections, which, after a long series of generations, have renovated the science of astronomy, and thus brought the art of navigation to a pitch of perfection which it could never have reached but for the purely theoretic inquiries of Archimedes and Apollonios. As Condorcet well observes, the sailor, whom an exact calculation of longitude preserves from shipwreck, owes his life to a theory conceived, two thousand years ago, by men of genius who were thinking of nothing but lines and angles." This is the true view; and we need not fear that the scientific world will ever adopt any other. That inborn curiosity which, according to the Hebrew legend, has already made us like gods, knowing good and evil, will continue to inspire us until the last secret of Nature is laid bare; and doubtless, in the untiring search, we shall uncover many priceless jewels, in places where we least expected to find them.

The foregoing examples will suffice to illustrate the vagueness with which Comte conceived the limits of scientific and of philosophic inquiry. I have here cited them, not so much for the sake of exhibiting Comte's mental idiosyncrasies, as for the sake of emphasizing the radical difference between his conception of the scope of philosophy and the conception upon which the Cosmic Philosophy is founded. In giving to Comte the credit which he deserves, for having heralded a new era of speculation in which philosophy should be built up entirely out of scientific materials, we must not forget that his conception of the kind of philosophy thus to be built up was utterly and hopelessly erroneous. Though he insisted upon the all-important truth that philosophy is simply a higher organization of scientific doctrines and methods, he fell into the error of regarding philosophy merely as a logical Organon of the sciences, and he never framed the conception of philosophy as a Universal Science in which the widest truths obtainable by the several sciences are contemplated together as corollaries of a single ultimate truth. Not only did he never frame such a conception, but there can be no doubt that, had it ever been presented to him in all its completeness, he would have heaped opprobrium upon it as a metaphysical conception utterly foreign to the spirit of Positive Philosophy. We have just seen him resolutely setting his face against those very scientific speculations to which this conception of the scope of philosophy owes its origin; and we need find no difficulty in believing Dr. Bridges when he says that the Doctrine of Evolution would have appeared to his master quite as chimerical as the theories by which Thales and other Greek cosmogonists "sought to deduce all things from the principle of Water or of Fire."

Thus in a way that one would hardly have anticipated, we have disclosed a fundamental and pervading difference between the Positive and the Cosmic conceptions of philosophy. The apparently subordinate inquiry into Comte's reasons for excluding Logic from his scheme of sciences, has elicited an answer which gravely affects our estimate of his whole system of thought. That his conception of Philosophy as an Organon was a noble conception, there is no doubt; but that it was radically different from our conception of Philosophy as a Synthesis, is equally undeniable. But the full depth and significance of this distinction will only be appreciated when, in the following chapter, we shall have pointed out the end or purpose for which this scientific Organon was devised.

# CHAPTER X.

## COSMISM AND POSITIVISM.

TOWARD the close of the chapter on "Phenomenon and Noumenon," I observed that it has become customary to identify with Positivism every philosophy which rejects all ontological speculation, which seeks its basis in the doctrines and methods of science, and which is accordingly arranged in opposition to the current mythologies. The confusion is one which, after having once been originated, it is easy to maintain but exceedingly difficult to do away with ; since on the one hand, it is manifestly convenient for the theologian to fasten upon every new and obnoxious set of doctrines the odium already attaching to quasi-atheistic Positivism ; while on the other hand, the disciples of Comte are not unnaturally eager to claim for themselves every kind of modern thinking that can by any colourable pretext be annexed to their own province. The theological magazine-writer, who perhaps does not know what is meant by the Relativity of Knowledge but feels that there is something to be dreaded in Mr. Mansel's negations, finds an excellent substitute for intelligent criticism in the insinuation that this doctrine of relativity is a device of the Positivists, who refuse to admit the existence of God, and worship Humanity "symbolized as a woman of thirty, with a child in her arms." In similar wise the ardent disciple of Comte —who, so far as my experience goes, is not unlikely to be quite as narrow-minded as any theologian—is wont to claim all contemporary scientific thinkers as the intellectual offspring of his master, until their openly expressed dissent has reduced him to the alternative of stigmatizing them as "metaphysical;" very much as the Pope lays claim to the possession of all duly baptized Christians,[1] save those whom it has become necessary to excommunicate and give over to the Devil.

But aside from these circumstances, which partly explain the popular tendency to classify all scientific thinkers as Positivists, it is not to be denied that there are really plausible reasons why the Positive Philosophy should currently be regarded as representative of that whole genus of contemporary thinking which repudiates the subjective method, and, as Mr. Spencer says, "prefers proved facts to superstitions." As I have already shown, it was Comte who first inaugurated a scheme of philosophy explicitly based upon the utter rejection of anthropomorphism and the adoption of none but scientific doctrines and methods. I have already pointed out how great are our obligations to him for this important work, and I need not repeat the acknowledgment. For this reason it is obvious that whenever the theological thinker encounters a system which as far as possible rejects anthropomorphic interpretations, and whenever the metaphysician encounters a system which denies the validity of his subjective method, both the one and the other will quite naturally regard this system as some phase of Positivism. For the same reason, when we remember how strong is the tendency to "read between the lines" of any system of thought and thus to interpret it in accordance with our pre-conceptions, we shall see how easy it is for those who

[1] See the amusing letter of Pius IX. to the Emperor of Germany, dated August 7th, 1873.

first derived from Comte their notions of scientific method and of the limits of philosophic inquiry, to "read into" his system all the later results of their intellectual experience, and thus to persist in regarding the whole as Positive Philosophy. Of this tendency it seems to me that we have an illustrious example in Mr. Lewes, the learned historian of philosophy and acute critic of Kant, who in the latest edition of his "History" still maintains that the agreement between Comte and Spencer is an agreement in fundamentals, while the differences between them are non-essential differences. That I am not incapable of understanding and sympathizing with this tendency, may be inferred from the fact that during eleven years I espoused the same plausible error, and called myself a Positivist (though *never* a follower of Comte) in the same breath in which I defended doctrines that are utterly incompatible with Positivism in any legitimate sense of the word. So long as we allow our associations with the *words* to colour and distort our scrutiny of the *things*—a besetting sin of human philosophizing, from which none of us can hope to have entirely freed himself—so long it is possible for us to construct an apparently powerful argument in behalf of the fundamental agreement between Spencer and Comte. It may be said, for example, that both philosophers agree in asserting:

I. *That* all knowledge is relative;
II. *That* all unverifiable hypotheses are inadmissible;
III. *That* the evolution of philosophy, whatever else it may be, has been a process of deanthropomorphization;
IV. *That* philosophy is a coherent organization of scientific doctrines and methods;
V. *That* the critical attitude of philosophy is not destructive but constructive, not iconoclastic but conservative, not negative but positive.

Still confining our attention to the form of these propositions, and neglecting for the moment the very different meanings with which they would be enunciated respectively by the Cosmist and by the Positivist, it is open to us to maintain that, in asserting these propositions, Mr. Spencer agrees with Comte in asserting the five cardinal theorems of Positive Philosophy. Looking at the matter in this light, we might complain that Mr. Spencer, in his "Reasons for Dissenting, etc.," accentuates the less fundamental points in which he differs from Comte, and passes without emphasis the more fundamental points in which he agrees with Comte. We might urge that while the "Law of the Three Stages" is undoubtedly incorrect, nevertheless the essential point is that men's conceptions of Cause have been becoming ever less and less anthropomorphic. And similarly, when Mr. Spencer insists that Comte has not classified the sciences correctly, we might reply that, if we were to question M. Littré (who still holds to the chief positions of the Comtean classification), he would perforce admit that the fundamental point—the ground-question, as Germans say—is not whether physics comes after astronomy, or whether biology is an abstract science, but whether or not the sciences can be made to furnish all the materials for a complete and unified conception of the world.

In this statement of the case, which once seemed to me satisfactory, we have probably the strongest argument that can be devised in favour of the identification of Mr. Spencer's philosophy with Positivism. Yet, as above hinted, and as will be self-evident to everyone who has comprehended the foregoing chapters, its apparent strength rests entirely upon the verbal ambiguity of the five cardinal propositions, which are stated in such a way as to conceal the real points at issue between the two philosophies. With regard to the first two propositions, I have already shown that they are in nowise so peculiar to Comte that allegiance to them should make us his disciples or coadjutors. In accepting the Doctrine of Relativity, as well as in receiving from modern science the inheritance of the Objective Method, we are the "heirs of all the ages," and are in nowise especially beholden to Comte. As regards the fifth proposition, concerning the critical attitude of philosophy, the discussion of it does not belong to our Prolegomena but to our Corollaries, since before we can comprehend it we must make sure that we understand what is implied by the Doctrine of Evolution. In the concluding chapter of this work it will appear that our dissent from Positivism is practically no less emphatic in respect to the critical attitude of philosophy than in other respects. For the present we can willingly dispense with this proof, as our point will be quite sufficiently established by an examination of the third and fourth propositions above alleged as cardinal alike to Positivism and to Cosmism.

And first, as regards the fourth proposition, the preceding chapter showed that Comte's conception of the scope and functions of philosophy was by no means the same as that which lies at the bottom of the present work. We have seen that he treated philosophy as merely an Organon of scientific methods, and totally ignored the conception of philosophy as a Synthesis of truths concerning the Cosmos. Now in order to comprehend the full purport of this, we must ask what was Comte's aim in constructing a system of philosophy? *To what end was this elaborate Organon devised?* It was not devised for the purpose of aiding the systematic exploration of nature in all directions, for we have seen that Comte began by discouraging and ended by anathematizing a large class of most important inquiries, chiefly on the ground of their "vainness" or "inutility." To understand the purpose of all this admirable treatment of philosophy as an Organon, we must take into account the statement of Dr. Bridges that Comte's philosophic aims were not different in his later epoch from what they had been in the earlier part of his career. From the very outset Comte intended to crown his work of reorganizing philosophy by constructing a polity which should be competent to reorganize society. The belief that society can be regenerated by philosophy is a belief which underlies all his speculations from first to last. His aims were as practical as those of Saint-Simon and Fourier, the difference being chiefly that these unscientific dreamers built their utopias upon abstract theories of human nature, while Comte sought to found his polity upon the scientific study of the actual tendencies of humanity as determined by its past history. In a future chapter I shall have occasion to show that this whole attempt of Comte's was based upon a profound misconception of the true state of the case. For the present we need only observe that with Comte the construction of a Philosophy meant ultimately the construction of a Sociology, to which all his elaborate systematization of scientific methods was intended to be ancillary. Why must we study observation in astronomy, experiment in physics and chemistry, comparison in biology? In order, says Comte, to acquire the needful mental training for sound theorizing in sociology. To him the various physical sciences were not sources from which grand generalizations were to be derived, embracing the remotest and most subtle phenomena of the Universe; they were whetstones upon which to grind the logical implements to be used in constructing a theory of Humanity. All other theorizing was to be condemned, save in so far as it could be shown to be in some way subservient to this purpose. Thus Comte's conception of philosophy was throughout anthropocentric, and he utterly ignored the cosmic point of view. There can be little doubt that he who, in 1830, rejected the development-theory, which a more prescient thinker, like Goethe, was enthusiastically proclaiming, would have scorned as chimerical and useless Mr. Spencer's theory of evolution. We may now begin to see why Comte wished to separate Man from the rest of the organic creation, and why he was so eager to condemn sidereal astronomy, the study of which tends in one sense to dwarf our conceptions of Humanity. Comte was indeed too much of an astronomer to retreat upon the Ptolemaic theory, but in his later works he shows symptoms of a feeling like that which actuated Hegel, when he openly regretted the overthrow of the ancient astronomy, because it was more dignified for man to occupy the centre of the universe! It is true that, in his first great work, Comte points out the absurdity of the theological view of man's supremacy in the universe, and rightly ascribes to the Copernican revolution a considerable share in the overthrowing of this view, and of the doctrine of final causes, with which it is linked. In spite of all this, however, and in spite of his admirable scientific preparation, Comte's conception of philosophy as the summary of a hierarchy of sciences, presided over by sociology, led him irresistibly toward the anthropocentric point of view; and so, when it became necessary for him to crown his work by indicating its relations to religion, he arrived, logically enough, at a Religion of Humanity, although in order to reach such a terminus he was obliged to throw his original Positivism overboard and follow the subjective method. In view then of all this complicated difference between the Positivist conception of philosophy and the conception expounded in this work, I think we are quite justified in designating our own conception by a different and characteristic name.

But the most fatal and irreconcilable divergence appears when we come to consider the third cardinal proposition,—that which relates to deanthropomorphization. If we inquire how it was that Comte was enabled to perpetrate, in the name of philosophy, such a prodigious piece of absurdity as the deification of Humanity, we shall find the explanation to lie in his misconception of what is meant by the relativity of knowledge. A good illustration of his confused thinking on this subject, to which I have already had occasion to efer, is afforded by his treatment of atheism. Comte had no patience with atheists, because of the chiefly negative and destructive character of the atheistic philosophy dominant in the eighteenth century. But when he lets us into his philosophic reasons for rejecting atheism, we find him complaining of the atheists, not because of their denial of Deity, nor because their doctrine contravenes the relativity of knowledge, but because they indulge in "metaphysical attempts to explain the origin of life upon the earth's surface." (!) On reading such passages, it becomes sufficiently evident that Comte did not really understand why metaphysical inquiries are illegitimate, but rejected them very much as the general reader might reject them, because they muddled his mind; and we may acknowledge the justice of Prof. Huxley's sarcasm, that "metaphysics" is, with Comte a "general term of abuse for anything that he does not like." Certain it is that Comte never understood the true import of the doctrine of relativity, as it is stated in our fourth chapter, —that there exists an Unknowable Reality, of which all phenomena, as presented in consciousness, are the knowable manifestations. As I have already observed, his most illustrious follower, M. Littré, unreservedly stigmatizes as "metaphysical" this very doctrine of the Unknowable, upon which the Cosmic Philosophy bases its rejection of metaphysics. Had Comte ever understood this doctrine, he would neither have sought to impose upon us a phenomenal God, in the form of idealized Humanity, nor would he have virtually abandoned his original Positivism in the wild attempt to "regenerate" the subjective method. All these things show that Comte never really fathomed the distinction between metaphysics and science; and as the final outcome of all this complicated misconception, we find him, in his famous "Law of the Three Stages," setting forth as the goal of all speculative progress a state or habitude of mind which never has existed and which never can exist. Herein the antagonism between Cosmism and Positivism becomes so fundamental as to outweigh all minor points of agreement, even were the points of agreement ten times as numerous as they are. For since we deny that the Positive mode of philosophizing, implying the recognition of nothing beyond the contents of observed facts, is a practicable mode at all, it is clear that we cannot, save by the utter distortion and perversion of human speech, be classified as Positivists.

Casting aside, then, our third and fourth cardinal propositions, temporarily assumed for the purpose of emphasizing this rejection of them, we may briefly restate as follows the fundamental issue between Cosmism and Positivism.

We have seen that Comte discerned the fact that there has been a continuous progress in men's conceptions, of which the chief symptom has been deanthropomorphization, and of which the result must be the destruction of ontology. He also discerned the fact, that after giving up ontology, it is still possible to build up a philosophy out of materials furnished by the sciences. We have freely admitted that, in each of these cases, the step taken by Comte was sufficient to work a revolution in the attitude of philosophy; and we may add that, by virtue of this twofold advance, Comte was justified in calling his system of philosophy "positive," in contrast with the absolutely sceptical or "negative" philosophy of the eighteenth century.

But, while admitting all this, we have also seen that Comte supposed the terminal phase of deanthropomorphization to consist in the ignoring of an Absolute Power manifested in the world of phenomena; and that he regarded philosophy merely as an Organon of scientific methods and doctrines useful in constructing a theory of Humanity and a social Polity. On the other hand, the Cosmic Philosophy is founded upon the recognition of an Absolute Power manifested in and through the world of phenomena; and it consists in a Synthesis of scientific truths into a Universal Science dealing with the order of the phenomenal manifestations of the Absolute Power. And manifestly these differences between the two systems of philosophy constitute an antagonism which is fundamental and irreconcilable. If the Positivist conception of philosophy be true, then the work which I am now writing is founded upon a baseless metaphysical fallacy; and conversely it is impossible to accept the doctrine expounded in this work, without *ipso facto* declaring the main position of Positivism to be untenable.

I shall hereafter have occasion to examine the views concerning Psychology, Sociology, Religion, and Practice, which are characteristic of the Positive Philosophy; and, as heretofore, while dissenting from those views in every instance, I shall have no hesitation in acknowledging their merits or in assigning a full meed of homage to the great thinker by whom they were propounded. But while my dissent upon all these points will serve to emphasize and illustrate the fundamental dissent declared in these Prolegomena, it will not be needful again to demonstrate in detail that we are not adherents of the Positive Philosophy. With thrice-reiterated argument, and at the risk of wearying the reader, it has now been made sufficiently evident that Cosmism and Positivism, far from being identical or identifiable with each other, are in a certain sense the two opposite poles of scientific philosophizing. And in virtue of this demonstrated antagonism, the divergences hereafter to be signalized will appear not merely as easily intelligible but even as *à priori* inevitable.

## CHAPTER XI.

### THE QUESTION STATED.

We have now accomplished our preliminary task of defining and illustrating the scope and methods of Cosmic Philosophy, and are prepared to begin the work of constructing a theory of the universe out of the elements which science can furnish. It will accordingly become necessary for us to pass in review the sciences systematized in the eighth chapter, that we may be enabled to contemplate the widest truths which they severally reveal, as corollaries of some ultimate truth. In undertaking this task, there are two opposite courses, either of which we might pursue, though with differing degrees and kinds of success. On the one hand, we might begin with a survey of the concrete sciences; and having ascertained the most general truths respectively formulated by astronomy, geology, biology, psychology, and sociology, we might interpret all these truths in common by merging them all in a single widest generalization concerning the concrete universe as a whole; and lastly, through an analysis of this widest generalization we might seek the ultimate axiom by which the validity of our conclusions is certified. Or, on the other hand, we might begin by searching directly for this ultimate axiom; and having found it, we might proceed to deduce from it that widest generalization which interprets the most general truths severally formulated by the concrete sciences; and finally, by the help of these universal principles, we might perhaps succeed in eliciting sundry generalizations concerning particular groups of concrete phenomena which might otherwise escape our scrutiny.

The latter, or synthetic method of procedure, is much better adapted for our present purpose than the former, or analytic method. Indeed the mass of phenomena with which we are required to deal is so vast and so heterogeneous, the various generalizations which we are required to interpret in common are apparently so little related to one another, that it may well be doubted if the appliances of simple induction and analysis would ever suffice to bring us within sight of our prescribed goal. The history of scientific discovery affords numerous illustrations—and nowhere more convincingly than in the sublime chapter which tells the triumph of the Newtonian astronomy—of the comparative helplessness of mere induction where the phenomena to be explained are numerous and complicated. A simple tabulation and analysis of the planetary movements would never have disclosed, even to Newton's penetrating gaze, the law of dynamics to which those movements conform. But in these complicated cases, where induction has remained hopelessly embarrassed, the most brilliant success has often resulted from the adoption of a hypothesis by which the phenomena have been deductively interpreted, and which has been uniformly corroborated by subsequent inductions. The essential requisite in such an hypothesis is that it must have been framed in rigorous conformity to the requirements of the objective method. It must be based upon properties of matter or principles of dynamics that have previously been established or fully confirmed by induction; it must appeal to no unknown agency, nor invoke any unknown attribute of matter or motion; and it must admit ultimately of inductive verification. Such a hypothesis, in short, is admissible only when it contains no unverifiable element. And of hypotheses framed in accordance with these rigorous requirements, the surest mark of genuineness is usually that they are not only uniformly verified by the phenomena which first suggested them, but also help us to the detection of other relations among phenomena which would otherwise have remained hidden from us.

In conformity, then, to these requirements of scientific method, our course is clearly marked out for us. We have first to search, among truths already indisputably established, for that ultimate truth which must underlie our Synthesis of scientific truths. We have next to show how the widest generalization which has yet been reached concerning the concrete universe as a whole, may be proved to follow, as an inevitable corollary, from this ultimate truth. This widest generalization will thus appear, in the light of our demonstration, as a legitimate hypothesis, which we may verify by showing that the widest generalizations severally obtainable in the concrete sciences are included in it and receive their common interpretation from it. Throughout the earlier part of this special verification, in which we shall be called upon to survey the truths furnished respectively by astronomy, geology, biology, and psychology, I shall follow closely in the footsteps of Mr. Spencer, who has already elaborately illustrated these truths in the light of the Doctrine of Evolution. When we arrive at sociology—still following Mr. Spencer's guidance, but venturing into a region which he has as yet but cursorily and fragmentarily surveyed for us—I shall endeavour to show that our main hypothesis presents the strongest indications of its genuineness by affording a brilliant interpretation of sundry social phenomena never before grouped together under a general law. This interpretation I shall then seek further to verify by showing how it includes and justifies whatever is defensible in the generalizations which such writers as Comte and Buckle have obtained from an inductive survey of the facts of human history. Finally I shall apply our central hypothesis to the special problem of the Origin of Man, and show how, from its marvellous success in dealing with the difficult questions of intellectual and moral progressiveness, the Doctrine of Evolution must be pronounced to have sustained the severest test of verification which our present scientific resources enable us to apply upon this great scale. With this most significant and interesting inquiry, our Synthesis of scientific doctrines will be completed. Such ultimate questions as must inevitably be suggested on our route—questions concerning the relations of the Doctrine of Evolution to Religion and Ethics—will be considered, with the help of the general principles then at our command, in the Corollaries which are to follow.

At present, however, we are not at the goal, but at the starting-point of this arduous course; and our attention must first be directed to the search for that ultimate axiom upon which our Synthesis must rest. Where now shall we begin? In what class of sciences are we to look for our primordial principle? The above survey of our projected course has already assured us that we need not search for it among the concrete sciences. Obviously the widest proposition which can possibly be furnished by astronomy, or biology, or any other concrete science, cannot be wide enough to underlie a Synthesis of all the sciences. The most general theorems of biology are not deducible from the most general theorems of astronomy; nor *vice versâ*. But the most general theorems of each concrete science are ultimately deducible from theorems lying outside the region of concrete science. Where shall we find such theorems? If we turn to the purely abstract sciences—logic and mathematics—we shall get but little help. Useful as these sciences are, as engines of investigation, they do not contain what we are now looking for. Obviously mathematics, dealing only with relations of number, form, and magnitude, cannot supply the ultimate principle from which may be deduced such phenomena as the condensation of a nebula, the segmentation of an ovum, or the development of a tribal community. To build a system of philosophy upon any possible theorem of mathematics, would only be to repeat, after twenty-four centuries, the errors of Pythagoras. And the helplessness of abstract logic, for our purposes, is too manifest to need illustration.

Let us then turn to the abstract-concrete sciences; for in the widest generalizations at which these sciences have jointly arrived we must find, if anywhere, the theorem which we desire. I say "jointly," for in the deepest sense the subject-matter is the same, in molar physics, in molecular physics, and in chemistry. All three sciences deal, in one way or another, with the most general laws of those redistributions of matter and motion which are continually going on throughout the knowable universe. The first deals with the movements of masses; the second deals with movements of molecules, and with the laws of aggregation of molecules that are homogeneous; the third deals with the laws of aggregation of molecules that are heterogeneous. In either case the phenomena dealt with are movements of matter, whether movements of translation through space, or movements of undulation among molecules, or movements whose conspicuous symptom is change of physical state or of chemical constitution. The widest theorems, therefore, which the three abstract-concrete sciences can unite in affirming, must be universal propositions concerning Matter and Motion.

Obviously it is in this region of science that we must look for our primordial theorem. But little reflection is needed to convince us that all the truths attainable by the concrete sciences must ultimately rest upon truths relating to the movements of matter. It is with the movements, actual or inferred, of certain specific masses of matter, that astronomy in both its branches is concerned. Movements of matter, likewise, in a specific region of the universe, and under specific conditions characteristic of this region, constitute the facts about which geology speculates. We need but remember that nutrition is at bottom merely a process in which certain molecules shift their positions, and that the life of an organism is simply a long-continued series of adjustments and readjustments among mutually-related and mutually-influencing systems of aggregated molecules, in order to see that the fundamental laws of the movements of matter must underlie biology also. And although the phenomena of mind—whether manifested in individuals or in communities—cannot be explained as movements of matter; yet, as will be hereafter shown, there is no mental phenomenon which does not involve, as its material correlate, some chemical change in nerve-tissue consisting in a redistribution of molecules; so that in psychology and sociology likewise, our conclusions must become ultimately implicated with theorems concerning matter and motion. Thus in every department of concrete science, the leading problem is in some way or other, either directly or indirectly or very remotely, concerned with distributions and redistributions of matter and motion; and in all our specific conclusions some general conclusion relating to movements of matter must be directly or indirectly or very remotely involved.

Our course is thus still more definitely marked out. We must first search for the deepest attainable truth respecting matter and motion abstractly considered. We must pursue this truth and its corollaries, among the most general groups of phenomena in which these corollaries are exemplified, until we arrive at some concrete result concerning the most general aspects of that redistribution of matter and motion which is everywhere going on. And upon this concrete result we shall find that universal generalization to be based, the validity of which we have afterwards to certify by its agreement with inductions drawn from the several groups of phenomena with which the concrete sciences deal.

Here, before proceeding further, we may fitly pause for a moment, to relieve a puzzling doubt which may ere this have disturbed the mind of the reader. Did we not elaborately prove, in our opening chapter, that concerning the movements of molecules and their aggregation into masses. not only nothing can be known, but no tenable hypothesis can be framed? Did we not, with full knowledge of what we were doing, hang up as the very sign-board of our *φροντιστήριον* or philosophy-shop, the proposition that all that either sense or reason can tell us concerning the intimate structure of a block of wood is utterly and hopelessly delusive? Did we not show that the hypothesis of attractive and repulsive forces lands us straightway in an insoluble contradiction? Did we not find it impossible to get rid of the difficulties which surround the conception of an atom or a molecule, whether regarded as divisible or as indivisible? And did we not conclude that the conception of matter acting upon matter is a pseud-conception which can by no effort be construed in consciousness?—Yet in spite of all this, it may be said, we are about to base the entire following Synthesis upon preliminary conclusions relating to the movements of molecules and their aggregation into masses; we are likely to draw inferences from the assumed intimate structure of certain bodies; we have inevitably to make use of the hypothesis of attractive and repulsive forces; we shall constantly have tacit reference to the conception of atoms and molecules; and we shall be obliged to take account of matter as constrained in its movements by other neighbouring matter. Is there not here, it may be asked, a *reductio ad absurdum*, either of the Synthesis which is to follow, or of the initial arguments upon which the claims of such a Synthesis to stand for the whole of attainable philosophy were partly based?

I state this dilemma as strongly as possible, because it forcibly illustrates the omnipresence of Mystery,—because it shows how, beneath every physical problem, there lies a metaphysical problem whereof no human cunning can detect the solution. Practically, however, the avenue of escape has sometime since been implicitly indicated,—in the fifth and sixth chapters of these Prolegomena. In the chapter on Causation it was shown that, though we can in nowise conceive matter as acting upon matter, yet, for the purposes of common-sense, of science and of philosophy, it is quite enough that one kind of phenomenal manifestation is invariably and unconditionally succeeded by some other kind of phenomenal manifestation. And in characterizing the Subjective and Objective Methods, we saw that the truth of any proposition, for scientific purposes, is determined by its agreement with observed phenomena, and not by its congruity with some assumed metaphysical basis. For example, the entire Newtonian astronomy—the most elaborate and finished scientific achievement of the human mind—rests upon a hypothesis which, if metaphysically interpreted, is simply inconceivable. The conception of matter attracting matter through an intervening tract of emptiness is a conception which it is impossible to frame,—and Newton knew it, or felt it to be so. But nowhere did his unrivalled wisdom show itself more impressively than in this,—that he accurately discriminated between the requirements of science and the requirements of metaphysics, and clearly saw that, while metaphysics is satisfied with nothing short of absolute subjective congruity, it is quite enough for a scientific hypothesis that it gives a correct description of the observed coexistences and sequences among phenomena.[1] In truth,

[1] This is distinctly stated by Copernicus: "Neque enim necesse est eas hypotheses esse veras, imo ne verisimile quidem, sed sufficit hoc unum, si

for scientific purposes, we are no more required to conceive the action of matter upon matter in the case of gravitation than in any other case of physical causation. All that the hypothesis really asserts is that matter, in the presence of other matter, will alter its space-relations in a specified way; and there is no reference whatever to any metaphysical *occulta vis* which passes from matter in one place to matter in another place.

There is, however, no good ground for objecting to the use of the phrase "attraction," provided it be employed only as a scientific artifice. There is a certain sense in which science, as well as legal practice, has its "fictions" that are eminently useful. The lines and circles with which geometry deals have nothing answering to them in nature; and the analyst employs a "scientific fiction" when he deals with infinitesimals, since it is impossible to conceive a quantity less than any assignable quantity. In like manner, there is nothing objectionable in using language which assimilates the case of a planet revolving about the sun to the case of a stone whirled at the end of a string; for there is real similarity between the phenomena. So if the science of chemistry had been obliged to wait until all the metaphysical difficulties which encompass the conception of a molecule or an atom had been cleared away, it might well have waited until the end of the world. Quite likely the "atom" in chemistry is as much a "scientific fiction" as the "infinitesimal" in algebra: but we cannot therefore complain of the chemist for assigning to it shape and dimensions, provided he makes a scientific and not a metaphysical use of the artifice. In the region of science such a fiction is no more illegitimate than that fiction in the region of common-sense by which I judge this writing-table to be solid, while, for aught I know to the contrary, the empty spaces between

calculum observationibus congruentem exhibeant."—See Lewes, *Aristotle*, p. 92; *Problems of Life and Mind*, vol. i. p. 317.

its particles may be as much greater than the particles as the interstellar spaces are greater than the stars. We need have no hesitation, therefore, in dealing with the aggregations of atoms and molecules, after the manner of the chemical philosopher, or with attractive and repulsive forces, after the manner of the physicist, so long as we take care that the substance of our propositions has reference only to verifiable coexistences and sequences among phenomena.

Another possible difficulty may be now more summarily disposed of. If it be urged that to frame a "generalization concerning the concrete universe as a whole" is manifestly to transgress the limits of sound philosophizing, since we can never know but a tiny portion of the concrete universe, and can never even know how much there is that lies beyond our ken; if such an objection be urged against the undertaking planned in the present chapter, we may again appeal to Newton as witness in our favour. The law of gravitation is expressed in terms that are strictly universal,—terms which imply that wherever matter exists, be it a million times more remote than the outermost limit of telescopic vision, the phenomena of gravitation must be manifested. Comte, indeed, questioned the legitimacy of extending the generalization beyond the limits of the solar system. But his doubt, which facts so soon refuted, was based on inadequate knowledge of the psychological aspect of the case. Newton's hypothesis simply detected and generalized the mode of manifestation of one of those properties by virtue of which matter is matter; and he was justified, according to the principles laid down in our third chapter, in basing a universal proposition upon a single instance. The final test of the presence of matter is the manifestation of the gravitative tendency; and such must be the case so long as we are unable to transcend experience. As I before observed, it is quite possible that there may be worlds in which numerical limitations like ours are not binding, and so it is very possible that there may be worlds in which there is neither matter nor gravity. But any such possible worlds, standing entirely out of relation to our experience, are practically non-existent for a philosophy which is based on the organization of experience.

Now, though the law of evolution is not, like the law of gravitation, the generalization of a property of matter, it is still the generalization of certain concrete results of known properties of matter. And the universality which in the following chapters will be claimed for this generalization, is precisely like the universality claimed for the law of gravitation. The law of evolution professes to formulate the essential characteristics of a ceaseless redistribution of matter and motion that must go on wherever matter and motion possess the attributes by which we know them. In Mr. Mill's hypothetical world where two and two make five, the law of evolution may not hold sway. But within the limits of our experience, the law is a "generalization concerning the concrete universe as a whole;" and if it be satisfactorily verified, we shall have achieved that organization of scientific truths into a coherent body of doctrine, which has been shown to be the legitimate aim of Philosophy.

Here in conclusion we may again call attention to the significance of the phrase by which I have designated the kind of philosophy that is expounded in this work. We may reiterate the statement, which has already been illustrated from various points of view, that our philosophy is peculiarly entitled to the name of Cosmic Philosophy. For while it may be urged that earlier philosophies have also been cosmic, in so far as they have sought to offer some explanation of the universe, on the other hand it must be acknowledged that never before has the business of philosophy, regarded as a theory of the universe, been undertaken with so clear and distinct a conception of its true scope and limitations.

Though other thinkers, before Mr. Spencer, may have generalized about the concrete universe as a whole, it cannot be denied that he has been the first to frame a verifiable hypothesis upon this stupendous scale. The law of evolution is the first generalization concerning the concrete universe as a whole, which has been framed in conscious conformity to the rigorous requirements of the objective method, and which has therefore served to realize the prophetic dream of Bacon, by presenting Philosophy as an organism of which the various sciences are members. Obviously a system which has achieved, or consciously sought to achieve, such a result, is entitled *par excellence* to the name of Cosmic Philosophy. It has been the first to give practical realization to that sublime thought of two master minds, which I have inscribed at the head of this work:—

"To a thinker capable of comprehending it from a single point of view, the universe would present but a single fact, but one all-comprehensive truth; and it is for this reason that we call it Cosmos, and not chaos."

# PART II.

## *SYNTHESIS.*

"Je unvollkommener das Geschöpf ist, desto mehr sind diese Theile einander gleich oder ähnlich, und desto mehr gleichen sie dem Ganzen. Je vollkommener das Geschöpf wird, desto unähnlicher werden die Theile einander. Je ähnlicher die Theile einander sind, desto weniger sind sie einander subordinirt. Die subordination der Theile deutet auf ein vollkommneres Geschöpf."—GOETHE, *Zur Morphologie.* 1807.

## CHAPTER I.

### MATTER, MOTION, AND FORCE.

In the third book of the "Philosophie Positive," Comte observes that it can hardly be by accident that the word "Physics," which originally denoted the study of the whole of nature, should have become restricted to that science which deals with the most abstract and general laws of the re-arrangement of Matter and Motion. This is one of the many profound remarks scattered through Comte's writings, the full significance of which he could hardly himself have realized.[1] For it will now appear—as the preceding chapter taught us to expect—that the study of Physics (including under that name, for the moment, the three abstract-concrete sciences) underlies the study of the whole of nature, and discloses those universal truths upon which a Synthesis of the widest truths disclosed by the concrete sciences must repose. It investigates the general phenomena of matter, motion, and force; while the concrete sciences investigate

[1] For immediately afterwards we find Comte basing the organic sciences upon physics, but excluding astronomy, which he calls an "emanation from mathematics." It is indeed difficult to see how astronomy, which involves the physical ideas of matter, motion, and force, can be an emanation from mathematics, which involves only the purely abstract ideas of space and number. In fact, as above shown (part i. chap. viii.), astronomy, no less than the other concrete sciences, is dependent upon physics. Here, as elsewhere, Comte was misled by his serial arrangement.

these phenomena as manifested in particular groups of aggregates. The primordial axiom, upon which our synthetic study of the universe must be founded, is one which is disclosed by the analytic study of the movements of masses and molecules. And thus the three-fold classification of the sciences, by which we found it necessary to replace the simple linear classification of Comte, will find itself practically justified in the very first step which we take toward the organization of scientific truths into a system of Cosmic Philosophy.

For at the bottom alike of molar physics, of molecular physics, and of chemistry, there lie, in fact, two universal propositions,—the one relating to Matter, the other relating to Motion. These are the familiar propositions that *Matter is indestructible,* and that *Motion is continuous.* Upon the truth of this pair of closely-related propositions depends the validity of every conclusion to which chemistry or either branch of physics can attain. If, instead of dealing with unalterable quantities and weights, the chemist and physicist "had to deal with quantities and weights which were apt, wholly or in part, to be annihilated, there would be introduced an incalculable element, fatal to all positive conclusions." And since motions of masses and molecules form a principal part of the subject-matter of the three abstract-concrete sciences, it is obvious that "if these motions might either proceed from nothing or lapse into nothing, there would be an end to scientific interpretation of them;" no science of chemistry, or of physics, molecular or molar, would be possible.

The evidence which has secured universal acceptance for these twin theorems has been chiefly inductive evidence. The ancients freely admitted that matter might be created and destroyed; and until the time of Galileo it was supposed that moving bodies had a natural tendency to lose their motion by degrees until they finally stopped. Falsifying many of the complex conditions in the case, the ancients verbally maintained the negations of the theorems that matter is indestructible and motion continuous; although, if they had tried to realize in thought their crude propositions, they would have found it impossible. But gradually it began to be perceived that in all cases where matter disappears—as in the burning of wood or the evaporation of water—the vanished matter has only undergone a molecular change which renders it temporarily imperceptible by our unaided senses. Of the manner in which quantitative chemistry has demonstrated this truth, pursuing, balance in hand, the vanished matter through all its protean transformations, it is unnecessary to speak. Similar has been the evidence in the case of motion. Observing that, the more effectually friction, atmospheric resistance, and other obstacles to the visible continuance of motion are eliminated, the longer the motion continues, the conclusion was reached, by the method of concomitant variations, that if all obstacles could be eliminated the motion would continue for ever. Finally, when it was shown that the apparent loss of motion caused by friction is, in fact, only a transformation of a certain quantity of molar motion into its equivalent quantity of that species of molecular motion known as heat, it was admitted on all sides that motion is indestructible, as well as matter.

But a brief analysis will show that the twin theorems which we are considering have a deductive warrant equally valid with their inductive warrant. Deep as are the truths that matter is indestructible and motion continuous, there is a yet deeper truth implied by these two. These theorems are not fundamental, but derivative; and it therefore becomes necessary to ascertain the axiom upon which they depend, since here, if anywhere, must be found the primordial truth which we are seeking.

Since we cognize any portion of matter whatever only as an aggregate of coexistent positions which offer resistance to our muscular energies; since it is primarily by virtue of such resistance that we distinguish matter from empty space, it follows that our idea of matter is built up of experiences of force, and that the indestructible element in matter is its resisting power, or the force which it exerts. Considering different portions of matter in their relations to each other, we are brought to the same conclusion. When we say that it is chemistry which has proved with the balance that no matter is ever annihilated, we imply that the test of the presence of matter is gravitative force, and that this force is proportional to the quantity of matter.

The case of motion is precisely similar. We cognize motion as the successive occupation of a series of positions by an aggregate of coexistent positions which offer resistance; and the essential element in the cognition—"the necessity which the moving body is under to go on changing its position"—has been proved to result from early experiences of force as manifested in the movements of our muscles. Consequently, as Mr. Spencer observes, when we find ourselves compelled to conceive motion as continuous, we find that what "defies suppression in thought is really the force which the motion indicates. The unceasing change of position, considered by itself, may be mentally abolished without difficulty. We can readily imagine retardation and stoppage to result from the action of external bodies. But to imagine this, is not possible without an abstraction of the force implied by the motion. *We are obliged to conceive this force as impressed in the shape of reaction on the bodies that cause the arrest.*"

Or to put the whole case briefly in another form:—The fundamental elements of our conception of matter are its force-element and its space-element, namely, resistance and extension. The fundamental elements of our conception of motion are its force-element and its space-and-time-element, namely, energy and velocity. That in each case the force-element is primordial, is shown by the facts that what we cannot conceive as diminished by the compression of matter is not its extension but its power of resistance; what we cannot conceive as diminished by the retardation of motion is not its velocity but its energy.

Therefore, in asserting that matter is indestructible and that motion is continuous, we assert, by implication, that force is persistent. Our two fundamental theorems are thus seen to derive their validity from a yet deeper theorem,—the proposition that the force manifested in the knowable universe is constant, can neither be increased nor diminished.

To this result, which we have here obtained through a general consideration of the problems treated by the abstract-concrete sciences, we shall be equally led by any special question of molar physics, molecular physics, or chemistry which we may choose to analyze. When we say that the curve described by a cascade in leaping from a projecting ledge of rock is a parabola of which the coordinates express respectively the momentum of the water and the intensity of gravity at the verge of the ledge; or when we say that the line followed by any solid body, drawn by two differently situated forces, is the diagonal of a parallelogram of which the sides express the respective intensities of the forces; the validity of our assertion depends entirely upon the postulate that the forces in question are constant in amount. Annihilate a single unit of force, and our proposition is hopelessly falsified. Similarly in molecular physics, when we enunciate the formula by means of which Joseph Fourier founded the mathematical theory of heat—namely, the formula that, in all cases of radiation and conduction, the thermological action between two bodies is proportional to the difference of their temperatures—we imply that action and reaction are always equal between the systems of molecules which compose the two bodies. And the equality of action and reaction between systems of atoms is taken for granted in every proposition of chemistry; as, for instance, when we say that it will take four molecules of any monatomic substance, like hydrogen, to saturate a single molecule of any tetratomic substance, like carbon. Now to assert the equality of action and reaction, whether between masses, molecules, or atoms, is to assert that force is persistent. "The allegation really amounts to this, that there cannot be an isolated force, beginning and ending in nothing; but that any force manifested, implies an equal antecedent force from which it is derived, and against which it is a reaction. Further, that the force so originating cannot disappear without result; but must expend itself in some other manifestation of force, which, in being produced, becomes its reaction; and so on continually."[1] Clearly, therefore, the assertion that force is persistent is the fundamental axiom of physics: it is the deepest truth which analytic science can disclose.

But now what warrant have we for this fundamental axiom? How do we know that force is persistent? If force is not persistent, if a single unit of force can ever be added to or subtracted from the sum-total at any moment existing, our entire physical science is, as we have seen, a mere delusion. In such case, it is a delusion to believe that action and reaction are always equal, that the strongest bow, bent by the strongest muscles, will always send its arrow to the greatest distance if otherwise unimpeded; it is a delusion to believe that the pressure of the atmosphere and its temperature must always affect the height of enclosed columns of alcohol or mercury, or that a single molecule of nitrogen will always just suffice to saturate three molecules of chlorine. And, this being the case, our concrete sciences also fall to the ground, and our confidence in the stability of nature is shown to be baseless; since for aught we can say to the contrary, the annihilation of a few units of the earth's

[1] Spencer, *First Principles*, p. 188.

centrifugal force may cause us to fall upon the sun to-morrow.

But how do we know that all science is not a delusion, since there still exist upon the earth's surface persons who will tell us that it is so? Why do we so obstinately refuse to doubt the constancy of the power manifested in nature? What proof have we that no force is ever created or destroyed?

Logically speaking, we have no proof. An axiom which lies below all frameable propositions cannot be deductively demonstrated. Below the world stands the elephant on the back of the tortoise, and if under the tortoise we put the god Vishnu, where is Vishnu to get a foothold? Nor can our axiom be demonstrated inductively, without reasoning in a circle. We cannot adduce the observed equality of action and reaction in proof of the persistence of force, because this persistence is taken for granted in every observation by which the equality of action and reaction is determined. Obviously it is impossible to prove the truth of an axiom by any demonstration in every step of which the truth of the axiom must be assumed.

But these results need not surprise or disturb us. As we saw, when discussing the Test of Truth, the process of demonstration, which consists in continually "merging derivative truths in those wider and wider truths from which they are derived," must eventually reach a widest truth, which cannot be contained in or derived from any other. At the bottom of all demonstration there must lie an indemonstrable axiom. And the truth of this axiom can only be certified by the direct application of the test of inconceivability. We are compelled to believe in the persistence of force, because it is impossible to conceive a variation in the unit by which force is measured. It is impossible to conceive something becoming nothing or nothing becoming something, without establishing in thought an equation between something and nothing; and this cannot be done. That one is equal to zero is a proposition of which the subject and predicate will destroy each other sooner than be made to unite.

Thus the proof of our fundamental axiom is not logical, but psychological. And, as was formerly shown, this is the strongest possible kind of proof. Inasmuch as our capacity for conceiving any proposition is entirely dependent upon the manner in which objective experiences have registered themselves upon our minds, our utter inability to conceive a variation in the sum-total of force implies that such variation is negatived by the whole history of the intercourse between the mind and its environment since intelligence first began. The inconceivability-test of Kant and the experience-test of Hume, when fused in this deeper synthesis, unite in declaring that the most irrefragable of truths is that which survives all possible changes in the conditions under which phenomena are manifested to us. The persistence of force, therefore, being an axiom which survives under all conditions cognizable by our intelligence, being indeed the ultimate test by which we are compelled to estimate the validity of any proposition whatever concerning any imaginable set of phenomena and under any conceivable circumstances, must be an axiom necessitated by the very constitution of the thinking mind, as perennial intercourse with the environment has moulded it.

Mr. Mill, indeed, in his "System of Logic," Book iii. Chap. xxi., maintains that our belief in the necessity and universality of causation (which was above shown[1] to be an immediate corollary from the persistence of force) rests upon an induction *per enumerationem simplicem*, which is, however, valid in this one case, because it is coextensive with all known orders of phenomena. The incompleteness of this view is shown by the fact that the persistence of force is necessarily assumed in every step of the vast induction by which the

[1] See above, part i. chap. vi.

law of causation is said to be established. Mr. Mill only emphasizes the incompleteness of his view when he repudiates the inconceivability-test as evidence of the law in question. This point has been already so fully discussed that little more need to be said about it here. When, in a future chapter, we come to deal especially with the evolution of intelligence, we shall see that Mr. Mill's inadequate treatment of this subject is due to imperfect mastery of the Doctrine of Evolution. We shall see that the so-called experience-philosophy is both wider and deeper than English psychologists, from Hobbes to Mill, have imagined. We shall see that not only our acquired knowledge, but even the inherited constitution of our minds, is the product of accumulated and integrated experiences, partly personal but chiefly ancestral. Upon this wider ground we shall find ourselves able to dwell in peace with our old foes, the intuitionalists, since it will be seen that the very intuitions upon which they rightly insist as inexplicable from individual experience are nevertheless explicable from the organized experiences of countless generations. And the conclusion will then assert itself, with redoubled emphasis, that the axiom of the persistence of force, being the product of the entire intercourse between subject and object, since the dawn of intelligence, must have the highest warrant which any axiom can have.

Let us for the present, however, content ourselves with reproducing the psychological argument by which Mr. Spencer clinches his demonstration of the necessity which we are under to conceive of force as persistent. "The indestructibility of matter and the continuity of motion, we saw to be really corollaries from the impossibility of establishing in thought a relation between something and nothing. What we call the establishment of a relation in thought, is the passage of the substance of consciousness from one form into another. To think of something becoming nothing, would involve that this substance of consciousness, having just existed under a given form, should next assume no form; or should cease to be consciousness. And thus our inability to conceive matter and motion destroyed, is our inability to suppress consciousness itself. What is thus proved true of matter and motion is *à fortiori* true of the force out of which our conceptions of matter and motion are built." Thus we see it is the persistence of consciousness itself which imposes on us the necessity of asserting the persistence of force. And accordingly this primordial axiom being involved in every act of conscious thinking, and being the basis of experience, "must be the basis of any scientific organization of experiences. To this an ultimate analysis brings us down; and on this a rational synthesis must build up."

The force of these considerations will become still more strikingly apparent as we proceed to contemplate the most general corollaries of this fundamental axiom with which the science of physics has furnished us. The first of these corollaries is the theorem that the relations among forces are persistent. That is to say, in all cases an aggregate of like causes will be followed by an aggregate of like effects. "If in any two cases there is exact likeness not only between those most conspicuous antecedents which we distinguish as the causes, but also between those accompanying antecedents which we call the conditions, we cannot affirm that the effects will differ, without affirming either that some force has come into existence or that some force has ceased to exist. If the cooperative forces in the one case are equal to those in the other, each to each, in distribution and amount; then it is impossible to conceive the product of their joint action in the one case as unlike that in the other, without conceiving one or more of the forces to have increased or diminished in quantity; and this is conceiving that force is not persistent."[1] It follows, therefore, from the persistence

[1] *First Principles*, p. 193.

of force, that there is an invariable order of succession between the totality of phenomena which exist at any given instant and the totality of phenomena which exist at the next succeeding instant. No matter how many special orders of sequences may interlace to form the grand web of sequent phenomena, the order of sequences, both separately and in the aggregate, must be invariable. In complicated mechanical problems, where many forces are involved, we proceed to eliminate one after another by means of the principle of the parallelogram of forces, until at last we retain but two differently located forces, the resultant of which is easily calculable. So, in the most complex cases of causation to be found in nature—as, for instance, in those concerned in the development of the moral character of individuals—if we possessed the means of measuring quantitatively the ratio of each set of antecedents to its set of consequents, we might eliminate one group after another, until at length a necessary relation of sequence would be disclosed between the resultant group of antecedents and consequents. As Mr. Mill observes: "For every event there exists some combination of objects or events, some given concurrence of circumstances, positive and negative, the occurrence of which is always followed by that phenomenon. We may not have found out what this concurrence of circumstances may be; but we never doubt that there is such a one, and that it never occurs without having the phenomenon in question as its effect or consequence."[1] Our unhesitating assurance that "there is a law to be found if we only knew how to find it" is thus the foundation of all the canons of inductive logic. The uniformity of the laws of nature is elsewhere called by Mr. Mill "the major premise of all inductions." The present analysis further shows us that this uniformity of law is resolvable into the persistence of relations among forces, and is therefore an immediate corollary from the persistence of force.

[1] *System of Logic*, 6th edit., vol. i. p. 367.

Besides this purely philosophical corollary from our fundamental axiom, we have to note three other corollaries, which, as belonging to the transcendental regions of physical science, must be set forth and illustrated before we can profitably begin our synthesis of scientific truths. Let us briefly consider these in their natural order.

The first of these corollaries is the generalization currently known as the "Correlation of Forces." Since each manifestation of force must have been preceded by some other equivalent manifestation of force, it follows that when any specific manifestation appears to terminate, it does not really cease to exist, but is only transformed into some other specific manifestation. That we may better apprehend this important truth, let us clear away some of the ambiguity which surrounds the terms commonly employed in the statement of it. The phrase "correlation of forces," which means the correlation of sensible motion with heat, light, electricity, etc., implies that heat, light, and electricity are forces. This is not strictly accurate. Heat and light are modes of undulatory motion, and electricity, with its kindred phenomena, is to be similarly interpreted. Now motion is not force, but one of the manifestations of force; and so the various modes of motion, molar and molecular, are differently conditioned manifestations of force. The force which produces or resists motion is known by us only under the twofold form of attraction and repulsion, which may be either polar or universal. Polar attraction or repulsion is that which acts with different power in different directions. An example of polar attraction is to be found in every case of crystallization, where molecules are grouped into a solid figure bounded by plane surfaces; and a familiar example of polar repulsion is that which is exhibited when the positive poles of any two magnets are brought into mutual proximity. Universal attraction or repulsion is that which acts with equal power in all directions. In universal attraction we are accustomed to distinguish three modes, respectively called gravity, cohesion, and chemism or chemical affinity.

The essential difference between these modes of primary force and the various modes of motion, is illustrated by the familiar facts that gravity causes molar motion while molar motion does not cause gravity; and that chemism gives rise to the species of molecular motion called heat, while heat cannot give rise to chemism, though it may result in a molecular rearrangement which will allow chemism to manifest itself. For example gravity causes a spent rocket to fall to the ground; but the upward motion of the rocket does not cause gravity, although it results in a position of the rocket which enables gravity to reveal itself by causing downward motion. So when nitrous oxide is decomposed into nitrogen and oxygen, a considerable amount of heat is evolved; but when all this thermal undulation is restored under appropriate conditions, and the compound is again formed, it is not that the thermal undulation gives rise to the chemism which draws the atoms of nitrogen and oxygen together; it is only that the thermal undulation results in such a redistribution of the atoms that their progress toward each other is unimpeded, and thus the latent force of chemism is revealed.

Now the law of the correlation of forces, which perhaps ought rather to be called the law of the transformation of motion, is simply the obverse of that corollary from the persistence of force, which affirms that whatever energy has been expended in doing work must reappear as energy. The energy of molar motion which disappears when an arrow sticks in its target is really transformed into the energy of molecular motion which is recognized partly as heat and partly as electricity. That the different modes of motion are transformable into each other, is now one of the commonplaces of physical science, and needs but little illustration here. What is called the arrest of motion by friction is now known to be the change of molar motion into heat, when the rubbing substances are alike in constitution,—into heat and electricity, when they are unlike. In violent collisions, as in the chipping of stones with a mason's chisel, the arrested molar motion is partly changed into light. And when an iron bar is suspended in the magnetic meridian and violently struck or continually jarred, a portion of the arrested motion reveals itself as magnetism.

The transformation of heat into molar motion may be seen in the rise and fall of the mercury in the thermometer, or in the driving of a piston by the molecular dilatation of aqueous vapour. When lime is introduced into an atmosphere of burning hydrogen, we see the conversion of heat into light. And when the heated ends of zinc and copper wires are brought together, we see heat generating electric currents. Conversely, electricity conducted down a lightning-rod is partly converted into heat; and in the bright flashes which are followed by claps of thunder, we witness electric energy partly consumed in originating light.

The phenomenon commonly called light is but a species of a mode of solar energy which may be called radiance or actinism, and which, according to the manner in which it affects our senses, is known as radiant heat, as light, or as the energy which works changes in the daguerreotype-plate and in the leaves of plants. The difference between the higher rays of the solar spectrum, which manifest themselves chiefly in causing chemical changes, and the lower rays, which are cognized as violet light, is generically the same as the difference between these and the still lower rays which are cognized as indigo, blue, green, yellow, orange, or red light; and the same is true if we descend to those still lower rays which are recognized only by their thermal effects. If we call the energy manifested in the solar beam by the general name of actinism, we may say that actinism is transformable into all the other modes of motion. In Mr. Grove's celebrated experiment, where a daguerreotype-plate is ingeniously connected with a galvanometer, a gridiron of silver wire, and a heat-registering helix, and where actinism is the initial mode of motion, there are obtained "chemical action on the plate, electricity in the wires, magnetism in the coil, heat in the helix, and [molar] motion in the needles."

In all cases where the disappearance of any given mode of motion is followed by the appearance of some other mode, the proof that there has been an actual transformation of the former mode into the latter is of two kinds. Deductive proof is furnished by the fact that the only alternative supposition is unthinkable,—namely, the supposition that the one kind of motion has been annihilated, while the other kind has been created for the occasion. Inductive proof is furnished by the fact that wherever it is possible to measure both the amount of motion that disappears and the amount that appears in its place, the two quantities are always found to be equal. Thus the molar motion implied in the fall of 772 pounds of matter through one foot of space, will always raise the temperature of a pound of water just one degree of Fahrenheit. And similar quantitative correlations have been established among other modes of motion.

The second corollary from the persistence of force asserts that the direction of motion in any case is always the resultant between the lines representing respectively the greatest traction and the least resistance exerted by the forces upon which the motion depends. In any plexus of forces whatever, the resultant of all the tractive forces involved will be the line of greatest traction; the resultant of all the resisting forces will be the line of least resistance; and the direction of motion in the resultant of this final pair of resultants follows directly from the persistence of force.

For the last resultant represents the direction and amount of a surplus force which remains after all the other forces have been equilibrated; and to assert that this force will not be manifested in motion along this line, is to assert that force may be expended without effect. Still more obvious does this become, when we remember that "our only evidence of excess of force is the movement it produces." Since we know force not in itself, but only as revealed to consciousness in matter and motion, it follows that motion in any direction is the only proof we have that there is a surplus of unantagonized force acting in that direction. So that our theorem becomes almost an identical proposition. But if we ask *why* the greater of two opposing forces is that which causes motion in its own direction, there can be no answer save the one already given. There is no warrant save the consciousness that the unneutralized surplus of force cannot cease to act.

The simplest case contemplated by this corollary is that of a moving body left to itself. There being here no force involved, save the body's own momentum, the direction of motion is an infinite straight line. But since the realization of such a case would involve the annihilation of all matter save the body in question, it is obvious that no such simple case can ever have existed within the limits of the knowable universe. The simplest case of motion which can come within our cognizance is really complex to a degree which baffles computation. Mr. Spencer somewhere remarks that when a man appears to be walking westward, he is really being carried eastward by the earth's rotation at the rate of 1,000 miles an hour. Besides this, the earth's orbital motion is carrying him westward at the differential rate of 67,000 miles an hour. Meanwhile the motion of the solar system toward the constellation Hercules is all the time bearing him in a direction neither east nor west. While, if we could comprehend in a single view the dynamic relations of the entire sidereal universe, we should find that even the enormous factors already taken into the account would help us but little toward determining the resultant direction in which the man is moving. The comparative ease with which astronomy ascertains the direction of the motions with which it deals, is due to our ability to isolate ourselves theoretically from an indefinitely extended universe of environing bodies; and this is due to the principle, established by Galileo, that the relative motions of the parts of an aggregate are not affected by the motion of the whole. If we could include in the problem the entire knowable universe, we should doubtless find the real motions of a planet as impossible to calculate mathematically as are now the motions of a corpuscle of nerve-substance when thrown out of equilibrium by an act of thinking.

Nevertheless, because of this principle that the relative motions of parts may be calculated independently of the motion of the whole, we are enabled legitimately to restrict our views, so that motion along the resultant of two or three forces may be determined and predicted with a near approach to accuracy. Witness the ease with which we can calculate the orbit of a comet. But when the forces become more numerous, it becomes impossible to determine their resultant. Witness the excessive difficulty of predicting the direction of currents in the atmosphere. The movements of organisms still more hopelessly baffle our powers of calculation. It is hardly probable that science will ever obtain equations for the motions of a lion in securing his prey; yet that would be a very shallow philosophy which should seek to assure us that each one of those motions does not take place along the resultant of all the forces involved. To an intelligence sufficiently vast, the motions of the earth in space would doubtless seem as complicated as those of the lion seem to us. But no amount of complexity can alter the fundamental principle that the direction of motion must be the resultant between the lines of greatest traction and of least resistance.

In conclusion let us observe that in many cases the total amount of traction is so small compared to the total amount of resistance, that for practical purposes it may be neglected; and *vice versâ*. Thus, when a meteor falls upon the earth, we may neglect the resistance of the atmosphere, and say that the meteor follows the line of greatest traction; and when a volcano throws up a column of lava, we may neglect the effects of gravity, and say that for the time being the lava follows the line of least resistance. We shall thus, without any considerable inaccuracy, avoid cumbrous verbiage; and in the case of molecular motions propagated through masses of matter, with which our exposition is chiefly concerned, it is sufficiently accurate to say that motion follows the line of least resistance.

## CHAPTER II.

### RHYTHM.

THE third corollary from the persistence of force may best be introduced by a reconsideration of the simplest case of motion contemplated by the preceding corollary. The realization of Galileo's first law of motion—the law that a moving body must for ever continue in a straight line with uniform velocity—obviously postulates the non-existence of any other matter than that contained in the body in question. If there were but one body in the universe, that body, when once set in motion, would never alter its direction, or undergo any increase or diminution of velocity. The introduction of a second body, attracting the first and attracted by it, alters the result in a way which now demands brief consideration. If the motion with which the two bodies start is such as would carry them along a straight line toward each other, they must obviously rush together, and the case is thus again reduced to that of a single moving body. But this case is too simple to have been ever actually realized. What we have to deal with is the case of two bodies which are moving in independent directions. For the sake of simplicity, let us suppose that the second body, B, is so much heavier than the first body, A, that the common centre of gravity of the two lies within B's periphery. What now will be the result? The *direction* of A's motion, instead of remaining unaltered, will be at each instant deflected from a straight line in such a way that A will continually approach nearer and nearer to a point somewhere in advance of B, upon the line in which B is moving: instead of a straight line we shall have a curve of which the coordinates will bear to each other a ratio equal to the ratio between A's momentum and B's tractive force. The *velocity* of A will also cease to be uniform. For as soon as A has passed on beyond B, a portion of its momentum will be at each instant consumed in neutralizing B's tractive force, so that the velocity due to the remaining momentum, will be at each instant diminished. Now, unless A's momentum be infinite, this process cannot go on for ever. By the time that A has arrived at the point directly in advance of B, so much momentum will have been lost that B's attraction will begin to overbalance it, and the curve in which A is moving will begin to turn back toward B. But now B's tractive force begins to augment at each instant the velocity of A, until, by the time that A has reached a position alongside of B, its momentum is considerably in excess of B's attraction, and it is consequently carried on toward a point in the rear of B. The same rhythmical decrease and increase in A's momentum continues until the curve is completed, and A has reached the position from which it started. Thus our attracted body, instead of moving in a straight line, moves in a closed curve of which one of the foci must coincide in position with the common centre of gravity of the attracted and attracting bodies. The result which we have here obtained by supposing A to be so much smaller than B that its reciprocal influence upon B's motion might be left unconsidered, is not altered if we suppose A and B to be equal in size. In this case the common centre of gravity lies midway between the two bodies, and is the common focus of the two closed curves respectively described by them.

The illustration is a very trite one, being approximately realized in every case of planetary revolution, but the space here given to it is justified by the supreme importance of the principle now to be generalized from it. To Galileo's first law of motion there is now to be added a supplemental law. As a single moving body, in an otherwise empty universe, would move for ever with unvarying velocity in an unvarying direction; so, on the other hand, two or more bodies, moving in independent directions and exerting attractive forces upon each other, must for ever move in directions which rhythmically vary, and with velocities which are rhythmically augmented and diminished. Thus the rhythm of motion is a corollary from the persistence of force. Our only alternatives are rhythm, or invariable velocity in an invariable direction. The latter alternative being excluded by the fact that in the known universe innumerable bodies coexist, it follows that we must adopt the former, and admit that all motion is and must be rhythmical.

The direct dependence of this conclusion upon the axiom of the persistence of force is still further illustrated by the case of the pendulum. Let us imagine, for the sake of definiteness, a heavy bob at the end of a rigid wire. When the bob is raised to leftward of the perpendicular, and then left to the action of gravity, it at once begins to descend. But while it is descending, gravity is at each instant adding to its momentum, so that, when it reaches the perpendicular, it cannot stop, but is carried along to rightward until all the added momentum is lost again; that is, until it has ascended to a height equal to that from which it began to descend. Being now left to the unhindered action of gravity, the same series of motions will occur in the reverse direction, and so on for ever. Strictly speaking, no such case can be realized; since all the lost momentum is not expended in neutralizing gravity, but part of it is employed in communicating motion to the environing atmosphere, and part of it is transformed into heat. But if all the molar momentum thus dissipated could be retained, the rhythmic motion of the pendulum would continue for ever. But why? Simply because the momentum acquired during the descending rhythm cannot cease to manifest itself, save as it is neutralized during the ascending rhythm. And to adduce this reason is to appeal directly to the persistence of force.

The case of undulatory motions propagated among the molecules of matter, is precisely similar. The passage of an undulation implies at each instant a momentary local rarefaction, followed by a momentary local condensation. At a given instant certain molecules are removed further from each other, while at the next succeeding instant they approach each other, and the molecules immediately adjacent are removed from each other. Why is rarefaction thus succeeded by condensation? What is it that determines the rebound of the disturbed molecule towards its original position? Obviously the progress of a pair of molecules toward positions farther and farther from each other is opposed by the inertia of adjacent molecules, which these push before them as they advance. The local rarefaction is achieved only at the expense of an adjacent condensation. This condensation of the adjacent molecules increases their elasticity until it begins to overbalance the momentum of the separating pair of molecules, and then these molecules are driven back toward each other. And so on, without intermission. Now the recoil of the advancing molecule is necessitated by the fact that the elasticity which it generates in the resisting molecule cannot expend itself without producing motion. And to say this is to recur again to our fundamental axiom.

Thus in all cases, whether molar or molecular, the rhythm of motion is necessitated by the fact that in a multiform universe no portion of matter can move uninfluenced by some other portion. The illustrations just given do but typify that which is for ever going on throughout the length and breadth of the Cosmos. Periodicity, rise and fall, recurrence of maxima and minima,—this is the law of all motions whatever, whether exemplified by the star rushing through space, by the leaf that quivers in the breeze, by the stream of blood that courses through the arteries, or by the atom of oxygen that oscillates in harmony with its companion-atoms of hydrogen in the rain-drop. Always, as in our initial illustration, the forces which are carrying a given portion of matter in a given direction become gradually altered in their distribution, and in their amounts, until the direction of the motion becomes practically reversed; and whether the given portion of matter be a planet or a molecule, the dynamic principle remains the same. Just as Newton's law of inverse squares applies to molecules as well as to masses, so the law of rhythm applies in both cases. Thus what we may call the elementary motions going on throughout the world of phenomena—the elementary motions by the various combinations of which all perceptible motions are made up—are all rhythmical or oscillatory. The phenomena which are presented to our consciousness as light, heat, electricity, and magnetism, are the products of a perpetual trembling, or swaying to and fro of the invisible atoms of which visible bodies are composed. When we contemplate the heavens on a clear autumn evening, and marvel at the beauty of Sirius, that beauty is conveyed to our senses through the medium of atomic shivers, kept up during the past twenty-two years, at the average rate of six hundred millions of millions per second. The difference between the tropical heat of India and the cold of the Arctic regions is simply the measure of untold millions of tiny differences in the rates of oscillation of countless atoms of atmospheric gases, determined in turn by innumerable oscillatory movements propagated from the sun to the earth. The difference between the faradaic current which cures some deep-seated abnormity of nutrition, and the lightning-flash which paralyzes and kills, is at bottom a difference in amounts and rates of atomic vibration. And according to the latest speculations in chemical philosophy, it is because of the synchronousness or rhythmical harmony of the oscillatory movements described by their atoms, that elementary substances are enabled to combine in myriadfold ways, thus making up the wondrous variety of forms, organic and inorganic, which the earth's surface presents for our contemplation.

Since the ultimate particles of which science regards the universe as composed are thus perpetually swaying to and fro, in accordance with a law of motion that admits of no exception, we may expect to find that the various aggregates of these particles which constitute perceptible bodies will exhibit a like rhythm, whether comparatively simple or endlessly compounded, in their motions. The law which governs the action of the parts must govern also the action of the whole, no matter how intricately the whole may be compounded. Whether it be in the case of organic or inorganic bodies, of complex or of simple aggregates, we must expect to come upon systems of rhythmical movements, which will be comparatively simple or endlessly complex, according to the structural complication of the bodies in question. Let us exhibit a few instances of this rhythmical action, before we pass to the stupendous consequences of the theorem which I have been endeavouring to elucidate. Some of the chief instances to be gathered from astronomic phenomena have been so admirably presented by Mr. Spencer, that I cannot do better than to quote in full his concise statement.

Along with the planetary revolutions which furnish the illustration with which I began this chapter, "the solar system presents us with various rhythms of a less manifest and more complex kind. In each planet and satellite there is the revolution of the nodes—a slow change in the position of the orbit-plane, which after completing itself commences afresh. There is the gradual alteration in the length of the axis major of the orbit; and also of its eccentricity; both of which are rhythmical alike in the sense that they alternate between maxima and minima, and in the sense that the progress from one extreme to the other is not uniform, but is made with fluctuating velocity. Then, too, there is the revolution of the line of apsides, which in course of time moves round the heavens—not regularly, but through complex oscillations. And further we have variations in the directions of the planetary axes—that known as nutation, and that larger gyration which, in the case of the earth, causes the precession of the equinoxes.

"These rhythms, already more or less compound, are compounded with each other. Such an instance as the secular acceleration and retardation of the moon, consequent on the varying eccentricity of the earth's orbit, is one of the simplest. Another, having more important consequences, results from the changing direction of the axes of rotation in planets whose orbits are decidedly eccentric. Every planet, during a certain long period, presents more of its northern than of its southern hemisphere to the sun at the time of its nearest approach to him; and then again, during a like period, presents more of its southern hemisphere than of its northern—a recurring coincidence which, though causing in some planets no sensible alterations of climate, involves in the case of the earth an epoch of 21,000 years, during which each hemisphere goes through a cycle of temperate seasons, and seasons that are extreme in their heat and cold. Nor is this all. There is even a variation of this variation. For the summers and winters of the whole earth become more or less strongly contrasted, as the eccentricity of its orbit increases and decreases. Hence during increase of the eccentricity, the epochs of moderately contrasted seasons and epochs of strongly contrasted seasons, through which alternately each hemisphere passes, must grow more and more different in the degrees of their contrast: and contrariwise during decrease of the eccentricity. So that in the quantity of light and heat which any portion of the earth receives from the sun, there goes on a quadruple rhythm: that of day and night; that of summer and winter; that due to the changing position of the axis at perihelion and aphelion, taking 21,000 years to complete; and that involved by the variation of the orbit's eccentricity, gone through in millions of years."[1]

The astronomic rhythms here enumerated are peculiarly interesting from the fact that, owing to their comparatively simple character, they are susceptible of mathematical treatment, so that their direct dependence on the principle of the persistence of force can be quantitatively demonstrated. In ascending to the order of phenomena next above them in point of complexity—the geologic phenomena occurring on the earth's surface—we enter a region where such quantitative proof, save of a very crude sort, cannot be obtained. The great complexity of geologic as contrasted with astronomic rhythms is shown by the fact that whereas on the one hand, we can readily calculate the variations of eccentricity in the earth's orbit which have taken place during millions of years gone by or which are sure to take place during millions of years to come, on the other hand we are not yet able to assign an approximate date for the most recent epoch at which our northern hemisphere was covered with glaciers. According to Mr. Wallace this epoch may have occurred no more than seventy thousand years ago, while others would assign to it an antiquity of at least two hundred thousand years, and there are yet others who urge strong arguments in behalf of the opinion that a million of years is barely enough to have produced the changes which

[1] *First Principles,* pp. 256, 257.

have taken place since that event. Nevertheless, though we cannot determine the amounts and durations of the movements which have occurred during the geologic history of the earth, we can still securely assert that these movements have been rhythmical in character. Though the verdict is rendered with less precision, its purport is still the same. In the alternating periods of elevation and depression which have succeeded each other at different places ever since the earth's crust began to be solidified, are exemplified the chief geologic rhythms, due to the slow deflection of the lines of least resistance along which the pressure of the earth's nucleus reveals itself by causing upward motion. But these immensely long rhythms are complicated by minor rhythmical changes of surface, due to continual shifting of river-beds and consequent variations in the areas of denudation and in the deposit of sedimentary strata. And these rhythms are still further complicated by rhythmic variations in the operation of climatic agencies, entailing periodic changes in the amount and distribution of rainfall, in the size and movements of icebergs and glaciers, and in the activity of frost. On the sea-shore we may witness the compound rhythm of the tides, "in which the daily rise and fall undergo a fortnightly increase and decrease, due to the alternating coincidence and antagonism of the solar and lunar attractions"; a source from which arise the most minute geologic rhythms, as those which arise from the secular cooling of the earth, and from its ever varying position in space, are the most vast.

But the subject of complex rhythms is still better illustrated in biology. The commonest physiological act, such as eating, is dependent upon a periodically occurring sensation of hunger, due to a periodic excess of waste over repair. The taking of nutriment is accomplished, in all animals, by a series of rhythmical motions,—either the motions of cilia, or of sphincter muscles, or of jaws, or indeed, of all three at once. Mr. Spencer adds that "the swallowing of food is effected by a wave of constriction passing along the œsophagus; its digestion is accompanied by a muscular action of the stomach that is also undulatory; and the peristaltic motion of the intestines is of like nature. The blood obtained from this food is propelled not in a uniform current but in pulses; and it is aerated by lungs that alternately contract and expand." To this we may add that assimilation is a continuous process of rhythmic interchange between the molecular constituents of the various tissues and of the blood by which they are bathed; that muscular action is the result of a series of oscillatory movements; and that nervous action depends upon a quickly alternating rise and fall in the chemical instability of the molecules which compose the nerve-centres. All these minor rhythms are as ripples upon the surface of the longer rhythm constituted by sleep and wakefulness. Recent researches have shown that sleep itself furnishes a beautiful illustration of the manner in which rhythm is necessitated by the continual redistribution of forces in the organism. According to the most recent view, sleep is caused by a diminution in the capacity of the cerebral arteries, which lessens the circulation of blood through the brain. It is the sympathetic nerve which effects this contraction of the arteries. During the day the activity of the cerebrum itself supplies the stimulus which causes arterial blood to flow through the head in large quantities, so as to keep the vessels duly distended. But after many hours of activity the ratio of repair to waste is sensibly diminished; there is a fall in the average chemical instability of the cerebral nerve-molecules, and a consequent diminution in the amount of cerebral stimulus; until presently the amount of stimulus sent up from moment to moment along the cervical branch of the sympathetic nerve exceeds the amount which the cerebrum can oppose to it. Experiment has shown that the effect of stimulating the sympathetic nerve is to contract the muscular walls of the cerebral arteries. The supply of arterial blood is thus so far diminished that consciousness ceases. But now the other half of the rhythm begins. The cessation of conscious activity greatly diminishes the waste of cerebral tissue; and, although repair is also somewhat lessened by the lessened blood-supply, yet the ratio of repair to waste is increased. The complex nerve-molecules are built up to higher and higher grades of instability, until it only needs a slight stimulus from without, in the shape of a sensation of sound or of light or of touch, to elicit a discharge of nerve-force from the cerebral ganglia. This discharge is instantly answered by a rush of blood, which distends the cerebral arteries, revives consciousness, and holds in abeyance the contractile energy of the sympathetic nerve, until the decreasing ratio of repair to waste by and by necessitates a recurrence of the rhythm. Thus the alternation of sleep and wakefulness is due to a periodic variation in the ratio between the amount of nerve-force stored up in the cerebrum and the amount stored up in the sympathetic ganglia. We recognize this truth in practice when we seek to induce sleep by stimulating the sympathetic nerve with such substances as bromide of potassium.

The phenomenon of sleep is still further interesting as the most familiar instance of the dependence of biologic rhythms upon astronomic rhythms. All organisms, animal and vegetable, from the highest to the lowest, exhibit alternations in the total distributions of their forces, which coincide with the periodic appearance and disappearance of sunlight. The longer astronomic rhythm, known as the earth's annual revolution, causes corresponding rhythms in vegetable and animal life; witness the blossoming and leafing of plants in the spring, the revival of insect activity at the same season, the periodic flights of migratory birds, the hybernating sleep of many vertebrates, and the thickened coats or the altered habits of others that do not hybernate. If we consider the species instead of the individual, we shall find that still longer astronomic rhythms, often complicated by geologic rhythms, cause periodic changes in the total manifestations of life upon the earth's surface. Recurring epochs of high eccentricity of the earth's orbit have so altered the distribution of solar radiance as to cause violent climatic vicissitudes. Large portions of the earth have been covered by glaciers, and there have been ensuing migrations of plants and animals, attended by the extinction of many forms, and by specific variations among the survivors. Other rhythms in the distribution of life have been caused by alternations in the elevation and subsidence of continents and islands. And all the foregoing causes, taken altogether, have been endlessly complicated by rhythmic changes in the relations of various groups of organisms to one another. The complexity of such relations is strikingly illustrated in an instance given by Mr. Darwin. The fertilization of heartsease and red clover is impossible without the agency of humble-bees in carrying the pollen from one flower to another. Other bees do not visit these flowers, as their probosces are not long enough to reach the nectar; while moths, which have sufficiently long probosces, are not heavy enough to bend down the petals in such a way that the anthers above may shed pollen upon their backs. Hence the partial or total destruction of humble-bees must involve the decrease or extinction of heartsease and red clover. But observation shows that the mortal foes of humble-bees are field-mice, who destroy their combs and nests. It is estimated that in England more than two-thirds of each generation of humble-bees are destroyed by mice. Hence it follows that the cat is a friend and protector of the humble-bee; and that any sensible variation in the number of cats in a given district must indirectly cause a variation in the numbers of heartsease and red clover which grow in the neighbourhood. It is only needful to add that in such variations we have a series of endlessly complex rhythms; as is obvious from the fact that the number of individuals in any species is never constant, but is continually fluctuating about an average mean. The cumulative result of such rhythms, going on through countless ages, is witnessed in the rhythmical changes of organic species revealed by palæontology. In all ages species have been encroaching on each other, and while some have been growing more abundant, others have gradually disappeared, Thus we find successive floras and faunas, characteristic of successive geological epochs, showing that "life on the earth has not progressed uniformly, but in immense undulations."

For the further illustration and more abundant proof of the law that all motion is rhythmical, I must refer to Mr. Spencer's "First Principles," where the subject is discussed much more fully than is here practicable. But our last illustration, from the succession of forms of life upon the earth, suggests still another supremely important aspect in which the general principle must be viewed, before we leave it.

As we saw in our initial illustration, from the movements of heavenly bodies, where a rhythmical motion is dependent on only two compounded forces, the result is a closed curve. Though each planet is, strictly speaking, subjected to a great number of variously compounded forces exerted on it by all its companion planets, yet these forces are so insignificant in quantity, compared to the two chief forces of solar gravity and the planet's own momentum, that they do not essentially alter the result. They prevent the curve in which any given plant moves from being perfectly regular, but they do not prevent its being a closed curve so far as the solar system alone is concerned; so that, at the end of each rhythm, the distribution of forces is very nearly the same as at its beginning. If there were only two bodies concerned, it would be exactly the same: every rhythm would end in bringing about precisely the same state of things with which it started. But where there are a vast number of forces at work, as in the evolution of the earth and of life upon its surface, the probability is infinitely small that any pair of forces can so far predominate over all the rest as to reduce their effects to comparative insignificance. Hence the resulting rhythms will not be closed curves, but endlessly complicated undulations; and every rhythm will end in bringing about a state of things somewhat different from that in which it started. To recur to some of the illustrations above given:—No geologic rhythm of elevation and subsidence leaves the distribution of land and water over the earth exactly as it found it. No biologic rhythm of sleep and wakefulness leaves the distribution of nutritive forces in the organism precisely as it found it; otherwise it would not be true that each day's functional activity is a member of the series of changes which is bearing us from the cradle to the grave. In an exogenous tree each annual rhythm results in a permanent increase of woody fibre: in a mammal it results in at least a relative increase of the solid constituents of the body as compared with the fluid and semi-fluid constituents. And our illustration from palæontology shows that the series of enormous rhythms in which the history of organic life consists, has introduced a new state of things in each geologic epoch.[1]

We have now proceeded as far as a survey of the widest generalizations of physics can carry us, and before we attempt to go further, we may fitly present in a single view the conclusions reached in this and in the preceding chapter.

We observed first that the three departments of abstract-concrete science are alike concerned with the investigation of the general laws of force as manifested in the motions of

[1] Hence the theory of Vico, that social progress takes place in cycles in which history literally repeats itself, is based upon a very inadequate knowledge of the results of the cooperation of many interacting forces.

matter. By an analysis of the widest propositions which these sciences can furnish, concerning the movements of masses and molecules, we arrived at the axiom that every manifestation of force must be preceded and followed by an equivalent manifestation. We saw that this axiom is involved, alike in every special theorem with which each physical inquiry sets out, and in the general theorem of the uniformity of law and the universality of causation with which all physical inquiries must equally set out. We saw next that this axiom gives rise to three corollaries which, as expressing truths that transcend the sphere of any single science, belong to that transcendental region of knowledge which we have assigned to philosophy. By our first corollary it appeared that any given mode of motion may be metamorphosed into several other modes; so that, when we contemplate such a complex system of motions as that presented by the various aggregations of matter upon the surface of our earth, it becomes legitimate to inquire from what antecedent form of energy proceeded all these motions. This inquiry we shall make in due season. By our second corollary it appeared that where motion results from the composition of two or more forces, it must always take place in the line of least resistance; but that the difficulty of calculating or predicting this resultant line must increase very rapidly with each addition to the number of forces which are concerned in producing it.

Our third corollary has given us glimpses of a truth, which, though less immediately obvious, is equally necessary and equally important with any of the foregoing. We have seen that, in the hypothetical case of a single moving body in an otherwise empty universe, the direction of motion would be in a straight line, and the velocity would be uniform. In the hypothetical case of a single pair of mutually attracting bodies moving in independent directions in an otherwise empty universe, the motion would be rhythmical both in direction and in velocity, but it would take place in closed curves, and the distribution of forces at the end of each rhythm would be the same as at the beginning. In the simplest of actual cases, however, — in the case of our planetary system,—such a result, though apparently realized so long as we eliminate from the problem all factors save the two principal ones, is not truly realized; and if we were to take into account the motions of the whole system, due to the forces exerted upon it by remote stellar systems, we should see that it is very far from being realized. Viewed in its relations to the entire visible universe of stellar bodies, no planet moves in a closed curve; and if we also take into consideration the unceasing loss of molecular motion by each cosmical body, we shall perceive that even in this relatively simple class of cases, the rhythms are far too complex ever to result in the reproduction of a given distribution of forces. In the relatively complex cases furnished by geology and biology, this truth is still more strikingly exemplified. Thus in the actual case with which our science has to deal—the case of a universe in which innumerable millions of bodies, from a gigantic star like Sirius down to an inconceivably minute atom of hydrogen, are ceaselessly exerting forces upon each other—we see, not only that all motions must be rhythmical, but that every rhythm, great or small, must end in some redistribution, be it general or local, of matter and motion.

Or to state this final conclusion in a slightly different form:—The mere coexistence of a vast number of bodies in the universe necessitates perpetual rhythm, resulting in a continuous redistribution of matter and motion. Thus fresh significance is given to the truth vaguely surmised by Herakleitos, that ceaseless change is the law of all things, and that the universe of phenomena is in a never-ending flux. But the scientific demonstration further shows us that the change is always from an old state to a new state, and thence to another new state, but never back to the old state. Among the untold millions of forces which science contemplates as cooperating to bring about any given state of things, the permutations and combinations are practically infinite; and not until they have all been exhausted can an expired epoch be reproduced in all its features.

# CHAPTER III.

## EVOLUTION AND DISSOLUTION.

We must now consider what use is to be made of these universal truths which the foregoing survey of the abstract-concrete sciences has disclosed. For if we inquire whether these theorems, singly or combined, can be made to supply the materials needful for constructing such an organized body of truths as may fitly be called Cosmic Philosophy,—it will require but a brief consideration to show us that much more is needed.

In respect of universality, no doubt, these truths leave nothing to be desired. That every manifestation of force must be preceded and followed by an equivalent manifestation; that correlated forms of energy are transmutable one into the other; that motion follows the line of least resistance; and that there is a continuous rhythmical redistribution of matter and motion;—these are propositions which are true alike of all orders of phenomena, and may therefore justly claim to be regarded, in a certain sense, as philosophic truths. Yet we need only fancy ourselves enunciating these abstract theorems as of themselves supplying the explanation of any given order of concrete phenomena, in order to realize how far we still remain from our desired goal. If we were to remind a biologist that in every step of his investigations he takes for granted the persistence of force, he would doubtless assent; but if we were to go on and assert that upon this axiom might be directly reared a science of organic phenomena, he would laugh us to scorn. If we were to assure him that every form of energy manifested by his organisms, from the molar motions of the stomach in digestion and the lungs in respiration to the molecular motions of cerebral ganglia, must have pre-existed in some other form, he would thoroughly agree with us, but would ask us of what use is all this unless we can trace the course and the results of the transformations. If we were still to insist that all the motions taking place in the aforesaid organisms occur rhythmically, along lines of least resistance, and that every such rhythm ends in a more or less considerable redistribution of molecular motions, we might still be met by the answer that all this does not give us a science of biology unless we can also point out the general character and direction of the changes in which organic rhythms result.

In other words our biologist might say to us, with Mr. Spencer, that all these profound truths, with which we were seeking to take away his occupation, are *analytical* truths, and that "no number of analytical truths will make up that synthesis of thought which alone can be an interpretation of the synthesis of things. The decomposition of phenomena into their elements," (he would continue,) "is but a preparation for understanding phenomena in their state of composition, as actually manifested. To have ascertained the laws of the factors is not at all to have ascertained the laws of their cooperation. The question is, not how any factor behaves by itself, or under some imagined simple conditions; nor is it even how one factor behaves under the complicated conditions of actual existence. The thing to be expressed is the joint product of the factors under all its various aspects. Only when we can formulate the total process, have we gained that knowledge of it which Philosophy aspires to."[1]

[1] *First Principles*, p. 274.

It is necessary for us therefore, having finished our analysis, to begin the work of synthesis. In the course of our search for the widest generalizations of Physics, we discovered, as the most concrete result of analysis, that there is going on throughout the known universe *a continuous redistribution of matter and motion.* Let us now, following out the hint of our imaginary interlocutor, endeavour to ascertain the extent, character, and direction of this continuous redistribution. Have the infinitude of changes in the aspect of things, which the rhythm of motion necessitates, any common character, and if they have, what is that character? Are the redistributions of matter and motion, which are going on all around us, aimless and unrelated, or do they tend in common toward some definable result? Can any formula be found which will express some dynamic principle, true of the whole endless metamorphosis?

Or, to state the case in a still more concrete form, when we assert "that knowledge is limited to the phenomenal, we have by implication asserted that the sphere of knowledge is coextensive with the phenomenal. Hence, wherever we now find Being so conditioned as to act on our senses, there arise the questions—how came it thus conditioned? and how will it cease to be thus conditioned? Unless on the assumption that it acquired a sensible form at the moment of perception, and lost its sensible form the moment after perception, it must have had an antecedent existence under this sensible form, and will have a subsequent existence under this sensible form. These preceding and succeeding existences under sensible forms are possible subjects of knowledge; and knowledge has obviously not reached its limits until it has united the past, present, and future histories into a whole."[1]

Let us not fail to note that science and ordinary knowledge concern themselves with such problems no less than

[1] *First Principles,* p. 278.

philosophy; and that in seeking to formulate the past, present, and future history of that aggregate of sensible phenomena which constitutes the knowable universe, philosophy transcends the sphere of science in just the same way that science transcends the sphere of ordinary knowledge, and in no other. A large portion of that imperfectly-organized knowledge which serves to guide the actions even of the least educated men, consists of information concerning the past and future careers of the objects which surround them. Thus we recognize the child of twenty years ago in the grown man of to-day; we know that the coat which the man wears recently existed in the shape of unspun and unwoven wool upon a sheep's back; and that the grass upon which this sheep fed, consisted of matter integrated by countless seeds with the aid of solar radiance. And we know, besides, that the man and the coat which he wears, the sheep and the grass upon which it feeds, must alike pass from their present state of aggregation into a future state of dissolution. This kind of knowledge science is ever extending, as when it traces back the man and the sheep to microscopic germ-cells, and the wool and the grass to certain nitrogenous and hydro-carbon compounds, pre-existing in the atmosphere and soil. Obviously, therefore, it is the business of philosophy, extending and generalizing the same kind of information, to describe the universal features of the process by which cognizable objects acquire and lose the sensible forms under which we know them.

By pointing out the two most obvious features of this process, we shall render still more intelligible the character of the problem which a synthetic philosophy must attempt to solve. The foregoing illustrations show us that a complete account of anything "must include its appearance out of the imperceptible, and its disappearance into the imperceptible." Now a change of state by virtue of which any object ceases to be imperceptible and becomes perceptible, must be a change from a state of diffusion to a state of aggregation; and the converse change, from aggregation to diffusion, must be the change by virtue of which the object again becomes imperceptible. If, for example, we study a cloud, we find that a complete history of it is contained in the explanation of its concentration from millions of particles of aqueous vapour, and its subsequent dissipation into a host of such particles. In like manner, if we study an organism, we find that from germination to final decomposition, its career consists of an epoch of concentration followed by an epoch of diffusion. A very small portion of its constituent matter pre-existed in a concentrated form in the embryo; by far the greater portion pre-existed in the shape of dispersed nitrogenous and carbonaceous compounds, which the growing organism has incorporated with its own structure. Nay, even if we inquire into the previous history of the small portion which was concentrated in the embryo, we may trace it back to an epoch at which it existed in a state of dispersion, as food not yet assimilated by the parent organism. If the organism in question belong to an order of carnivorous animals, we shall indeed have to follow its constituent elements through a series of phases of concentration; through the tissues of sundry herbivorous animals upon which it has fed, and again through the tissues of numerous plants upon which these have in turn subsisted; but in the end we shall always arrive at the host of dispersed molecules which these organisms have eliminated from the breezes and the trickling streamlets by which their leaves and roots were formerly bathed. On the other hand, when the animal dies, and the tree falls to decay, the particles of which they consist are again dispersed; and though they may again be brought together in new combinations, the career of the organism in question is ended with this dispersal. Again if, instead of a transient cloud or a mobile organism, we contemplate an apparently permanent and immobile rock, we are led to a like conclusion. If its origin be purely igneous, this rock may have pre-existed as a liquid stream of matter surging beneath the earth's solid envelope. If its origin be aqueous, its constituent particles were once diffused over a wide area of country, from which they were drawn together through sundry rivulets and rivers, and here at last deposited as sediment. In either case the process by which the rock has assumed an individual existence has been a process of concentration. And when it ceases to exist—whether it is blasted with gunpowder, or chipped away with chisels, or eaten down by running water, or ground to pieces by ocean waves, or lowered through some long geologic epoch until it is melted by volcanic heat—in any case its disappearance is effected by a process of diffusion.

But our account is as yet only half complete. In saying that the career of any object, from its initial appearance to its final disappearance, consists of a process of concentration followed by a process of diffusion, we omit an important half of the truth. For in making such a statement, we are attending only to the material elements of which objects are composed; and we are leaving out of the account the motions, both molar and molecular, which they exhibit, and which constitute an equally important part of the entire process. This defect we must now endeavour to remedy.

A brief reconsideration of the examples already cited will show us that universally the concentration of matter is accompanied by a dissipation of motion, while conversely the diffusion of matter is attended by an absorption of motion. The condensation of aqueous vapour into a cloud is effected whenever it loses by radiation a greater quantity of that kind of molecular motion known as heat than it is receiving from the sun and the earth; and when the loss of motion is still more considerable, there occurs a further condensation of the aqueous vapour into liquid rain. Conversely, when solar radiance, direct or reflected, begins to impart to the condensing cloud an amount of molecular motion in excess of that which it loses from moment to moment, condensation ceases, and the particles of vapour begin to be dissipated. The deposit of sediment at the mouth of a river is attended by the loss of the molar motions which brought its constituent particles from the upland regions which the river drains; and the hardening of the sediment into rock is a change to a state of aggregation in which, along with greater cohesion, the particles possess less mobility than before. In like manner the hardening of an igneous rock is effected by cooling, which implies the loss of internal motion. Indeed the phenomena of heat and cold exhibit *en masse* an illustration of the general principle. The progress of any mass of matter from a gaseous to a liquid, and thence tc a solid state, is attended by the continuous dissipation of molecular motion; while change in the contrary direction is attended by a continuous absorption of such motion. With molar motions the case is precisely similar. "Augment the velocities of the planets, and their orbits will enlarge; the solar system will occupy a wider space. Diminish their velocities, and their orbits will lessen; the solar system will contract. And in like manner we see that every sensible motion on the earth's surface involves a partial disintegration of the moving body from the earth, while the loss of its motion is accompanied by the body's reintegration with the earth." Finally, if we consider the case of organisms, we find that the incorporation of food into the substance of the tissues is constantly accompanied by the giving out of motion in some form of organic activity, while conversely. the decomposition which follows death is attended by an immense absorption of molecular motion. The latter statement is proved by the fact that the elements of which such an organism as the human body is composed, have more than twenty times the volume when free which they have when combined; and it is further illustrated by the fact that dead organisms, from which all supply of molecular motion from without is artificially cut off, are not decomposed. It is thus that animal remains are preserved for ages in blown sand and in peat-moss. And it is thus that the carcases of primeval mammoths, intact even to the bulbs of the eyes, are found imbedded in arctic ice near the mouths of Siberian rivers, just where they were slain by the cold a thousand centuries ago.[1]

But the study of organic phenomena shows us that our general theorem needs some further revision. As it now stands, it runs some risk of being supposed to assert that the career of any composite body is at first characterized solely by the concentration of matter and concomitant dissipation of motion, and is at last characterized solely by the diffusion of matter and concomitant absorption of motion. A reference to the history of any organism will at once show that this is not the case. While the human body, for example, is continually incorporating with its tissues new matter in the shape of prepared food, large portions of the matter once incorporated are continually diffused in the shape of excretions through the lungs, liver, skin, and kidneys. And while it is constantly parting with motion, in the shape of radiated heat, of expended nerve-force, and of molar motion communicated to the surrounding objects which it touches or handles, it is at the same time absorbing large quantities of molecular motion latent in its prepared nutriment. But at no time are the antagonist processes exactly balanced. During early life the excess of concentration over diffusion of matter results in growth. At a later date the rhythms due to the alternate predominance of concentration and diffusion, are exhibited in continual fluctuations in weight. Yet the fact that the healthy body usually increases in weight up to a late period, shows that ordinarily concentration is still predo-

[1] The heads of these animals are nearly always directed *southward.* See Lyell, *Principles of Geology*, 10th edit. vol. i. p. 184.

minant. And this is still more convincingly proved by the fact that in old age, when the body frequently decreases both in weight and in volume, the weight decreases less than the volume. There is a general increase in density, and concomitant loss of mobility, due to the increased ratio of the solid to the fluid constituents of the tissues, and exhibited in the hardness and brittleness of the bones, the stiffness of the joints, the sluggishness of the circulation, and the torpidity of the brain. Finally when, in accordance with the general principle of rhythm, the consolidation has gone so far as to become self-defeating, the antagonist process gains the mastery for which it has all along been striving, and the constituents of the body are separated and scattered.

But the coexistence and alternate mastery of these two opposing processes, though most strikingly exemplified in the case of organisms, is by no means confined to organic phenomena. Neither in the cloud, nor in the rock, which we have chosen as examples, does concentration or diffusion ever go on alone. The one is always antagonized by the other. Even while the cloud is most rapidly losing motion and integrating matter, it is receiving some solar radiance, either direct or reflected from the earth or moon, and the absorption of this radiance causes some disintegration of its matter. Even while it is most quickly vanishing under the burning solar rays, this cloud is still simultaneously losing heat by radiation, and the loss tends to reintegrate it. And likewise our sedimentary rocky deposit, while aggregating, is nevertheless daily abraded by passing currents, and at longer intervals is perhaps cracked by those telluric vibrations known as earthquakes.

As finally amended then, our formula asserts that the career of any composite body is a series of more or less complicated rhythms, of which the differential result is, *at first,* the integration of its constituent matter and the dissipation of part of its contained motion, and, *at last,* the diffusion of its constituent matter accompanied by reabsorption of the lost motion, or its equivalent.

Thus we are gradually reaching something like a concrete result. As we saw, in the preceding chapter, that rhythm necessitates a continual redistribution of matter and motion throughout the knowable universe, we now find that this continual redistribution everywhere results in alternate concentration and diffusion. Such, indeed, must inevitably be the result. The same universal principle of dynamics which prevents the perturbations in the solar system from ever accumulating all in the same direction, is also to be seen exemplified, on a more general scale, in the law that neither aggregation nor diffusion can proceed indefinitely without being checked by the counter-process. Unless we suppose that the sum of the forces which produce aggregation is infinitely greater or infinitely less than the sum of the forces which resist aggregation, so that either the one or the other may be left out of the account, we must admit that the only possible outcome of the conflict between the two is a series of alternations, both general and local, between aggregation and dissipation.

It is now the time to apply to these antagonist processes some more convenient and accurate names than the half-dozen pairs of correlative synonyms by which we have thus far described them. The names selected by Mr. Spencer will be practically justified by the entire exposition contained in the following chapters; but even the cases already fragmentarily studied enable us partly to realize the significance of the terms Evolution and Dissolution, by which he has designated these processes. In Mr. Spencer's terminology, the integration of matter and concomitant dissipation of motion is Evolution; while the absorption of motion and concomitant disintegration of matter is Dissolution. Both these terms possess the signal advantage that, while they admit of precise scientific definition they are at the same time currently used in senses strictly analogous to those in which they are here employed. As we shall presently see, the phenomena of organic life are those in which both the primary and the secondary characteristics of Evolution and Dissolution are most conspicuously exemplified. Especially in the career of the animal organism, these complementary processes are manifested in groups of phenomena that are more easily generalized and more immediately interesting than any others of like complexity; and to these groups of phenomena the terms Evolution and Dissolution have long been popularly applied.

On a superficial view it may now seem as if we were ready to proceed, in the next chapter, to describe in detail the process of Evolution, as exemplified in that most gigantic instance of concentration of matter and dissipation of motion, —the development of our planetary system, by condensation and radiation, from ancestral nebulous matter. In this origin, by aggregation, of our system of worlds, and in that ultimate dissipation of it into nebulous matter which sundry astronomic facts have long taught us to anticipate, we shall presently find a complete and striking illustration of the dynamic principles herein set forth. But we are not yet quite prepared to enter upon the consideration of these phenomena. We need but remember that in the development of the solar system, with its mutually dependent members sustaining complex and definite relations to each other, much more is implied besides concentration of planetary matter and diffusion of molecular motion in the shape of heat; we need but remember this, and we shall see that some further preliminary study is requisite. While, indeed, the primary characteristics of Evolution and Dissolution are those which are expressed in the pair of definitions above given, and which it has been the object of the foregoing inquiry to illustrate; there are also, as just hinted, certain secondary characteristics which it is equally necessary to formulate. While Evolution always consists primarily in an integration of matter and concomitant dissipation of motion, it ordinarily implies much more than this. And it is obvious that only when all the characteristics, both primary and secondary, of Evolution and Dissolution, are expressed in a single formula, can we be said to have obtained the law of the continuous redistribution of matter and motion which rhythm necessitates throughout the knowable universe.

To show how this—the most sublime achievement of modern science—has been brought about, will be the object of the following chapter.

## CHAPTER IV.

### THE LAW OF EVOLUTION.

LAPLACE has somewhere reminded us that, while gratefully rendering to Newton the homage due to him for his transcendent achievements, we must not forget how singularly fortunate he was in this—that there was but one law of gravitation to be discovered. The implication that, if Newton had not lived, Laplace might himself have been the happy discoverer, is perhaps a legitimate one, though it does not now especially concern us. But the implied assertion that Nature had no more hidden treasures comparable in worth and beauty to that with which she rewarded the patient sagacity of the great astronomer, is one which recent events have most signally refuted. We now know that other laws remained behind—as yet others still remain—unrevealed; laws of nature equalling the law of gravitation in universality, and moreover quite as coy of detection. For while it may be admitted that the demonstrations in the "Principia" required the highest power of quantitative reasoning yet manifested by the human mind; and while the difficulties and discouragements amid which Newton approached his task, destitute as he was alike of modern methods of measurement and of the resources of modern analysis, impress upon us still more forcibly the wonderful character of the achievement; it must still be claimed that the successful coordination of the myriad-fold phenomena formulated by the Law of Evolution, was a gigantic task, requiring the full exertion of mental powers no less extraordinary than those required by the other. In an essay published thirteen years ago, youthful enthusiasm led me to speak of Mr. Spencer's labours as comparable to those of Newton both in scope and in importance. More mature reflection has confirmed this view, and suggests a further comparison between the mental qualities of the two thinkers; resembling each other as they do, alike in the audacity of speculation which propounds far-reaching hypotheses and in the scientific soberness which patiently verifies them; while the astonishing mathematical genius peculiar to the one is paralleled by the equally unique power of psychologic analysis displayed by the other. As in grandeur of conception and relative thoroughness of elaboration, so also in the vastness of its consequences—in the extent of the revolution which it is destined to effect in men's modes of thinking, and in their views of the universe —Mr. Spencer's discovery is on a par with Newton's. Indeed, by the time this treatise is concluded, we may perhaps see reasons for regarding it as, in the latter respect, the superior of the two.

To give anything like an adequate idea of the extent and importance of this discovery, or of the enormous mass of inductive evidence which joins with deduction in establishing it, is of course impracticable within the limits of a single chapter. We must be content for the present with exhibiting a rude outline-sketch of its most conspicuous features, leaving it for the succeeding series of discussions to finish the picture. Let us begin by briefly summing up the results already obtained.

It has been shown that the coexistence of antagonist forces throughout the knowable universe necessitates a universal rhythm of motion; and that in proportion to the number of forces anywhere concerned in producing a given set of motions, the resulting rhythms are complex. It has been further shown that, save where the rhythms are absolutely simple—a case which is never actually realized—there must occur a redistribution of matter and motion as the result of each rhythm. It next appeared that such a redistribution involves on the one hand an integration of matter, which implies a concomitant dissipation of motion, and on the other hand a disintegration of matter, which implies a concomitant absorption of motion. The former process, which results in the acquirement of an individual existence by sensible objects, has been named Evolution: the latter process, which results in the loss of individual existence by sensible objects, has been named Dissolution. And we saw it to be a corollary from the universality of rhythm that, while these two antagonist processes must ever be going on simultaneously, there must be an alternation of epochs during which now the former and now the latter is predominant. In conclusion, it was barely hinted that these two fundamental modes of redistribution must give rise, in the majority of cases, to secondary redistributions, which it is the business of a scientific philosophy to define and formulate.

Now, as we are about to start upon a long and complicated inquiry, the proper treatment of which must task our utmost resources of exposition, it will be desirable at the outset to disencumber ourselves of all such luggage as we are not absolutely obliged to take along with us. We shall therefore, for the present, leave the process of Dissolution entirely out of the account, or shall refer to it only incidentally, in cases where such a reference may assist in the elucidation of the counter-process. In the following chapter we shall have occasion to treat of Dissolution in some detail as exemplified in the probable future disintegration of our planetary system; at present we are concerned only with Evolution, which we have already seen to consist in the integration of matter and concomitant dissipation of motion, but which, as we shall presently see, implies in most cases much more than this. Let us first point out the conditions under which the secondary redistributions attending Evolution take place; and let us then proceed to point out the common characteristics of these secondary changes.

Obviously in speaking of secondary redistributions that go on while a body is integrating its matter and losing its motion, we refer to redistributions among the parts of the body and among the relative motions of the parts,—or, in other words, to alterations in structure and function going on within the body. Now the ease with which such redistributions are effected, and the ease with which they are maintained, must depend alike, though in precisely opposite ways, upon the amount of motion retained by the integrating body. The greater the amount of retained motion, the more easily will internal redistributions be effected. The smaller the amount of retained motion, the more easily will such redistributions be rendered permanent. These propositions are so abstruse as to require some further illustration.

When water is converted, by loss of its internal motion, into ice, the amount of secondary rearrangement which occurs among its particles is comparatively slight, but it is permanent so long as the state of integration lasts. During the continuance of the solid state there is not enough mobility among the particles to admit of further rearrangement to any conspicuous extent. On the other hand, after steam has been integrated into water, the retention of a considerable amount of molecular motion allows internal rearrangement to go on so easily and rapidly that no momentary phase of it has a chance to become permanent; and there can thus be no such stable arrangement of parts as we call structure. The phenomena of crystallization supply us with kindred, but slightly different examples. When a crystal is deposited from a solution, there is a certain point up to which the retention of motion keeps the crystal's molecules from uniting; but as soon as this point is passed, the motion is suddenly lost, the crystal solidifies, and there is no further redistribution of its particles. Conversely, when a molten metal is allowed to cool until it assumes a plastic semi-fluid state, its molecular motion is lost so slowly that a perceptible rearrangement of parts is possible: currents may be set up in it, gravity will cause it to spread out wherever it is not confined at the side, and pressure here and there will variously mould it. But when it becomes solid, the rearrangements which occurred latest become permanent, and further rearrangements cannot be produced save by a fresh supply of molecular motion. In like manner, when we come to study planetary evolution, we shall find strong reasons for believing that on small bodies, like the moon and the asteroids, which have rapidly lost their internal heat, there has been but little chance for such complex secondary rearrangements as have occurred upon our relatively large and slowly cooling earth.

Even after the attainment of solidity, however, a new supply of motion from without may cause some further redistribution without causing the body to relapse into fluidity. Thus a wrought-iron rail, which when new is tough and fibrous, gradually acquires the brittle crystalline texture of cast-iron, under the influence of the vibrations communicated by the cars which pass over it. And the magnetization of steel rods, when fastened in the meridian and frequently jarred, is cited by Mr. Spencer as a fact of like import. Many other excellent illustrations, gathered from physics and chemistry, may be found in the thirteenth chapter of the second part of "First Principles."[1]

[1] Throughout this work, reference is made only to the second and rewritten edition of "First Principles," London, 1867. The statement of the law of evolution, as contained in the first edition, is much less complete and coherent.

If now we contemplate in a single view the general principles above illustrated, we shall seem for a moment to have got into difficulties. Unavoidably, in using the word Evolution, we have suggested the idea of increase in structural complexity; and such increase of course implies a considerable amount of permanent internal rearrangement as consequent upon the primary process of integration. Yet under the conditions thus far studied, we find that "on the one hand, a large amount of secondary redistribution is possible only where there is a great quantity of contained motion; and, on the other hand, these redistributions can have permanence only where the contained motion has become small—opposing conditions which seem to negative any large amount of permanent secondary redistribution." We must therefore search for some more peculiar and special combination of conditions before we can understand how Evolution may result in great structural complexity.

It is in the case of organic bodies "that these apparently contradictory conditions are reconciled; and that, by the reconciliation of them, permanent secondary redistributions immense in extent are made possible." The distinctive peculiarity of organic bodies "consists in the combination of matter into a form embodying an enormous amount of motion at the same time that it has a great degree of concentration." Let us enumerate the several ways in which organic bodies are enabled to retain vast quantities of molecular motion, without losing their high degree of concentration. The facts to be contemplated are among the most beautiful and striking facts which the patient interrogation of nature has ever elicited.

In the *first* place, while one of the four chief components of organic matter is carbon, a solid substance which cannot be fused by the greatest heat that man can produce, the other chief components—oxygen, hydrogen, and nitrogen—are gases which human art is unable to liquefy. At a temperature of more than 200 degrees below the zero of Fahrenheit, and under a pressure so enormous as to shorten the steel piston employed, oxygen remains gaseous; and hydrogen and nitrogen display a like obstinate molecular mobility. Now, of these four substances, carbon has the most highly compounded molecule. In chemical language, the molecule of carbon is tetratomic, while that of nitrogen is triatomic, that of oxygen is diatomic, and that of hydrogen is monatomic. That is to say, a single molecule of carbon will hold in combination two molecules of oxygen, or four molecules of hydrogen; while three molecules of carbon will hold four molecules of nitrogen. It follows that in any organic compound, made up of the four above-named elements, a large number of molecules, possessing enormous mobility, must be held in combination by a relatively small number of molecules possessing little mobility. And, since it is a corollary from the persistence of force that the sum of properties belonging to any compound must be the *resultant* of the properties belonging to its constituent elements, it follows that a compound molecule of organic matter must concentrate a great amount of motion in a small space. If, for example, we suppose ten molecules of carbon united with four of oxygen, eight of hydrogen, and eight of nitrogen, we shall have a compound in which ten immobile molecules hold together twenty highly mobile molecules. And while the twenty retain much of their mobility, the immobile ten prevent this mobility from disintegrating the compound.

Here we have reached a most beautiful and marvellous truth. If we now proceed, *secondly*, to follow out the way in which these quantitative relations are compounded, the case will appear still more remarkable. Instead of tens and twenties, we have to deal with hundreds of integrated molecules. Instead of such hypothetical cases as the one just cited, we have to contemplate real cases like the following. A single molecule of albumen is built up of two molecules of sulphur and one of phosphorus, compounded with ten organic molecules, of which each one contains forty molecules of carbon, five of nitrogen, twelve of oxygen, and thirty-one of hydrogen. Or, to reduce the statement to its simplest form,—in every molecule of albumen we have 1,600 atomic equivalents of carbon, 150 of nitrogen, 240 of oxygen, 310 of hydrogen, 10 of sulphur, and 6 of phosphorus; making a grand total of 2,316 atomic equivalents. And the molecule of fibrine is still more intricately compounded.

*Thirdly,* when we recollect that the simplest organic matter actually existing contains not one but very many albuminous molecules, and that these molecules are arranged, not in the crystalloid, but in the colloid form,—in "clusters of clusters which have movements in relation to one another," —we see still more clearly how vast must be the quantity of motion locked up within a small compass.

Our *fourth* item is perhaps the most remarkable of all. In the albumen-molecule, the sum of all the atomic equivalents, except those of carbon, is 716. In order to hold these in combination, only 716 atomic equivalents of carbon would appear to be needed; yet we find 1,600 equivalents. Why this apparent excess of carbon?—The answer is to be found in the fact that nitrogen, unlike most other substances, absorbs heat on entering into combination. To the molecular motion which keeps it when free in a gaseous state, it adds a vast quantity of molecular motion. It has been calculated that the union of a pound of oxygen with nitrogen, in forming nitrous oxide, is attended by the absorption of enough heat to raise the temperature of 9,232 pounds of water one degree Centigrade. It is probably owing to this peculiarity that nitrogen, which is so inert when free, is so wonderfully active when combined. Hence, too, we may understand the extreme instability of such nitrogenous substances as gunpowder, gun-cotton, and nitro-glycerine. And hence we may begin to discern the reason why nitrogen is the most important of the chemical elements concerned in maintaining vital activity. Now when we compare this property of nitrogen with the apparent excess of carbon in the albumen-molecule, we may fairly surmise that the two facts indicate a balance between the forces that tend to produce internal rearrangement and the forces that tend to prevent disintegration.

*Fifthly*, besides the fact that organic bodies usually possess an amount of heat which keeps their temperature somewhat above that of their inorganic environment, we have to note the fact that all organic matter is permeated by water. Hence, while sufficiently solid to preserve their continuity of structure, organic bodies are sufficiently plastic to allow of much internal rearrangement.

If we had time, it would be interesting to go on and trace the facts just enumerated through many complex exemplifications. We might comment at length upon the significance of the facts that certain animals, as the *Rotifera*, lose their vitality when dried and regain it when wetted; that vital activity everywhere demands a supply of heat, and that the most complex organisms are in general the warmest; that animals contain more nitrogen than plants, and are at the same time more highly evolved; that carnivorous animals are relatively stronger and more active than herbivorous animals; that the parts of animals which are the seats of the highest vitality are mainly nitrogenous, while the more inert parts are mainly carbonaceous; that the highly nitrogenous matter composing the nervous system is nevertheless —as if to preserve the balance—always accompanied by inert carbonaceous fat; and that, while a nitrogenous diet renders possible the greatest quantity of physical and mental activity, at the same time carbonaceous alcohol retards the waste of nervous tissue.

But even without entering upon such a course of illustration—which would oblige us to defer our main subject until another occasion—we are now enabled to see how it is that organic bodies can practically solve the dynamic paradox of acquiring a high degree of concentration, even while retaining an immense amount of motion. We are prepared to find, under these quite peculiar conditions, the structural rearrangements characteristic of Evolution carried on to a great extent. And we need not be surprised at finding these secondary phenomena here displayed so conspicuously as to obscure the significance of the primary phenomenon, integration. It was, in fact, through the study of organic phenomena by physiologists that a formula was first obtained for the most conspicuous features of Evolution; while the less obtrusive but more essential feature not only remained unnoticed until Mr. Spencer discerned it, but was not adequately treated even by him previous to the publication of his rewritten "First Principles," in 1867. I think it therefore advisable, in dealing with the law as generalized from organic phenomena, to begin by describing these most conspicuous features. We shall thus obtain a clearer view of the whole subject than we could well obtain in any other way. Having shown that Evolution is always and primarily an integration of matter attended by a dissipation of motion; and having shown that under certain conditions, most completely realized by organic bodies, certain secondary but equally important phenomena of structural rearrangement may be expected to accompany this fundamental process; we must next show what these secondary phenomena are.

The exposition will be rendered clearer by the preliminary explanation of four technical terms, which will continually recur, and which must be thoroughly understood before any further step can be taken toward comprehending the Law of Evolution. These terms are neither obscure in themselves, nor newly coined, but because we shall henceforth employ them in a strict and special sense, they require careful definition.

I. An object is said to be *homogeneous* when each of its parts is like every other part. An illustration is not easy to find, since perfect homogeneity is not known to exist. But there is such a thing as relative homogeneity; and we say that a piece of gold is homogeneous as compared with a piece of wood; or that a wooden ball is homogeneous as compared with an orange.

II. An object is said to be *heterogeneous* when its parts do not all resemble one another. All known objects are more or less heterogeneous. But, relatively speaking, a tree is said to be heterogeneous as compared with the seed from which it has sprung; and an orange is heterogeneous as compared with a wooden ball.

III. *Differentiation* is the arising of an unlikeness between any two of the units which go to make up an aggregate. It is the process through which objects increase in heterogeneity. A piece of cast-iron, before it is exposed to the air is relatively homogeneous. But when, by exposure to the air, it has acquired a coating of ferric oxide, or iron-rust, it is relatively heterogeneous. The units composing its outside are unlike the units composing its inside; or, in other words, its outside is differentiated from its inside.

IV. The term *integration* we have already partly defined as the concentration of the material units which go to make up any aggregate. But a complete definition must recognize the fact that, along with the integration of wholes, there goes on (in all cases in which structural complexity is attained) an integration of parts. This secondary integration may be defined as the segregation, or grouping together, of those units of a heterogeneous aggregate which resemble one another. A good example is afforded by crystallization. The particles of the crystallizing substance, which resemble each other, and which do not resemble the particles of the solvent fluid, gradually unite to form the crystal; which is thus said to be *integrated* from the solution. Integration is also seen in the rising of cream upon the surface of a dish of milk, and in the frothy collection of carbonic-acid bubbles covering a newly-filled glass of ale.

Obviously as it is through differentiation that an aggregate increases in *heterogeneity*, so it is through integration that an aggregate increases in *definiteness*, of structure and function. But there is still another way in which integration is exemplified. Along with increasing heterogeneity and definiteness of structure and function, the evolution of an aggregate is marked by the increasing subordination of the various functions, with their structures, to the requirements of the general functional activity of the aggregate. In other words, along with growing specialization of parts, there is a growing cooperation of parts, and an ever-increasing mutual dependence among parts. An illustration is furnished by the contrasted facts, that a slightly-evolved animal, like a common earth-worm, may be cut in two without destroying the life of either part; while a highly-evolved animal, like a dog, is destroyed if a single artery is severed, or if any one of the viscera is prevented from discharging its peculiar functions. This third kind of integration is the process through which an evolving aggregate increases in *coherence*. And with this, our definition of the factors which concur in the process of evolution is complete.

We are now prepared to show inductively that wherever, as in organic aggregates, the conditions permit, *the integration of matter and concomitant dissipation of motion, which primarily constitutes Evolution, is attended by a continuous change from indefinite, incoherent homogeneity to definite, coherent heterogeneity of structure and function, through successive differentiations and integrations.* In illustration of this statement, let us describe first, some of the differentiations, and secondly, some of the integrations, which successively occur during the development of an individual organism.

Two centuries ago the researches of Harvey on generation established the truth that every animal at the outset consists simply of a structureless and homogeneous germ. Whether this germ is detached from the parent organism at each generation, as in all the higher animals, or only at intervals of several generations, as for example, in the *Aphides* or plant-lice, matters not to the general argument. In every case the primitive state of an animal is a state of relative homogeneity. The fertilized ovum of a lion, for instance, possesses at first no obvious characteristic whereby it can be distinguished from the fertilized ovum of a man, a dog, a parrot, or a tortoise. Each part of the germ-cell is, moreover, as nearly as possible like every other part, in molecular texture, in atomic composition, in temperature, and in specific gravity. Here in two ways we may notice how homogeneity is eventually succeeded by heterogeneity. In the first place, all animal germs are homogeneous with respect to each other, while the animals developed from them present all kinds and degrees of diversity; and, in the second place, each germ is homogeneous with regard to itself, while the creature developed from it is extremely heterogeneous. The vegetable world exhibits a state of things essentially the same, though less conspicuous in its contrasts.

Starting from the homogeneous germ, we may follow out a parallel series of differentiations, resulting respectively in molecular rearrangements of chemical elements and in molecular and molar modifications of tissues and organs. The chemical differentiations have been so well and so concisely described by Mr. Spencer that I cannot do better than cite the passage entire:—"In plants the albuminous and amylaceous matters which form the substance of the embryo, give origin here to a preponderance of chlorophyll and there to a preponderance of cellulose. Over the parts that are becoming leaf-surfaces, certain of the materials are metamorphosed into wax. In this place starch passes into one of its isomeric equivalents, sugar; and in that place into another of its isomeric equivalents, gum. By secondary change some of the cellulose is modified into wood; while some of it is modified into the allied substance which, in large masses, we distinguish as cork. And the more numerous compounds thus gradually arising, initiate further unlikenesses by mingling in unlike ratios. An animal ovum, the components of which are at first evenly diffused among one another, chemically transforms itself in like manner. Its protein, its fats, its salts, become dissimilarly proportioned in different localities; and multiplication of isomeric forms leads to further mixtures and combinations that constitute many minor distinctions of parts. Here a mass darkening by accumulation of hæmatine, presently dissolves into blood. There fatty and albuminous matters uniting, compose nerve-tissue. At this spot the nitrogenous substance takes on the character of cartilage; and at that, calcareous salts, gathering together in the cartilage, lay the foundation of bone. All these chemical differentiations slowly and insensibly become more marked and more multiplied."[1]

The differentiations of tissues and organs are equally interesting. In the growth of any exogenous stem, the outer layer, or bark, first becomes distinguished from the woody interior. Then while the bark gradually becomes differentiated into the liber, made up of woody tissue, the green and corky envelopes, made up of parenchyma, and the epidermis; the interior becomes differentiated into the pith, the medullary sheath, the woody layer, made up of bundles of greatly elongated cells, and the medullary rays, or what is called the *silver grain* in maple and oak. Meanwhile between this heterogeneous bark and the heterogeneous wood which it surrounds there appears a zone of delicate cells, charged with dextrine and other assimilable matter, and known as the cambium layer. At the same time

[1] *First Principles*, p. 334.

differentiations are going on at the upper extremity of this complicated structure. Portions of the green envelope protrude from between the liber and the epidermis, accompanied by tough fibres sent forth partly by the liber and partly by the woody layer. While the green portions flatten out horizontally, the fibres ramify through them and serve to stiffen them; and thus is developed the leaf, which, when mature, usually exhibits a further differentiation between blade and petiole, while by a continuance of the same process stipules often appear at the base of the petiole. Nor is this the end of the story. For while the chlorophyll-cells that make up the upper stratum of the leaf-tissue remain densely crowded, and are often covered by a wax-like cuticle, making the upper surface smooth and glossy; the cells composing the lower stratum become less and less crowded, until the result is a spongy surface, filled with innumerable pores, through which the moisture of the plant may be exhaled. Finally a differentiation arises between the axillary buds, some of which elongate into branches, repeating the chief characteristics of the stem, while others are developed under the still more heterogeneous forms of flowers, with their variously-cleft calyx and corolla, and their variously-compounded stamens and pistils.

In the fertilized mammalian ovum the earliest step toward heterogeneity consists in the division and redivision of the nucleated embryonic cell. As the cell-nucleus grows, by continuous integration of the nutritious protoplasm in which it is imbedded, it slowly becomes grooved, and ultimately divides into a pair of nuclei, about each of which is formed a cell-wall. This process continues until the entire yolk is absorbed, by which time it has become differentiated into a mulberry-like mass of cells. And these cells, at first all alike spherical or nearly so, become club-shaped or hexagonal or pointed, as the mass further consolidates and squeezes them together. A grand differentiation next occurs between the outer and inner portions of the yolk-mass: the outer cells become flattened and pressed together, so as somewhat to resemble a mosaic pavement, and thus form a peripheral membrane. As this membrane continues to thicken by the integration of adjacent materials, it differentiates into two layers, wrapped the one within the other, like two coats of an onion. The outer layer, or ectoderm, absorbing larger quantities of nitrogenous matter than the other, is the one which by further immense differentiation is destined to produce the bony, muscular, and nervous systems; while the inner layer, or endoderm, is destined to produce the digestive apparatus. Between these two, by a further differentiation, arises a vascular layer, the rudiment of the circulatory system. Now on the interior surface of the endoderm appears a grooved channel, of which the edges gradually rise and fold over towards each other until joining they form a tube,—the primitive alimentary canal. At first nearly uniform, this channel becomes slowly more and more multiform. Near the upper end it bulges so as to form a stomach, while the long lower portion, variously wrapped and convoluted, is differentiated into the small and large intestines. From various parts of the now heterogeneous canal, there bud forth variously-organized secreting glands,—those which make saliva, and those which make gastric juice, bile-cells, pancreatic cells, and intestinal follicles. While from the exterior coat of the endoderm, thus wonderfully transformed, there shoot out, near the upper end, little flower-like buds, which by and by become lungs. In the intermediate or vascular layer, equally notable differentiations simultaneously occur. The vascular channels become distinguished as veins, arteries, and capillaries. "The heart begins as a mere aggregation of cells, of which the inner liquefy to form blood, while the outer are transformed into the walls." Presently the auricle, or chamber which receives blood, is differentiated from the ventricle, or chamber which expels it; and still later a partition-wall divides first the ventricle and afterwards the auricle into two portions—one for the venous, the other for the arterial blood. Along with all these changes, parallel processes, too numerous to be more than hinted at, are going on in the ectoderm. Masses of nitrogenous cells here give rise to muscles, which ramify through the whole interior of the embryo; and there to cartilaginous structures, in which deposits of earthy phosphate, hardening around certain centres, generate bone. The nervous system, first appearing as a mere groove upon the surface of the germinal membrane, finally exhibits an almost endless heterogeneity. First there is the difference between grey and white tissue, of which the first generates the peculiar kind of molecular motion vaguely termed nerve-force, while the latter transmits such motion. Then there are the differences between the nervous centres which, differently bundled together, make up the cerebrum, the cerebellum, the corpora quadrigemina, the medulla oblongata, the spinal cord, and the sympathetic ganglia, each of which aggregates is extremely heterogeneous in itself. And then there are the innumerable differences entailed by the highly complicated connections established between one nervous centre and another, by the inosculations of different sets of nerves with each other, and by the circumstance that some nerves are distributed upon muscles, others upon glands, and others upon ganglia.

These must suffice as examples of differentiation. To go on until we had exhausted the series of differentiations which attend the evolution of a single individual, would be to write the entire history of an organism, and thus to convert our philosophic discussion into a special scientific monograph. That history was long since thoroughly written by Von Baer. Following out hints furnished by Linnæus, K. F. Wolff, Goethe, and Schelling, this illustrious embryologist announced, in 1829, his great discovery that the progressive change from homogeneity to heterogeneity is the change in which organic evolution essentially consists. It was this formula which Mr. Spencer began, some twenty years later, to extend into the universal law of evolution. But, far from having anticipated the essential portion of Mr. Spencer's discovery. Von Baer's formula stands in much the same relation to it in which the speculations of Copernicus stood with reference to the discovery of Newton. Just as Copernicus was essentially in error in maintaining that the planets revolve in circular orbits, Von Baer was essentially in error in considering the process of differentiation as the fundamental characteristic of evolution, as well as in ignoring the process of integration. The whole foregoing exposition has shown, and the entire remainder of the exposition will still further convince us, that the fundamental characteristic of evolution is integration of matter with dissipation of internal motion; and that the change from homogeneity to heterogeneity is but the secondary rearrangement which results wherever the retained motion is great enough to allow it.

Still more, in ignoring the process of integration, Von Baer failed to include in his formula that change from indefiniteness and incoherence to definiteness and coherence, which is equally important with the change from homogeneity to heterogeneity. In the evolution of an organic germ, integration is just as essential a part of the whole process as differentiation. If the latter were alone to take place, the result would simply be a chaotic medley of organs and tissues. Both operations are requisite to produce a system of organs capable of working in concert. And if differentiation goes on, unattended by integration, in any part of the body, disease, and often death, is the result. Cancers and malignant tumours are merely indefinite results of differentiation, which, never becoming integrated into harmony with the rest of the organism, end by maiming and finally destroying it. As Dr. Beale has shown, a cancer is a new variety of cellular tissue, fungoid in character, which grows at the expense of the organism, and eats it up as effectually as a carnivorous enemy could eat it. To employ an instructive metaphor, a cancer is a rebellion within the organism,—a setting up of an independent centre of government,—a fatal interference with the subordination of the parts to the whole. Yet the organism in which a cancer has begun to grow is more heterogeneous than the healthy organism. In like manner the first stages of decomposition increase the heterogeneity of the organism as a whole; but because each new retrograde product follows henceforth a career of its own, free from the control of the organic aggregate, the result is not evolution, but dissolution. The differentiations which occur during the normal growth of the germ, differ from those which constitute cancer and gangrene, alike in their common subordination to the primary process of growth, and in the definiteness of the resulting structures. "In the mammalian embryo, the heart, at first a long pulsating blood-vessel, by and by twists upon itself and integrates. The bile-cells constituting the rudimentary liver, do not simply become different from the wall of the intestine in which they at first lie; but as they accumulate, they simultaneously diverge from it, and consolidate into an organ. The anterior segments of the cerebro-spinal axis, which are at first continuous with the rest, and distinguished only by their larger size, undergo a gradual union; and at the same time the resulting head folds into a mass clearly marked off from the rest of the vertebral column. The like process, variously exemplified in other organs, is meanwhile exhibited by the body as a whole; which becomes integrated somewhat in the same way that an outspread handkerchief and its contents become integrated when its edges are drawn in and fastened to make a bundle." Mr. Spencer, from whom I have quoted this embryologic illustration, goes on to cite parallel instances in the development of lower forms of animal life; a few of which may be here epitomized. In the growth of the lobster from its embryo, a number of calcareous segments, originally separable, become integrated into the compact boxes which envelope the organs of the head and thorax. A similar concentration occurs in the spider, the bee, and the butterfly. In contrast with this, we may profitably observe what goes on in many annuloid worms, where the multiplication of segments by differentiation results in the fission of the animal into two distinct individuals, because the integrating power of the organism is slight.[1] Similarly in the development of the higher crusta-

[1] Here, without prejudice to the general argument, I may call attention to the very ingenious hypothesis propounded by Mr. Spencer, to account for the origin of the annulose or articulated sub-kingdom of animals. According to this hypothesis, any annulose animal is in reality a compound organism, each of its segments representing what was originally a distinct individual. In other words, an annulose animal is a colony or community of animals which have become integrated into an individual animal. Strong *primâ facie* evidence of such a linear joining of individuals primevally separate is furnished by the structure of the lowest annelids. Between the successive segments there is almost complete identity, both internal and external. Each segment is physiologically an entire creature, possessing all the organs necessary for individual completeness of life ; not only legs and bronchiæ of its own, but also its own nerve-centres, its own reproductive organs, and frequently its own pair of eyes. In many of the intestinal worms each segment has an entire reproductive apparatus, and being hermaphrodite, constitutes a complete animal. Moreover in the development of the embryo the segments grow from one another by fission or gemmation, precisely as colonies of compound animals grow. At the outset the embryo annelid is composed of only one segment. The undifferentiated cells contained in this segment, instead of being all employed in the formation of a heterogeneous and coherent structure within the segment, as would be the case in an animal of higher type, proceed very soon to form a second segment, which, instead of separating as a new individual, remains partially attached to the first. This process may go on until hundreds of segments have been formed. Not only, moreover, does spontaneous fission occur in nearly all the orders of the annulose sub-kingdom, but it is a familiar fact that artificial fission often results in the formation of two or more independent animals. So self-sufficing are the parts, that when the common earth-worm is cut in two, each half continues its life as a perfect worm,—as is above observed, in the text. Very significant, too, is the fact that in some genera, as in chætogaster, where the perfect individual consists of three segments, there is formed a fourth segment, which breaks off from the rest and becomes a new animal.

All these facts, together with many others of like implication, point to the conclusion that the type of annulosa has arisen from the coalescence, in a linear series, of little spheroidal animals primevally distinct from one another. How are we to explain, or classify, such a coalescence ? May we not most plausibly classify it as *a case of arrested reproduction by spontaneous fission?* In other words, whereas the aboriginal annuloid had been in the ceans, the parallel chains of ganglia, which constitute the nervous system of the embryo, unite into a single chain.

habit of producing by gemmation a second individual which separated itself at a certain stage of growth, there came a time when such separation became arrested before completion ; so that, instead of a series of independent organisms, the result was a colony of organisms linked together in a linear chain. Let us observe that by this brilliant explanation the origin of the annulose type is completely assimilated to the origin of the lowest animal and vegetal types. The primordial type alike of the vegetable and of the animal, is a single spherical or spheroidal cell, which reproduces itself by spontaneous fission. That is, it elongates until room is made for a second nucleus, after which a notch appears in the cell-wall between the nuclei ; and this notch deepens until the old and new cells are quite separated from each other. Now when many such primordial cells are enclosed in a common membrane, so that, instead of achieving a complete separation, they multiply into a jelly-like or mulberry-like mass, there is formed — whether the case be taken in the animal or in the vegetal kingdom—an organism of a type considerably higher than the simple cell. There is an opportunity for differently conditioned cells comprised in the same mass to become differently modified, and thus to subserve various functions in the economy of the organism. There is a chance for division and combination of labour among the parts. Now the progress achieved when the spheroidal members of an annuloid compound remain partly connected, instead of separating, is precisely similar to this. Among the indubitably compound animals of cœlenterate or molluscoid type, in which the fission is not arrested, it is but seldom that the individuals stand related to one another in such a way that there can be any need of their severally performing diverse and specialized functions. For instance, among the hydrozoa, each member of the compound can get food for itself, can expand or contract its tentacles in any way without affecting the general welfare of the compound. But now, if the members of such a compound as the hypothetical primitive annuloid are grouped in a linear series, there must arise a difference between the conditions which affect the extreme members of the series, and the conditions which affect the intermediate members. And consequently there will ensue an advantage to the compound in the struggle for life, if the members, instead of continuing to perform identical functions separately, become sufficiently united to allow of their performing different functions in concert. Hence we obtain the lowest actual type of annuloid, in which the segments are mere repetitions of each other, with the exception of the extreme front and rear segments, which subserve different functions related to the welfare of the aggregate.

Viewed in this light, the various great classes of the annulose sub-kingdom beautifully illustrate that progressive coordination of parts becoming more and more unlike one another, which is the chief characteristic of Evolution as displayed in the organic world. In very low annelids, such as the intestinal worms, we see hardly any specialization among the parts ; and as we proceed upwards through the lower types, ending with the myriapoda, we meet with a great but varying number of segments, which show but little specialization save in the head and tail. The same is true in general of the larvæ and caterpillars of the higher types. But as we rise to the adult forms of the insect-group—comprising crustaceans, arachnoids, and true insects—we find the number of segments reduced to just twenty. And while this number remains unvarying, the modifications undergone by different seg-

The same kind of integration may be traced in the nervous systems of insects; and the reproductive system of the vertebrata furnishes like instances of coalescence which are so conspicuous that they are now usually made one of the primary bases of classification in this sub-kingdom. The reason why Von Baer overlooked this essential process, is probably to be found in the fact that each secondary integration, resulting in increased definiteness, serves to make the accompanying differentiation still more prominent. The differentiation of lungs, for instance, from the outer coat of the endoderm, becomes marked in proportion as the flower-like buds become integrated into organs of definite contour. But while the two correlative processes go on hand in hand, it is none the less true that they are distinct processes, and that a comprehensive formula of evolution must explicitly describe them both.

In further illustration of this twofold aspect of evolution, we may cite a fact which will by and by be seen to have other important bearings, but which may here serve as a valuable appendix to the foregoing discussion. This is the fact that, in ranking different organisms as high or low in the scale of life, we always proceed chiefly with reference to the degree of heterogeneity, definiteness, and coherence which they exhibit. Those plants and animals which we rank as lowest in the scale are simply cells, like the homogeneous cells from which higher plants and animals are developed. So little specialized are these forms that they do not exhibit even those characteristics by which we ordinarily distinguish

ments in conformity to the requirements of the aggregate are almost endless in variety, the extremes, both of concentration and of specialization, being seen in the ant, the spider, and the crab. In many of the details of this gradual fusion of distinct individuals into a coherent whole, we see the hypothesis interestingly illustrated and justified. In the annelids of low type, each segment has its own spiracles which have no internal communication with one another. On the other hand, in the insect-group there is a complete system of vessels connecting the respiratory systems. While in the intermediate myriapoda we find, as might be expected, a partial communication.

between vegetal and animal life. As we ascend the vegetal scale, we find the ferns and lichens decidedly more heterogeneous than the algæ ; and as we meet with endogens and exogens, we find the increasing heterogeneity accompanied by a definiteness and coherence of structure that is ever more and more conspicuous. Going up the animal scale, we find the annulosa, on the whole, much more heterogeneous, definite, and coherent than the mollusca ; while the vertebrata, on the whole, exhibit these characteristics more strikingly than either of the other sub-kingdoms. The relatively homogeneous and unintegrated polyps are ranked below all of these. Within each group the same principle of classification is universally followed. Contrast the centipede, whose multitudinous segments are almost literally copies of each other, or the earth-worm, which may be severed in the middle and yet live, with the highly differentiated and integrated hive-bee, spider, or crab. Compare the definite and symmetrical contour of the cuttlefish, which is the highest of the mollusca, with the unshapely outline of the molluscoid ascidians. Or, to cite cases from the two extremes of the animal scale, consider first the complicated mammal, whose growth from the embryo we have lately contemplated ; and then turn to the hydra, or freshwater polyp, which is a mere bag of organized matter, digesting with its inner surface and respiring with the outer,—yet so little specialized that, if turned inside out, the digestive surface will begin to respire, and the respirative surface to digest, as imperturbably as if nothing had happened. In short, in a survey of the whole organic world, progress from lower to higher forms is a progress from forms which are less, to forms which are more, differentiated and integrated.

One further point must be noticed before we conclude this preliminary sketch of the process of evolution. The illustrations above given refer almost exclusively to differentiations and integrations of *structure*, or, in other words, to rearrangements of the *matter* of which organic bodies are composed. It remains to be shown how the rearrangements of the *motion* retained by developing organisms exhibit the same characteristics, and manifest themselves as differentiations and integrations of *function*. All organic functions are either molar motions of contractile muscles, or of circulatory fluids, or else they are molecular motions in nerves, or in secreting organs, or in assimilative tissues in general. To show how these various motions become more specialized and more consolidated as the organism is developed, let us briefly reconsider the case of the alimentary canal, whose structural modifications were lately described. The primitive alimentary canal exhibits from end to end a tolerably uniform series of molar motions of constriction. But as the canal becomes more heterogeneous, the molar movements in its different parts simultaneously become more unlike one another. While the waves of contraction and expansion remain constant and moderate throughout the small intestine, they are replaced in the œsophagus by more violent contractions and expansions that recur at longer rhythmical intervals. In the stomach the mechanical undulations are so much more powerful as to triturate the contained food, and their rhythms are differently compounded; while the movements of the mouth are still further specialized in the actions of biting and chewing. In the molecular motions constituting secretion and absorption there is a similar specialization. While absorption is confined chiefly to the area covered by the lacteals, secretion is specialized in various localities—in the salivary glands, in the gastric and intestinal follicles, in the liver, and in the pancreas—and in each place it has acquired a peculiar character. A like increase in heterogeneity and definiteness marks the circulatory movements. In a slightly-evolved animal the nutritive fluid, answering to blood, moves about here and there at seeming random, its course being mainly determined by the local pressure of the tissues. But in a highly-evolved animal, which possesses a well-developed vascular system, the blood runs in definite channels, and with well-marked differences of movement. Its movement is slow and continuous in the capillaries, fast and continuous in the veins, still faster but discontinuous in the arteries; while the rhythms in all are subordinated by the central rhythm of the heart. Still more remarkable, in the most complex organisms, is that kind of functional integration which consists in the mutual dependence of different functions. Neither alimentation nor circulation nor respiration can go on alone; and all three are dependent upon the continuance of nervous action, which in turn depends alike upon each of the three. A few whiffs of tobacco, for example, setting up slight molecular changes in the medulla oblongata, increase the heart's rate of pulsation, and stimulate every one of the alimentary secretions, while it is probable also that, through the medium of the sympathetic ganglia, the sectional area of every artery is slightly altered. The cautious physician, in prescribing a powerful drug, knows that he is dealing with an integration of motions so extensive that the disturbance of any one will alter the directions and composition of all the others to a degree which baffles accurate calculation. Contrasting with such cases as these the homogeneous, indefinite and uncombined movements of those lowest animals, that are borne hither and thither by the vibrations of cilia, it becomes evident that the formula which expresses the structural evolution of matter, expresses also the functional evolution of the motion which the integrating matter retains.

Embracing now in one general view the various kinds of transformation exemplified in the present chapter, we find that our survey of organic development completely justifies Mr. Spencer's technical statement:—"*Evolution is an integration of matter and concomitant dissipation of motion,* *during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity; and during which the retained motion undergoes a parallel transformation.*"[1]

Here, it will be observed, we have obtained a formula which applies not to organic development merely, but to the transformations of Matter and Motion in general. Though we have been led to it solely by the consideration of those organic phenomena which, for reasons already presented, most conspicuously exemplify it, and in connection with which it was first partially generalized by Goethe and Von Baer; yet now that we have arrived at this formula, we find ourselves expressing it in terms that are universal. Instead of a mere law of biology, we have enunciated the widest generalization that has yet been reached concerning the concrete universe as a whole. Having ascertained that in organic aggregates, where the conditions are such as to allow of relatively permanent structural rearrangements, the process of Evolution is characterized by a change from indeterminate uniformity to determinate multiformity, we have assumed that like conditions will everywhere be attended with like results. The law asserts that wherever a relatively permanent system of rearrangements is possible, whether in organic or in inorganic aggregates, the change from indeterminate uniformity to determinate multiformity will be manifested. This leap of inference on Mr. Spencer's part, like the similar leap taken by Newton from the fall of the apple to the motions of the moon, is the daring act which completes the formation of the hypothesis. This grand hypothesis we must now proceed to verify by showing that the widest generalizations severally obtainable in the concrete sciences are included in it, and receive from it their common interpretation. It is to be shown that in the case of sundry inorganic aggregates or

[1] *First Principles*, p. 396.

systems of parts (forming the subject-matter of astronomy and geology), where circumstances not yet recounted permit the retention of a considerable relative motion of parts, the processes of differentiation and integration are quite conspicuously manifested; although, as we might expect, these processes are never carried so far here as in the case of organic aggregates. It will next be shown that the hypothesis is verified, alike by the scanty facts which are at our disposal concerning the genesis of Life, and by the enormous multitude of facts which prove beyond the possibility of doubt that the more complex living creatures have originated by physical derivation from ancestral creatures that were less complex. Next, although—as I have already remarked—the phenomena of Mind are in no sense identifiable with material phenomena, yet as in all our experience there is no manifestation of Mind which is not mysteriously conditioned by movements of matter, we shall find that these super-organic phenomena do not fail to conform to the universal law. It will be shown that the development of conscious intelligence, alike in the individual and in the race, is characterized by the change from indeterminate uniformity to determinate multiformity. The history of the products of conscious intelligence exemplify the same principle; and nowhere shall we find more striking confirmation than is furnished by the phenomena of social progress. By the time we have narrated the results of this vast induction, we shall be convinced that "from the earliest traceable cosmical changes down to the latest products of civilization," the law of organic evolution here expounded is the law of all evolution whatever.

But the universality of this law admits of deductive proof, which may properly be adduced while concluding this chapter, and before entering upon the long course of inductive verification which comes next in order. Already we have seen that the changes which primarily constitute Evolution are necessitated by the rhythm of motion, and therefore indirectly by the persistence of force. We have now to show how the secondary changes, differentiation and integration, are equally necessitated by the same primordial fact.

It is a corollary from the persistence of force, "that, in the actions and reactions of force and matter, an unlikeness in either of the factors necessitates an unlikeness in the effects." When the different portions of any homogeneous aggregate are exposed to the action of unlike forces, or to unequal intensities of the same force, they are of necessity differently affected thereby. Between the unequally exposed parts there arise structural differences, entailing differences of property and function. That which before was homogeneous has become heterogeneous through the appearance of certain unlikenesses; and, under the name of differentiation, the rise of such unlikenesses has already been described. It remains to be observed that such unlikenesses cannot but arise, that differentiation must needs take place, because it is impossible for all the parts of any aggregate to be similarly conditioned with reference to any incident force. Whether it be the mechanical vibrations caused by a blow, the slow undulations constituting heat, or the more rapid undulations constituting light, that are propagated through any body, it equally follows that the respective vibrations will be communicated in different degrees to those particles which are situated on the nearer and on the farther side of the body, and to those particles which are laterally near to or remote from the line followed by the incident force. The different parts will be variously moved, heated, or chemically affected, and a series of differentiations will thus have arisen. We need go no farther than the kitchen, to perceive that the crust formed on a loaf of bread or a joint of roasted meat, is due to the necessarily unequal exposure of outside and inside to the incident force coming in the shape of heat from the walls of the oven. In the impossibility of balancing an accurately made pair of scales, in the equal impossibility of keeping a tank of water free from currents, in the rusting of iron, and in the uneven cooling of a heated metal, is exemplified the principle that the state of homogeneity is an unstable state. Universally the tendency of things, amid the conflict of unlike forces, is toward heterogeneity.

Coincident with the differentiation of aggregates, there is a differentiation of the incident forces. When a moving body is broken up by collision, its original momentum is severed into a group of momenta, which differ both in amount and in direction. The ray of solar light which falls upon the foliage of a tree and upon the wall of the brick building behind it, is separated by reflection into red and green rays, in which the undulations differ both in height and in breadth. Each portion of the differentiated force must in its turn enter as a factor into new differentiations. The more heterogeneous an aggregate becomes the more rapidly must differentiation go on; because each of its component units may be considered as a whole, bearing relations to the other units similar to those which the aggregate bears to other aggregates; and thus the differentiation of the whole must be followed by the differentiation of the parts. There must thus be a multiplication of effects as heterogeneity increases; because, with increasing heterogeneity, the forces which bodies and parts of bodies mutually exert upon each other must become ever more varied and complex in their amounts and directions.

We may see, therefore, that differentiation is a necessary consequence of the fundamental relations of matter and motion. And the same is true of that secondary integration or union of like units, which serves to render differentiation more conspicuous by substituting a demarcated grouping for a vague one. Considering what happens when a handful of pounded sugar, scattered before the breeze, falls here and there according to the respective sizes of the fragments,—we perceive that the units which descend in company are those of equal size, and that their segregation results from their like relations to the incident force. The integration of several spinal vertebræ into a sacrum, as the result of exposure to a continuous strain in the same direction, is a still better example; and from the phenomena of morphological development many parallel cases might be cited. Wherever different parts of any group of units stand in different relations to an incident force, differentiation must result; and wherever any sub-group of these units, after becoming unlike the rest, is acted on by a common force, the result must be the integration of the sub-group. But manifestly the primary process of consolidation cannot long go on in any aggregate, without bringing sundry groups of units into dissimilar relations to adjacent groups; nor can it long go on without subjecting each group, thus differentiated, to a predominant force exerted by the totality of the companion-groups. Hence the change from indefinite incoherent homogeneity to definite coherent heterogeneity must accompany the integration of matter; and no alternative conclusion can be reached without denying the persistence of force.

I am aware that scanty justice is here done to the arguments by which, in three interesting chapters, Mr. Spencer establishes this deductive conclusion. But since the brief exposition here given is not intended as a substitute for the study of Mr. Spencer's treatise, but rather as a commentary upon it, his position has been perhaps sufficiently indicated.

We are now prepared to study with profit some of the phenomena presented by the past history of our planetary system. In the evolution of the sun, with his attendant planets and satellites, from a vast primeval mass of vapour, we shall be called upon to witness a grand illustration not only of that integration of matter and concomitant dissipation of motion which is the fundamental characteristic of Evolution in general, but also of that change from indefinite and incoherent homogeneity to definite and coherent heterogeneity which is its most striking derivative feature.

## CHAPTER V.

### PLANETARY EVOLUTION.

AMONG the notable phenomena presented by the structure of our planetary system, there are some which have become so familiar to us that we commonly overlook them altogether, and through sheer inattentiveness fail to realize their significance. For example, all the planets revolve about the sun in the same direction, which coincides with the direction of the sun's own rotation upon his axis. All the planets, moreover, revolve in planes which are but slightly inclined to the plane of the sun's equator. Satellites conduct themselves similarly with reference to their primaries. Every satellite revolves about its primary in the direction of the primary's axial rotation, and in a plane but little inclined to the plane of the primary's equator. Again, with the single interesting exception of Uranus—and possibly also of Neptune—all the planets, as well as the sun, rotate upon their axes from west to east, in the same direction with their orbital revolutions. And lastly, all the planets, both primary and secondary, move in elliptical orbits of small or moderate eccentricity.

We are so accustomed to acquiesce in these facts, as if they were ultimate, that we seldom stop to consider them in their true light, as unimpeachable witnesses to the past history of the solar system. Yet as Laplace has shown, it is practically impossible that such harmonious relations should hold between the various members of the solar system, unless those members have had a common origin.

The clue to that common origin may be sought in facts which are daily occurring before our very eyes. Every member of our planetary system is constantly parting with molecular motion in the shape of heat. Our earth is incessantly pouring out heat into surrounding space; and, although the loss is temporarily made good by solar radiation, it is not permanently made good,—as is proved by the fact that during many millions of years the earth has been slowly cooling. I do not refer to the often-cited fact that the Arctic regions were once warm enough to maintain a tropical vegetation; for this high temperature may well have been due to minor causes, such as the greater absorptive power of the ancient atmosphere with its higher percentage of carbonic acid and ozone. Nor need we insist upon the alleged fact that extensive glaciation appears to have been unknown until a comparatively late epoch; although glaciation, whether brought about by changes in the distribution of land and sea or by a variation in the eccentricity of the earth's orbit, certainly does seem to imply a progressive dependence of the earth upon the supply of solar heat, due to the lowering of its own proper temperature. Such facts, however, are wholly inadequate to describe the primitive heat of the earth. The flattening of the poles being considerably greater than could have been produced by the rotation of a globe originally solid on the surface, it follows that the whole earth was formerly fluid. And this conclusion, established by dynamical principles, is uniformly corroborated by the observed facts of geology. Now the fluidity of the entire earth, with its rocks and metals, implies a heat sufficient to have kept the planet incandescent, so that it must have shone with light of its own, like the stars. Similar conclusions are indicated by the observed geologic features of Mars and Venus; and in the case of the moon we shall presently see what a prodigious loss of heat is implied by the fact that the forces which once upheaved its great volcanoes are now quiescent. The sun, too, is pouring away heat at such a rate that, according to Sir John Herschel, if a cylinder of ice 184,000 miles in length and 45 miles in diameter were darted into the sun every second, it would be melted as fast as it came. Or, as Mayer has calculated, the amount of heat lost every minute by the sun would suffice to raise the temperature of thirteen billion cubic miles of water one degree Centigrade. Although this prodigious loss is perhaps partly compensated by heat due to the arrested motion of meteors falling upon the sun's surface, yet it is by no means probable that it is in this way compensated to any noteworthy extent. It is in every way indisputable that from time immemorial sun, moon, and earth, as well as the other members of our system, have been parting with their internal motion, in the shape of heat radiated into surrounding space.

Thus in the history of our planetary system we may already begin to witness that dissipation of motion which has been shown to be one of the prime features of the process of Evolution, wherever exemplified. But, as we have also seen, the dissipation of motion is always and necessarily accompanied by the concentration of matter. It is not simply that, with two or three apparent exceptions, which have no bearing upon the present argument, all cooling bodies diminish in size and increase in density; but it is also that all contracting bodies generate heat, the loss of which, by radiation, allows the process of contraction to continue. In any contracting mass the particles which tend toward the common centre have their molar motions constantly opposed by friction upon each other, and most of the motion thus arrested is converted into heat. If this heat is lost by radiation as fast as it is thus generated, the contraction of the mass will go on unceasingly. It is in this way that physicists now account for the internal heat of the sun and the planets. A diminution of the sun's diameter by the amount of twenty miles could not be detected by the finest existing instruments; yet the arrest of motion implied in this slight contraction would generate enough heat to maintain the present prodigious supply during fifty centuries. And in similar wise the internal heat of the earth during a given moment or epoch must be chiefly due to that very contraction which the radiation of its heat during the preceding moment or epoch has entailed.

The generation of all this heat, therefore, which sun and planets have from time immemorial been losing, implies the transformation of an enormous quantity of molar motion of contraction. It implies that from time immemorial the various members of our planetary system have all been decreasing in volume and increasing in density; so that the farther back in time we go, the larger and less solid must we suppose them to have been. This is an inevitable corollary from the companion laws that contracting bodies evolve heat, and that radiating bodies contract.

Obviously, therefore, if we were to go back far enough, we should find the earth filling the moon's orbit,[1] so that the matter now composing the moon would then have formed a part of the equatorial zone of the earth. At a period still more remote, the earth itself must have formed a tiny portion of the equatorial zone of the sun, which then filled the earth's orbit. At a still earlier date, the entire solar system must have consisted simply of the sun, which, more than

[1] It is not presumed, however, that the moon's orbit was originally so large as at present. For by its tidal action upon our oceans the moon exerts a drag upon the earth's rotation, and the motion thus lost by the earth is added to the moon's tangential momentum, thus increasing the dimensions of its orbit. A precisely similar qualification is needed for the two next-succeeding statements in the text.

filling Neptune's orbit, must have consisted of diffused vaporous matter, like that of which the irresolvable nebulæ have recently been proved to consist. Now in the slow concentration of the matter constituting this solar nebula, as both Kant and Laplace have elaborately proved, the most prominent peculiarities of the solar system find their complete explanation. Supposing the sun to have been once a mass of nebulous vapour, extending in every direction far beyond the present limits of the solar system, these thinkers proved that the mere contraction of such a mass must inevitably have brought about just the state of things which we now find. Let us observe some of the processes which must have taken place in this nebulous mass.

Note first that we are obliged to accredit the various parts of this genetic nebula with motions bearing some reference to a common centre of gravity; for the rotation of the resulting system must have had an equivalent amount of motion for its antecedent, and it is a well-known theorem of mechanics that no system of bodies can acquire a primordial rotation merely from the interaction of its own parts. In making this assumption, however, we are simply carrying out the principle of the continuity of motion. It is not necessary to suppose, in addition, that all these motions primordially constituted a rotation of the whole mass in one direction. Such a hypothesis seems to me not only gratuitous, but highly improbable. It is more likely that these primeval motions took the shape of currents, now aiding and now opposing one another, and determined hither and thither according to local circumstances. In any case, such indefiniteness of movement must finally end in a definite rotation in one direction. For unless the currents tending eastward are exactly balanced by the currents tending westward—a supposition against which the chances are as infinity to one—the one set must eventually prevail over the other. And after some such manner as this our solar nebula must have acquired its definite rotation from west to east.

Let us next observe the mechanical consequences of this rotation. No matter what may have been the primitive shape of the nebula—and, if we may judge from the analogy of irresolvable nebulæ now existing, it may very likely have been as amorphous as any cloud in a summer sky—no matter what its primitive shape, it must at last inevitably assume the form peculiar to rotating bodies in which the particles move freely upon each other. It must become an oblate spheroid, flattened at the poles and bulging at the equator, because at the equator the centrifugal tendency generated by rotation is greatest. Furthermore as the mass contracts, it must rotate faster and faster; for as the total quantity of rotation is unalterable, the velocity must increase as the space traversed diminishes.

In accordance with these principles of mechanics, as our solar nebula continued to radiate heat and contract, it continued to rotate with ever-increasing velocity, its poles became more and more flattened, and its equatorial zone protruded more and more, until at last the centrifugal tendency at the equator became greater than the force of gravity at that place. Then the bulging equatorial zone, no longer able to keep pace with the rest of the mass in its contraction, was left behind as a detached ring, girdling, at a small but steadily increasing distance, the retreating central mass.

What must now have been the career of this detached ring? Unless subjected to absolutely symmetrical forces in all directions—an infinitely improbable supposition—such a ring must forthwith break into a host of fragments of very unequal dimensions. For in order that it should break into equal-sized fragments, the strains exerted upon it must be disposed with absolute symmetry; and against this supposition also the probabilities are as infinity to one. It would break, much as a dish breaks when dropped on the floor, into hundreds of fragments, of which some few would be relatively large, while the numerous small ones would vary endlessly in their sizes. At this stage, then, instead of a continuous ring, we have a host of satellites, surrounding the solar equator, revolving in the direction of the solar rotation, and following each other in the same orbit. If undisturbed by any powerful attraction from without, these fragments would continue in the same orbit, and would gradually differ more and more in their velocities. Each large fragment would, by its gravitative force, retard the smaller fragment in front of it, and accelerate the smaller fragment behind it, until at last two or three fragments would catch up with each other and coalesce. Thus, in the earliest case known to us,—that of the planet Neptune,[1]—this process went on until all the fragments were finally agglomerated into a spheroidal body, having a velocity compounded of the several velocities of the fragments, and a rotation made up of their several rotations.

Meanwhile the central mass of the vaporous sun continued to radiate heat and to contract, until, when its periphery came to coincide with what is now called the orbit of Uranus, its centrifugal force at the equator again showed an excess over gravity, and a second equatorial belt was left behind; and this belt, breaking up and consolidating, after the manner above described, became the planet Uranus. In like manner were formed all the planets, one after another; and from the detached equatorial belts of the cooling and contracting planets, were similarly formed the satellites.

A very curious physical experiment, devised by M. Plateau, strikingly illustrates the growth of our planetary system from

[1] It is not strictly impossible that there may be one or two planets exterior to Neptune, and therefore earlier in formation. Supposing the distances of such planets to conform, even as imperfectly as in Neptune's case, to the law f Titius, these distances must be so enormous as to prevent our readily discovering the planets, either directly by observation, or indirectly, by inference from possible perturbations of Neptune's movements.

the solar nebula. M. Plateau's experiment consists in freeing a fluid mass from the action of terrestrial gravity, so that its various parts may be subject only to their own mutual attractions; and then in imparting to this mass an increasingly rapid movement of rotation. A quantity of oil is poured into a glass vessel containing a mixture of water and alcohol, of which the lower strata are heavier than the oil, while the upper strata are lighter. The oil, when poured in, descends until it reaches the stratum of the same density with itself, when being freed from the action of terrestrial gravity, and subjected only to the mutual attraction of its own molecules, it assumes a spherical form. By an ingenious mechanical contrivance, M. Plateau now causes the sphere of oil to rotate about its own centre of gravity. While the movement is slow, the excess of centrifugal force at the equator of the oil-globe causes a bulging of the equator and corresponding flattening of the poles, like that observed in the sun and in all the planets. From a sphere the oil-globe becomes a "spheroid of rotation." If now the movement is considerably accelerated the equatorial portion of the oil-globe becomes detached, and surrounds the central sphere of oil in the shape of a nearly circular ring, like Saturn's ring-system. Finally, if the movement is kept up for a sufficient length of time, the oil-ring breaks into fragments, which revolve like satellites about the oil-globe, and each of which keeps up for a time its own movement of rotation in the same direction with the revolution of the ring.

The common origin of the planets from the sun's equator, as thus strikingly illustrated, explains at once the otherwise inexplicable coincidence of their rotations, their revolutions, and their orbital planes. At a single glance we see why the planetary orbits are always nearly concentric and nearly in a plane with the solar equator; and we see that, since the sun must always have rotated, as at present, from west to east, the planets formed from him must have kept up a revolution, and acquired a rotation, in the same direction.

Such is the grand theory of nebular genesis, first elaborated with rare scientific acumen by Kant in 1755, and afterwards independently worked out by Laplace in 1796. The claims of this theory to be regarded as a legitimate scientific deduction have been ably stated by Mr. Mill, in his "System of Logic," book iii. chapter xiv. As we are there reminded, "there is in this theory no unknown substance introduced on supposition, nor any unknown property or law ascribed to a known substance." Once grant that the sun and planets are cooling bodies, the inference is unavoidable that the matter which composes them was formerly much more rare and diffused than at present. If we are to infer the sun's past condition from its present condition, we must necessarily suppose that its constituent matter once occupied much more space than at present, "and we are entitled to suppose that it extended as far as we can trace effects such as it might naturally leave behind it on retiring; and such the planets are." The abandonment of successive equatorial zones by the shrinking solar nebula follows from known mechanical laws; and the subsequent breaking up of each zone, and the consolidation of its fragments into a planet, are processes which similarly involve none but established dynamical principles. It equally follows, from elementary laws of mechanics, that the planets thus formed would revolve and rotate both in the directions and in the planes in which they are actually observed to revolve and to rotate. There is thus, observes Mr. Mill, nothing gratuitous in Laplace's speculation: "it is an example of legitimate reasoning from a present effect to a possible past cause, according to the known laws of that cause."

But the evidence in favour of the theory of nebular genesis is not restricted to these general coincidences between observation and deduction. Many striking minor details in the structure of the solar system, otherwise apparently inexplicable, are beautifully explained by the theory of nebular genesis. Let us first consider a case which would appear to be an obstacle, not only to this, but to any other frameable theory. We have already hinted that Uranus, while revolving in the same direction with the other planets, has a backward rotation, so that to an observer placed upon Uranus the sun would seem to rise in the west and set in the east. His moons revolve about him in the same retrograde direction; and his axis, instead of standing at a great angle to his orbit-plane, as is the case with all the nearer planets, lies down almost upon the orbit-plane. It has been asserted that these peculiarities are also manifested by Neptune; though our opportunities for observing the latter planet are so few that this point cannot yet be regarded as established. Why now should such exceptional phenomena be manifested in the case of either or both of these outermost planets? In his essay on the Nebular Hypothesis, Mr. Spencer has shown that these phenomena may be explained by a reference to the shape of the rings from which the outermost planets were formed. When the solar nebula was so large as to fill the orbit of Neptune, its rotation must have been slower, and its figure consequently less oblate, than at later stages of contraction. Now the ring detached from a very oblate spheroid, which bulges greatly at the equator, must obviously be shaped like a flat quoit, as is the case with Saturn's rings; while conversely the ring detached from a spheroid which bulges comparatively little at the equator, will approximate to the shape of a hoop. Hence the rings which gave rise to Neptune and Uranus, having been detached before the solar nebula had attained the maximum of oblateness, are likely to have been hoop-shaped; and when we consider the enormous circumferences occupied by these rings, compared with the moderate sizes of the resulting planets, we see that they must have been very thin hoops. Now in such a hoop the angular velocities of the inner and outer surfaces respectively will be nearly equal, and the planetary mass into which such a hoop concentrates will have its greatest diameter at right angles (or nearly so) to the plane of its orbit; so that its tendency to rotate in the line of its revolution will be so slight as to be easily overcome by any one of a hundred possible disturbing circumstances. Without feeling required to point out the precise nature of such circumstances, we may readily see that, in the case of the outermost planets, the causes which ordinarily make the rotation coincide with the line of revolution were at their minimum of efficiency. So that the retrograde rotation of Uranus, though not perhaps actually implied by the hooped shape of its ancestral ring, is at any rate quite in accordance with it.

I cite this example, not merely on its own account, but also by reason of the further disclosures to which it leads us. Whatever may be thought of the special interpretation just cited, there is no doubt that Mr. Spencer's conception of hoop-shaped and quoit-shaped rings points to a notable series of harmonies among the phenomena of the solar system. Observe, first, that according to the theory, the outer planets ought in general to be much larger than the inner planets; and for a very simple reason. The ancestral rings which coincided with the immense orbits of Uranus and Neptune must of course have been larger than the ancestral rings which coincided with the smaller orbits of Mars and the earth. A ring, for example, which is seventeen thousand millions of miles in circumference may be expected to contain more matter than a ring which is less than six hundred millions of miles in circumference; and hence we may understand why Neptune contains at least sixteen times as much matter as the earth.

But this, though significant, is not a complete explanation; for as the case now stands, it would seem as if there ought to be a regular gradation in the sizes of the planets. Not only ought Mercury to be the smallest, but Neptune ought to be the largest. The facts, however, do not accord with this view. The four outer planets are indeed much larger than the four inner ones. But of the inner group the largest is not Mars, but the earth; while in the outer group we find Jupiter three-and-a-half times as large as Saturn, which in turn is seven times larger than Uranus. Now the key to these apparent anomalies must, I think, be sought in the shapes of the rings from which the planets were respectively formed. Neptune and Uranus, formed from very thin hoop-like rings, at a period when the solar equator protruded but slightly, are indeed large planets, but not so large as would be inferred from the size of their orbits alone. But as the solar nebula continued to contract, its increasing equatorial velocity rendered it more and more oblate in figure, so that the rings next detached were quoit-shaped. Hence the resulting planets not only had their major diameters but little inclined to their orbit-planes, but they were also larger in size. The very broad quoits which gave rise to Jupiter and Saturn may well have contained more than fourteen times as much planetary matter as the extensive but slender hoops which formed the two oldest planets. If instead of looking at the sizes of the resulting planets, we consider the thicknesses of the genetic rings, as determined by comparing the size of a planet with the size of its orbit, we shall see that, from Neptune to Jupiter, there was a regular increase in the thickness of the rings, such as the theory might lead us to anticipate.

But now after the separation of Jupiter from the parent-mass, we encounter a break in this series of phenomena. The thickness of the detached rings sinks to a minimum in the case of the asteroids, and then steadily increases again until in Mercury there is once more an approach to the quoit-shape. Observe the curious sequence of facts, which hitherto, so far as I know, has never been noticed by any of the writers who have treated of the nebular hypothesis. Since the mass of Mercury is four-fifths that of Venus, while the circumference of his orbit is about one-half that of the orbit of Venus, it follows that his ancestral ring must have been much thicker than that of Venus. Again, the earth is but little larger than Venus, while the circumference of its orbit exceeds that of the latter nearly in the ratio of five to three, so that it must have originated from a thinner ring. Mars, with an orbit exceeding the earth's in the ratio of eight to five, and containing but one-eighth as much planetary matter as the earth, must have been formed from a still thinner ring. And since the asteroids, if all piled together, would not make a planet as large as Mars,[1] while they move through a very much greater orbit, it follows that their parent-ring must have been the thinnest of all. In marvellous conformity to this general statement, it also happens that the inner planets rotate in planes which diverge more widely from their orbit-planes than in the case of Jupiter and Saturn, though less widely than in the case of Uranus and Neptune.[2] And lastly let us note that the velocities of the planetary rotations supply

[1] It may be objected that we have probably not yet discovered all the asteroids. Those not yet discovered, however, must obviously be so small that the addition of them to the aggregated mass of those already known would not materially affect the truth of my statement.

[2] Curiously enough, if we examine the different systems of satellites, we find a similar general contrast in size between the members of outer and inner groups. The two outer satellites of Jupiter are much larger than the two inner ones ; and the same relation holds between the four acknowledged satellites of Uranus ; while of the eight Saturnian satellites, the four outer ones seem to be decidedly larger than the four inner ones. Moreover the largest of Jupiter's moons is not the outermost, but the third ; and of Saturn's moons the largest is not the eighth, but the sixth. To these interesting facts which Mr. Spencer has pointed out, I will add one which he has not observed. If instead of looking at the sizes of the moons, we consider the thicknesses of their genetic rings, as determined by comparing the size of a moon with the size of its orbit, we find in the Jovian system a regular increase in the thickness of the rings, from the outermost to the innermost. Similar evidence from the Saturnian system is not yet forthcoming, since the masses and even the volumes of Saturn's moons have not yet been determined with sufficient accuracy for this purpose. And concerning the Uranian system our knowledge is still more inadequate. It will be observed, however, that even the facts here fragmentarily collated point clearly to some

further confirmation; for "other things equal, a genetic ring that is broadest in the direction of its plane will produce a mass rotating faster than one that is broadest at right angles to its plane"; and accordingly Jupiter and Saturn, originating from relatively quoit-shaped rings, rotate very swiftly; while all the inner planets, originating from relatively hoop-shaped rings, rotate with much less rapidity.

Here we may profitably consider the singular instance in the history of the solar system in which a detached ring has failed to become integrated into a single planetary mass. Everyone remembers how, in accordance with the law of Titius concerning planetary intervals, Kepler was led to predict the existence of a planet between Mars and Jupiter; and how, at the beginning of the present century, not one only, but four such planets, were suddenly discovered. More than a hundred of these little bodies have now been detected, and each year adds new names to the list. The four earliest observed—Vesta, Juno, Ceres, and Pallas—are of respectable dimensions; Pallas having a diameter of 600 miles, or more than one fourth the diameter of our moon. Most of the others are quite tiny, the smallest having a surface perhaps not larger than the state of Rhode Island. Not only do they occupy the position which would normally belong to a single planet between Mars and Jupiter, but it is hardly questionable that they have all originated from a single ring; for their orbits are interlaced in such a complicated way that, if they were material rings instead of ideal lines in space, it would be possible to lift them all up by lifting any one of them. Why should just one of the solar rings have failed to develope into a single planet, and why should such an arrest of development have occurred in just this part of the solar system?

common mode of genesis for both planets and satellites; and are likely, when completely generalized, to yield important testimony in behalf of the nebular theory.

According to Olbers, the discoverer of Pallas and Vesta, this is not a case of arrested development, but these little bodies are merely the fragments of an ancient well-developed planet, which has been in some way exploded. But this hypothesis, though countenanced by Mr. Spencer, seems to me unsatisfactory. In Mr. Spencer's essay, it is closely connected with the hypothesis of a gaseous nucleus for all the planets, which, though there ingeniously elaborated, seems to me as yet too doubtful to serve as a basis for further explanations. And even granting the hypothesis, it would be necessary further to show why in this planet alone the outward pressure of the gaseous nucleus should have overcome the resistance of the solidified crust. I believe that the problem is much nearer a solution when we treat it as a case of arrested development; for on this view the peculiar fate of the ancestral ring may be at least partially explained by a reference to the perturbing attraction exerted upon it by Jupiter.

When we reflect upon the immensity of the distances which separate the outer planets from each other, even in conjunction, we perceive that during the earlier stages of nebular contraction no planet was in danger of being disturbed in its formation by the attraction of its next outer neighbour and predecessor. But as the increasing equatorial protuberance of the solar spheroid began to result in the formation of larger and larger planets, and as the formation of planets began, according to the law of Titius, to occur at shorter and shorter intervals, there began to be some danger of such disturbance. There was no chance for a catastrophe, however, until the time when the asteroid-ring was detached. The enormous Jupiter-ring was at least 370,000,000 miles removed from Saturn, besides which its huge mass, implying powerful gravitative force among its constituent parts, served further to insure its equilibrium. Hence it ran little risk of incurring disaster in the course of its planetary development.

It was otherwise with the ancestral ring of the asteroids. This thinnest and weakest of rings started on its independent career at a distance of only 240,000,000 miles from Jupiter, the planet whose gravitative force is more than twice that of all the other planets put together. Under such circumstances it would seem impossible that a planet could be formed. The asteroid-ring must have been liable to rupture, not only from the causes which affect all planet-forming rings alike, but also from the strain exerted upon it, now in one part and now in another, by Jupiter's attraction. The fragments of a ring, torn asunder by such a cause, would not continue to occupy the same orbit; they would be dragged from the common path in various directions and to various distances, according to the ever-changing position of the disturbing body. Henceforward, instead of chasing directly on each other's heels, they would rush along in eccentric, continually intersecting paths, and there would thus be no opportunity for consolidation, except in the case of two fragments meeting each other at the intersection of their orbits. As a final result we should have, not one good-sized planet, but a multitude of tiny planets, with intersecting orbits exhibiting great differences in eccentricity. All this is true of the group of asteroids. While the mean breadth of the ideal zone occupied by their orbits is about 100,000,000 miles, its extreme breadth reaches 250,000,000 miles. While the orbit of Europa is more nearly circular than any of the orbits of the true planets, on the other hand the orbit of Polyhymnia attains an almost cometary eccentricity, the difference between its perihelion and aphelion being nearly 200,000,000 miles.

There is one other circumstance, however, which my hypothesis thus far fails to explain. While the true planets revolve in planes but slightly inclined to the ecliptic—the orbit of Mercury showing an inclination of about seven degrees as the maximum instance—the asteroids, on the contrary, revolve in planes of quite various degrees of inclination, the orbit of Pallas rising above the ecliptic at an angle of thirty-four degrees. As the disturbing attraction of Jupiter, however various in direction, would seem to have been exerted wholly in one plane, I am unable to account for this diversity of inclinations. Yet in spite of this shortcoming in the hypothesis—which might perhaps be removed by some one more thoroughly conversant with dynamics—all the other circumstances in the case point unmistakeably to the forcible rupture of the genetic ring by the attraction exerted by Jupiter; and thus it would seem that, just when such an untoward event in the history of the solar system might have been expected to occur, it did occur.

Supposing this explanation to be sound in principle, it is quite easy to show why such an event has not occurred subsequently. The next ring—the one which gave rise to Mars—must have been more than twice as thick as the genetic ring of the asteroids, and consequently better fitted to resist a strain from without. And, moreover, being 115,000,000 miles farther removed from Jupiter, the latter planet could exert upon it only four-ninths of the disturbing force which it had exerted upon the asteroid-ring. Thus the Mars-ring was permitted to develope into a planet. In turn, the small size of Mars prevented him from exerting any disastrous perturbing force upon the ring which gave rise to the earth, though his distance from that ring could not have exceeded 50,000,000 miles. A simple computation will show that Mars could exert upon the earth-ring not much more than one-hundredth part of the attraction exercised by Jupiter upon the ancestral ring of the asteroids. On the other hand, had the mass of Mars been one twenty-fifth as great as that of Jupiter—that is, thirteen times as great as the mass of the earth—he might have prevented the formation of the planet on which we live. And had the mass of Mars been equal to that of Jupiter, he might have dealt destruction to all the planetary rings subsequently detached between himself and the present solar surface. The earth, Venus, and Mercury would in such a case have been represented by a triple zone of asteroids, revolving in more or less eccentric orbits, and the portions of planetary matter which constitute the German armies beleaguering Paris might to-day[1] have been peacefully whirling in space, ten million miles removed from the portions which constitute the starving population of that unhappy city.

Joining together all the foregoing considerations, we have a most interesting array of facts, which I believe have not hitherto been contemplated in connection with one another. Though in the sizes of the planets, superficially regarded, we find no conspicuous symmetry of arrangement, yet in the thickness of the genetic rings, as obtained by a legitimate process of inference, we find a symmetry of disposition that is striking and suggestive. From Neptune to Jupiter we find a progressive increase in thickness that is entirely in conformity with the nebular hypothesis. From the asteroids to Mercury there is a similar progressive increase which is similarly in entire harmony with the hypothesis. And in the only group of satellites concerning which we have adequate data, there is observed a parallel phenomenon. But in the solar system there is a conspicuous break in the uniformity of succession; and this break curiously occurs just at the place where, according to the most plausible supposition, there was an arrest or failure in the normal formation of a planet. I have partially succeeded in tracing this arrest or failure to the immediate effects wrought by the mere proximity and gigantic size of the planet just preceding in the order of detachment. Whether it can be shown that this cause, which well-nigh accounts for one of this group of phenomena, will account in some analogous way for the whole group; whether it can be shown that the detachment of this gigantic mass may have altered the dynamic relations

[1] That is, in December, 1870.

of the central spheroid in such a way as to reduce to a minimum its power of eliminating further rings; I will not pretend to say. It seems to me better to leave the problem with this clear and definite statement, rather than to encumber it with hypothetical explanations which are quite likely to prove purely gratuitous. Of the various explanations which have occurred to me, none seem at all satisfactory; and I will gladly resign, into abler hands, the task of solving the problem. What we may regard, however, as fairly established, is this: that while, after the formation of Jupiter, the detachment of rings followed the same law of progression as before, there was nevertheless some newly-introduced circumstance present which affected the whole series of detachments in common. But while the non-explanation of this newly-introduced circumstance leaves a serious gap in the argument, it is to be noted that all the facts, so far as collated, are in harmony with the nebular hypothesis,—the existence of the zone of asteroids, in particular, furnishing powerful evidence in its favour.

If we pass from this complicated problem to the much simpler one of the distribution of the satellites, we shall find evidence in behalf of nebular genesis so remarkable as almost to amount to demonstration. Whoever has read the favourite speculations of theologians concerning the "plurality of worlds," will doubtless remember how strikingly the divine goodness is illustrated in the law that in general the remoter planets have the greater number of satellites. Here however, as in so many cases, observes Mr. Proctor, "the scheme of the Creator is not so obvious to human reasoning as some have complacently supposed." The "contrivances" for lighting Saturn are by no means what they ought to be, according to this teleological hypothesis. The illuminating power of our moon is (from its greater proximity to the sun) sixteen times greater than that of all the eight moons of Saturn combined; while if that planet were habitable, his rings would prove a formidable nuisance. Mr. Proctor has shown that, in latitudes corresponding to that of New York and Naples, they cause total eclipses of the sun, which last seven terrestrial years at a time. But the problem which natural theology thus fails to solve, is completely solved by a very simple mechanical consideration. Since the detachment of a moon-forming ring from a contracting planet depends on the excess of centrifugal force over gravity at its equator, it is evident that rings will be detached in greatest numbers from those planets in which the centrifugal force bears the highest ratio to gravitation. Such planets will have the greatest number of moons. And such, in fact, is the case. Of the four inner planets, which rotate slowly, and in which the centrifugal force is therefore small, only the earth is known to have a satellite.[1] But Jupiter, whose centrifugal force is twenty times greater than that of any of the inner planets, has four satellites. Uranus, with still greater centrifugal force, has at least four, and probably six or eight moons. And finally Saturn, in which the centrifugal force is one-sixth of gravity, being nearly fifty times greater than on the earth, has at least eight moons, besides his three unbroken (or partly-broken) rings. Mr. Spencer may well declare that this emphatic agreement of observation with deduction is an unanswerable argument in favour of the nebular theory. Here, where the dynamic relations involved are so simple that we have no difficulty in tracing them, the significance of the result is unmistakeable. Where we are enabled thus directly to put the question to Nature, there is no ambiguity in her answer.

In the quoit-shaped rings which girdle Saturn, we have a curious vestige—upon the significance of which Kant strongly insisted—of the ancient history of our planetary

[1] It is not improbable that Venus may have a satellite also. Several astronomers have declared that they have seen such a satellite; but as their testimony seems difficult to reconcile with that of other astronomers, equally competent as observers, the question must remain an open one for the present.

system. So great has been the centrifugal force upon Saturn, due to his rapid rotation and small specific gravity, that the detachment of rings would seem to have gone on after the surface of the planet had assumed the liquid state; and whether the rings thus formed be now continuous, or (as is far more probable) discontinuous, they have obviously had a much better chance of preserving their equilibrium than the ordinary vaporous moon-forming rings. The dynamics of the Saturnian system still present many difficult questions; but the fact that Saturn is the one planet which is still girdled by rings that are apparently-continuous, is a very powerful argument in favour of the nebular hypothesis.

But the evidence does not end with these mechanical illustrations. In the present physical condition of the various planets, so far as it can be determined, we shall find further corroborative testimony. It is a corollary from the nebular hypothesis that all the planets, having successively originated from the same vaporous mass, must be composed in the main of similar chemical elements; and this inference has thus far been uniformly corroborated by spectroscopic observation wherever there has been an opportunity to employ it. Hence it follows that the process through which the earth has passed in contracting to its present dimensions has been, or will be, repeated to a certain extent upon all the other planets. Upon any planet there must eventually occur a solidification of the crust, an extensive evaporation and precipitation of water, an upheaval of mountains, an excavation of river-beds, and a deposit of alluvium, resulting in sedimentary strata. But obviously the time at which these phenomena occur must depend, not merely upon the antiquity of the planet, but also upon the rate with which it parts with the heat generated during its contraction. Since the outer planets are so much older than the inner ones, it might at first be supposed that they must have progressed much further in consolidation. But against this must be offset the consideration that the ratio of volume to mass is likely to have been from the first very much greater in the case of the earlier planets than in the case of the interior ones, since formed from a denser sun. Even now the high ratio of volume to mass is one of the most striking characteristics of the four outer as compared with the four inner planets; and as bulky bodies radiate heat much more slowly than small ones, it may well be that this relatively small density indicates the retention of a relatively great amount of molecular motion. Of all the factors in the case, bulk is undoubtedly the most important. Just as the hot water in the boiler may remain warm through a winter's night, while the hot water in the tea-kettle cools off in an hour, so a great planet like Jupiter may remain in a liquid molten condition long after a small planet like the earth, though formed ages later, has acquired a thick solid crust and a cool temperature. Hence in a general survey of the solar system we may expect to find the largest planets still showing signs of a heat like that which formerly kept the earth molten, and we may expect to find the smallest planets in some cases showing signs of a cold more intense than any which has been known upon the earth.

Now this series of inferences, constituting simply an elaborate corollary from the theory of nebular genesis, is fully confirmed by observation in the cases of Saturn, Jupiter, Mars, and the Moon,—the only planets whose surfaces have been studied with any considerable success. According to the nebular hypothesis, Jupiter and Saturn ought to be prodigiously hot; and so they appear to be when carefully examined. The tremendous atmospheric disturbances observed upon both these planets are such as cannot well be explained by the comparatively sluggish action of the sun's radiance upon such distant orbs. The atmosphere of Jupiter is laden with masses of cloud, whether composed solely of water or not, whose cubic contents far exceed those of all the oceans on the earth. The trade-winds, due to the swift rotation of the planet, gather these enormous masses into belts parallel with its equator. Storms and typhoons are incessantly raging in this vapour-laden atmosphere; and the forces at work there are so stupendous that dense cloud-belts, thousands of miles in width, are often formed in a single hour. This state of things is not like that which is now witnessed upon the earth's surface; it is more like the state of things observed upon the sun, where tornadoes continually occur, in which the earth, if it were there, would be whirled along like a leaf in an equinoctial gale. A similar state of things must have existed, in miniature, upon our own planet, in that primitive age when its oceans were in large part held suspended in the dense seething atmosphere, and when the intense volcanic fires within kept the surface in ceaseless agitation. In Saturn similar phenomena are witnessed. The appearance called the "square-shouldered figure" of Saturn, first observed by Sir William Herschel in 1805, has suggested the conclusion that the giant bulk of the planet "is subject to throes of so tremendous a nature as to upheave whole zones of his surface five or six hundred miles above their ordinary level." Whether this be really the case, or whether, as Mr. Proctor more plausibly suggests, the prominences which give the square-shouldered aspect are due to the shoving up of immense masses of cloud far above the mean layer of Saturn's cloud-envelope, we must equally recognize the presence of intense heat and furious volcanic action in the interior of that planet. When we add that recent calculations have made it almost certain that both Jupiter and Saturn are to some extent self-luminous, it becomes probable that these great planets still resemble their parent, the sun, more closely than they resemble their younger and smaller brethren.

Very different is the state of things witnessed upon the moon. The absence of an atmosphere from the lunar surface was long since proved by the fact that "when stars are occulted by the moon, they disappear instantaneously,"—which would not be the case had the moon an appreciable atmosphere; and spectroscopic evidence has confirmed this conclusion. Nor are there any signs of the presence of liquid oceans, or of running water. Yet if the moon was originally formed from an equatorial zone of the earth, it would seem that it ought to contain the same materials which have from the oldest times constituted a considerable part of the terrestrial surface. Besides this, the vast plains on the moon which the old astronomers supposed to be seas, and named as such, are now held to be areas underlaid by sedimentary rocks implying the former presence of water.[1] If this view be correct, there must in all probability have been winds to excite the erosive movements of the water which caused this sedimentation. For tidal action upon the moon cannot be regarded as a considerable factor in the erosion, unless we go back to that enormously remote period when the earth's tidal pull was still employed in dragging the moon's rotation into synchrony with its revolution.

Here there is an apparent discrepancy, which will disappear, however, when we inquire further into the past career of the moon as indicated by the present condition of its surface. To a great extent the lunar surface is made up of huge masses of igneous rock, through which at short intervals yawn enormous volcanic craters, whose fires seem to be totally extinguished. The giant forces required to bring about such a state of things are now quiescent. And this implies that the moon is a dead planet. It implies that the thermal energies which were once instrumental in raising those huge cones, Tycho, Copernicus, and the rest—quaintly named after our terrestrial heroes of science—and which once drove up fiery streams of molten lava through their ample

[1] Moreover, "it is not to be forgotten that, so far as terrestrial experience is concerned, water is absolutely essential to the occurrence of volcanic action." Proctor, *The Moon*, p. 353.

mouths, are now clean gone, radiated off into space. This cessation of volcanic activity indicates that the planet has reached its limit of consolidation, and is no longer generating heat from within.[1] Now the degree of cold implied by this stoppage of further lunar consolidation must immeasurably exceed anything within terrestrial experience. It may well have been great enough to freeze all the lunar oceans, and even to liquefy, or perhaps to solidify, the gases of the lunar atmosphere. The moon is indeed subjected at each rotation to the fierce noontide heat sent from the sun; but however this may scorch and blister the rocky surface, it can exercise but little melting power. An atmosphere, as Mayer has happily observed, is like a valve which lets water run through

[1] "Nevertheless, there are processes at work out yonder which must be as active, one cannot but believe, as any of those which affect our earth. In each lunation, the moon's surface undergoes changes of temperature which should suffice to disintegrate large portions of her surface, and with time to crumble her loftiest mountains into shapeless heaps. In the long lunar night of fourteen days, a cold far exceeding the intensest ever produced in terrestrial experiments must exist over the whole of the unilluminated hemisphere; and under the influence of this cold all the substances composing the moon's crust must shrink to their least dimensions—not all equally (in this we find a circumstance increasing the energy of the disintegrating forces), but each according to the quality which our physicists denominate the coefficient of expansion. Then comes on the long lunar day, at first dissipating the intense cold, then gradually raising the substance of the lunar crust to a higher and higher degree of heat, until (if the inferences of our most skilful physicists, and the evidence obtained from our most powerful means of experiment can be trusted) the surface of the moon burns (one may almost say) with a heat of some 500° F. Under this tremendous heat all the substances which had shrunk to their least dimensions must expand according to their various degrees; not greatly, indeed, so far as any small quantity of matter is affected, but to an important amount when large areas of the moon's surface are considered. Remembering the effects which take place on our earth, in the mere change from the frost of winter to the moderate warmth of early spring, it is difficult to conceive that such remarkable contraction and expansion can take place in a surface presumably less coherent than the relatively moist and plastic substances comprising the terrestrial crust, without gradually effecting the demolition of the steeper lunar elevations. When we consider, further, that these processes are repeated not year by year, but month by month, and that all the circumstances attending them are calculated to render them most effective because so slow, steadfast, and uniform in their progression, it certainly does not seem wonderful that our telescopists should from time to time recognize signs of change in the moon's face."—Proctor, *The Moon*, pp. 380–382.

in one direction, but not in the other. Through an enveloping atmosphere the solar rays easily pierce, but return with difficulty. But from the airless surface of the moon the solar radiance must be immediately reflected into space, as from the surface of a polished mirror. Just as on the summits of the Himalayas, where the atmosphere is so rare, the huge snow-masses remain through centuries unmelted, in spite of the sun's blazing heat; so on the surface or in the deep abysms of the moon, the air and water once frozen must remain frozen forever.

We have not yet, however, reached a satisfactory interpretation of the original disappearance of the lunar atmosphere. Granting the disappearance of the atmosphere, the maintenance of a more than arctic cold in spite of the utmost intensity of solar radiation may readily be admitted. But in this explanation the absence of a surface atmosphere is presupposed rather than accounted for. Yet I have thought it worth while to introduce the case in this way, as we thus get a more vivid impression of the actual state of things upon the moon. For the original disappearance of the lunar air and water, a far more thoroughgoing explanation was propounded some years since by M. Saemann;[1] but in this explanation the extreme cooling of the moon, as just illustrated, is implicitly involved. According to M. Saemann, the lunar air and water have been literally *drunk up* by the thirsty rocks. On our own globe the tendency of the surface-water is constantly to percolate through the soil of the land or sea-bottom, and thence through the rocks, downward towards the centre of the earth. Yet with our present supply of internal heat, it is not probable that any water can reach more than one hundredth part of the distance towards the earth's centre, without becoming vaporized and thus getting

[1] In a paper on the unity of geological phenomena throughout the solar system, translated by Prof. Sterry Hunt, and published in the *American Journal of Science*, January, 1862.

driven back towards the surface. In this way there is kept up a circulation of water through the peripheral portions of the earth's crust. But as the earth becomes cooler and cooler, the water will be enabled to circulate at greater and greater depths, thus materially lowering the level of the ocean. In this way, long before the centre has become cool, all the surface-water of the earth will have been sucked into the pores of the rocks, and a similar process will afterwards take place with the atmosphere. M. Saemann shows that by the time the earth had reached complete refrigeration, the pores of the rocks would absorb more than one hundred times the amount of all the oceans on the globe, while room would still be left for the retiring atmosphere. Now this state of things, which will no doubt by and by be realized on the earth, would seem to be already realized on the moon. Being forty-nine times smaller than the earth, the moon has cooled with great rapidity, and its geologic epochs have been correspondingly short.[1]

After the moon, we are more familiar with the surface of Mars than with that of any other heavenly body, the position of Venus being very unfavourable for thorough observations. Concerning the physical geography and meteorology of Mars, some trustworthy information has been obtained. The distribution of land and sea over his surface is sufficiently obvious to be delineated in maps. He possesses liquid oceans, proved by spectroscopic evidence to consist of water, and his atmosphere is gaseous. That he possesses climates analogous to our own might be inferred from the inclination of his axis to his orbit-plane, and is inductively proved by the fact that we can actually see his polar snows accumulate during the Martial winter and melt away at the approach of the

[1] It should be added that the rapid cooling of the moon would greatly increase the porosity of its substance. Prof. Frankland has shown that "assuming the solid mass of the moon to contract on cooling at the same rate as granite, its refrigeration through only 180° F. would create cellular space equal to nearly fourteen and a half millions of cubic miles."

Martial summer. Coincidences like these bear sufficient testimony to a general resemblance between Mars and the earth. For where there are oceans and clouds and an atmosphere and polar snows, there must also be currents, aerial and oceanic, as well as rains, rivers, and sedimentary rocks; so that the surface of Mars must probably present geologic phenomena not essentially unlike those witnessed upon the earth. Whether such geologic similarity has entailed a further resemblance in the case of organic and super-organic phenomena, must be left for the more profound deductive science of some future day to determine.

Thus from whatever point of view we study our planetary system, we find such a congeries of phenomena as would have been produced by the gradual development of the system from a homogeneous nebula. On summing up the conspicuous facts already cited, we see that the nebular hypothesis fully explains the shapes of the planetary orbits, and their slight inclinations to the plane of the solar equator; the shapes of the satellite-orbits, and their proximate coincidence with the equatorial planes of their primaries; the inclinations of the planetary axes to their orbit-planes; the oblate figures of the planets; their velocities of rotation; the directions in which they revolve; and the directions in which they rotate. To this last clause the apparent obstacle presented by the retrograde rotation of Uranus (and possibly of Neptune also) is seen on closer examination to be no real obstacle; and the fact that the exception occurs among the outermost planets, just where we might expect it to occur, if at all, is a powerful argument in favour of the general theory. A like powerful argument is furnished by the existence of apparently-continuous rings about Saturn, the planet upon which the centrifugal force bears the highest ratio to gravity. Still more convincing is the testimony rendered by the distribution of satellites,—a testimony well-nigh meeting all the requirements of crucial proof. Irregular as are the sizes of the planets on a superficial view, we find beneath this apparent irregularity a marvellous symmetry of disposition the explanation of which, though incomplete, is as far as it goes in favour of the nebular hypothesis. The breaking up of the zone of asteroids, though not fully explained, is seen to have occurred in the only part of the system where such an event, according to the hypothesis, was likely to occur. And finally the geologic or meteorologic phenomena manifested by the four planets whose surfaces have thus far been successfully studied, are just what the theory requires them to be. The intense heat and furious volcanic activity of Jupiter and Saturn, the extreme loss of heat and cessation of volcanic activity upon the moon, the moderate temperature and habitable aspect of Mars, are alike deducible from the nebular hypothesis.

I doubt if such persistent agreement between deduction and observation has ever been witnessed in the case of an erroneous or radically inadequate hypothesis. If the sole ultimate test of a theory is that it reconciles the order of conceptions with the order of phenomena, may we not say that the theory of Kant and Laplace, having sustained the repeated application of this test, may be accepted provisionally as a true account of the past history of our system of worlds? It is true that the application of the test has not yet been made exhaustive; the verification is not yet complete. Some of the interpretations above given are still, as I have acknowledged, but partial; and there are yet other groups of phenomena with which I have not ventured to meddle. To the various densities of the planets I have alluded but incidentally; and the various angular velocities, as well as the order of distances formulated in the law of Titius, still await an explanation. Besides which, the evidence from the physical condition of the surfaces of Mercury and Venus, Uranus and Neptune, and the moons of the four outer planets, is not yet forthcoming. It would be asserting too much, therefore, to assert that the nebular hypothesis is completely verified, like the hypothesis of gravitation. But on the other hand, they understand little of the logic of scientific inquiry who expect to obtain the same kind and degree of evidence in the former case as in the latter. It was part of Newton's rare good fortune that his hypothesis was the generalization of a physical property of matter, which could be verified by a single crucial instance. In none of the concrete sciences can such kind of verification be looked for. A theory relating to a heterogeneous assemblage of concrete phenomena can only be verified gradually, as the successive groups of phenomena in question are one after another successfully studied and interpreted. Thus the complete verification of the nebular hypothesis, as applied merely to the solar system, involves the complete explanation of the chief dynamic and physical features of the system; and for this we have yet to wait. Meanwhile the theory possesses such unmistakeable marks of genuineness, it conforms in so many and various ways to the test of reconciling the order of conceptions with the order of phenomena, that no one capable of estimating scientific evidence would hesitate in provisionally accepting it. Devised to account for a certain limited group of phenomena, it not only accounts for these, but also for other groups of phenomena, not considered by its propounders. Facts which on a superficial view appeared as obstacles to the theory, have on closer examination turned out to be powerful arguments in its favour. It is sustained by all the facts within our ken, and invalidated by none. And it has so far thriven with the progress of discovery during the past hundred and twenty years, that at the present moment it commands wider assent than at any previous time since its first promulgation.

Of this last statement we find striking confirmation as we pass beyond the limits of the solar system and seek for evidence in the remotest depths of stellar space. It is well known that Sir William Herschel supposed certain irresolvable nebulæ to consist of self-luminous vapour hovering cloud-like in space. Laplace associated this hypothesis with his own theory of planetary evolution; pointing to the present existence of nebulous masses as confirmatory proof of the past existence of such a nebulous mass as his theory required. According to this view, the irresolvable nebulæ are simply starry systems in embryo; and when our planetary system consisted simply of the sun diffused in gaseous form over a circumference of perhaps thirty thousand million miles, it was just like one of these nebulæ. But since Herschel's time many nebulæ, which he regarded as irresolvable, have been resolved into dense starry clusters. The great nebula in Orion, upon which Herschel placed great reliance, was resolved both by Lord Rosse's reflector and by our Harvard refractor; and the suspicion began accordingly to arise that, if our telescopes were only powerful enough, there might prove to be no irresolvable nebulæ at all. Hence many writers thoughtlessly hastened to proclaim that the nebular theory had lost its chief support, forgetting that the overwhelming evidence furnished by the comparatively well-known structure of the solar system must take precedence of any hypothesis as to the character of remote and less-known sidereal phenomena. Mr. Chambers, in giving an account of the resolution of the "dumb-bell" nebula in Vulpecula, rather gleefully wrote the obituary of the nebular hypothesis; but like many other obituaries, this one turned out to be premature. For now came Mr. Huggins, with his spectroscope, and proved once for all that the wary and sagacious Herschel, who hardly ever made a false step, was right, here as elsewhere. In 1864 Mr. Huggins analyzed the light sent from a nebula in Draco, and found it to contain the bright lines which are sure evidence of the gaseous condition of the luminous body. Since then several other nebulæ have been proved to be gaseous; so that the question may now be regarded as settled for ever, and as settled in favour of the nebular hypothesis. Henceforth, to the evidence found in the structure of our planetary system, there may be added the weighty argument that masses of matter still exist in space, in the very condition in which our system must have originally existed.

If the nebular hypothesis was ever to be subjected to a hazardous trial, one would suppose that the discovery of spectrum analysis must have furnished the occasion. Here is a discovery which has suddenly enlarged our knowledge of the stellar universe in a manner utterly beyond the power of the greatest and subtlest mind to have predicted twenty years ago, — a discovery which not only reveals to us the actual motions of the stars, but even penetrates into their molecular structure, and discloses the chemical elements of which their surfaces are composed as well as the physical state of aggregation of those surfaces. Now if ever, one might think, is the time to find out whether our nebular hypothesis, devised in an era of comparatively scanty astronomical knowledge, is a sound hypothesis or not. If it survives this immense, unprecedented extension of our knowledge, what more magnificent triumph could we wish for it? And here we see that the very first result of the application of spectrum analysis to sidereal phenomena has been the placing of the nebular hypothesis upon a firmer basis than ever before, removing the only serious obstacle which had hitherto deterred many cautious thinkers from committing themselves to it.

Spectroscopic researches but lately undertaken, and not yet carried out to a decisive result, seem likely not only further to strengthen the noble theory of Kant and Laplace, but to give it a comprehensive significance of which those great thinkers could never have dreamed. Along with further confirmation of the process of mechanical and physical evolution, as originally formulated in their hypothesis, evidences are daily coming in to show that there is going on a parallel process of chemical evolution from homogeneity to heterogeneity, which is no less wonderful in its significance. The old empirical classification of stars according to their colours is beginning to have a new meaning. The method of comparison is becoming applicable in astronomy, as it has long been employed in the study of organisms, of societies, and of languages. It begins to be probable that among the various groups of stellar bodies there may be found cosmical matter in many different stages of evolution,—from the primitive nebula which yields but a simple hydrogen-line, to such a highly-evolved body as our own sun with the many-lined vapour of iron abundant in its heated atmosphere. But into this fascinating region of speculation it would be somewhat premature for us now to enter. Merely indicating what a rich harvest of discovery is here likely to reward the labourers of the immediate future, I would call attention to an interesting speculation of Mr. Spencer's, the possible inadequacy of which need not weaken the effect of the evidence above cited from planetary phenomena, and which is in every way worthy of serious consideration.

According to Mr. Spencer, the distribution of nebulæ affords a significant illustration of the nebular hypothesis. Speaking generally, nebulæ occur in regions where developed stars are scarce. The vast groups of spherical nebulæ, here and there partly developed into starry clusters, which constitute the so-called Magellanic Clouds, are situated in a district of the sky that is otherwise starless. Now by far the most striking of this class of facts is one which serves to bring the entire sidereal system into direct comparison with that little portion of it to which we belong. Just as the planets lie almost entirely in a single plane, so the stars are distributed in almost infinite numbers in the plane of the Milky Way, while elsewhere thev occur rarely. And just as the comets are chiefly distributed about the poles of our solar system, their orbits cutting its equatorial plane at great angles, so the nebulæ are found in greatest numbers about the poles of the galaxy. It seems unlikely that this parallelism, which Mr. Spencer was the first to point out, should be accidental. It indicates a common mode of evolution of the whole starry system. It vaguely points to a gigantic process of concentration going on throughout the galaxy, analogous to the local process of concentration which has gone on in our own little planetary group. Still more obvious will this become when we consider the explanation of these phenomena which Mr. Spencer has offered.

Observation shows that while the more consolidated nebulæ are oval or spheroidal in shape, the less consolidated nebulæ are often extremely irregular, throwing out long arms of vaporous matter into the adjacent spaces. This agrees with what we have learned to expect in any rotating mass which gravitation is slowly drawing closer and closer together. The oval form is due, as we have seen, to the combined effects of gravitation and rotatory movement. But this implies an earlier state in which the figure was irregular. Now while the heavier portions of the mass were being drawn together so as to acquire a spheroidal contour, the lighter portions, floating farther from the centre of gravity, would remain like detached shreds of cloud, or like long luminous streaks. And while all these would ultimately be compelled by gravitation to revolve about the centre of the mass, nevertheless the lightest and outermost shreds would be a long time in acquiring a definite direction of revolution. While the greater number would be doubtless drawn in and absorbed by the main mass at an early stage, the chances are that some would not arrive until the main mass had become considerably contracted. Now it is easy to see that such late arriving flocculi, coming toward the centre of gravity from a great distance, and therefore having small angular velocities, will move in very eccentric ellipses. In the next place, while they will come from all parts of the space which the mass originally occupied, they will come chiefly from regions remote from the plane in which integration has been most marked,—that is, from the poles of the nebula rather than from its equatorial regions. And thirdly, having failed to accompany the retreating mass of the nebula while it was first acquiring a definite direction of rotation, their own revolutions will be determined chiefly by their irregular shapes, and they will be as likely to be retrograde as direct.

All this is true of comets: they come chiefly from high solar latitudes, along immensely eccentric orbits, and in directions which are indifferently direct or retrograde. And when we add that they are nebulous in constitution, it appears highly probable that they are simply outlying shreds of the nebula from which our planetary system has been developed. As for the irresolvable patches of nebulous matter which are distributed about the poles of the galactic circle, their distance from us is so great that we have not yet ascertained anything trustworthy concerning their motions. But the fact that their position in high galactic latitudes is explicable upon the same general principles which explain the positions of comets, raises a presumption that their relation to the galaxy as a whole may somewhat resemble that which comets bear to the solar system. Between the possible careers of the nebulæ and the comets, there is, however, a mighty difference. The nebula which we see through quadrillions of miles shining by a light of its own must needs be an enormous object—enormous in mass as well as in volume—and its gravitative force must be proportionate to its size. While, therefore, its gradual contraction is likely to be attended by its development into a planetary system, by a process of integration and differentiation such as we have here described; on the other hand the comet is an object of inconsiderable mass, though often of considerable volume. The slight concentration of which it is capable will not produce planetary systems or even asteroids, but only streams of meteors or shooting-stars, such as are now poured down upon the earth and its neighbour planets at the rate of a hundred thousand million each year. The researches of the past ten years have gone far to show that such meteoric streams differ from nebulous comets in no respect save in their greater aggregation; the difference being similar to the difference between a cloud and a shower of rain-drops. We are constantly encountering portions of these condensed comets and uniting them with our own planetary substance. And in this way the integration of the outlying portions of our primitive nebula is, at this late day, still going on.

As we pause to survey, in a single comprehensive glance, this gigantic process of Planetary Evolution, in which the integration of matter and concomitant dissipation of molecular motion, kept up during untold millions of ages, has brought about the gradual transformation of a relatively homogeneous, indefinite, and incoherent mass of nebular vapour into a decidedly heterogeneous, definite, and coherent system of worlds; we are at first struck by the peculiarity that the process has apparently long since come to a close in the establishment of a complete moving equilibrium. Habituated as we are to the contemplation of fleeting phenomena, the stars in their courses have become the types of permanence; and the stability of our planetary system has furnished a fruitful theme for the admiring comments of the mathematician and the theologian. In so far as this appearance of eternal stability is well founded, it admirably illustrates the theorem, already cited in our discussion of the rhythm of motion, that wherever the forces in action are few in number and simple in composition, the resultin rhythms will be simple and long-enduring. Nevertheless the processes still going on in our system are such as to forbid the conclusion that this apparently permanent equilibrium is destined really to be permanent. The concentration of matter and concomitant dissipation of molecular motion, which has gone on from the beginning, must still continue to go on until it has reached its limit. That consolidation and accompanying refrigeration which has changed the earth from a nebula into an incandescent star, and from a star into an inhabitable planet, must continue until a state of things is inaugurated for which we must seek a parallel in the present condition of the moon. So, too, the contraction which generates the prodigious quantity of heat daily lost by the sun, cannot go on forever without reducing the sun to a solidity incompatible with the further generation of radiant energy.

Thus the moon appears to afford an example of the universal death which in an unimaginably remote future, awaits all the members of the solar system. It then becomes an interesting question whether this cosmic death will be succeeded by Dissolution,—that is, by the rediffusion of the matter of which the system is composed, and by the reabsorption of the lost motion or its equivalent. We shall find it difficult to escape the conclusion that such a Dissolution must ultimately take place.

If, along with the dissipation of molecular motion already described, the planets are also losing that molar motion to which is due their tangential momentum, this loss of motion must ultimately bring about their reunion with the sun. Upon such a point direct observation can help us but little; but there are two opposing considerations, of a force which none will deny, and based on facts which none can dispute. Two sets of circumstances are struggling for the mastery,—the one set tending to drive the planets farther and farther away from the centre of the system, the other set tending to draw them towards the centre. Let us see which set must prevail in the end.

Hitherto, in all probability, the first set of circumstances has had the advantage. There is little reason to doubt that all the planetary orbits, both primary and secondary, are somewhat larger now than they were originally. This is an indirect consequence of the slow loss of rotatory momentum due to tidal action. The calculation by which Laplace thought he had proved that the terrestrial day had not lengthened since the time of Hipparchos, has been shown by Prof. Adams to be vitiated by the inclusion of an erroneous datum; and the theory involved is no longer tenable. It has been proved that the tidal wave which the moon draws twice a day around the earth, in the opposite direction to the terrestrial rotation, acts upon the earth like a brake on a carriage-wheel. Owing to this circumstance, the day is now one eighty-fourth part of a second longer than at the beginning of the Christian era; and it is destined to continue lengthening until in the remote future there will be from three to four hundred hours between sunrise and sunset. But the rotatory momentum thus lost by the earth is not destroyed. In conformity with a well-known principle of dynamics, it is added to the tangential momentum of the moon, and thus lengthens the radius of the moon's orbit. The more slowly our planet rotates, the farther the moon retires from us. A similar relation holds good in the case of the planets and the sun. Not only is it demonstrable *à priori* that the planets must cause tides upon the surface of the sun, but the tides caused by all the primary planets, save Mars, Uranus, and Neptune, have been actually detected by a minute comparison of the variations in the solar spots. These tidal waves are drawn around the sun in the direction opposite to that of his rotation, and must therefore exert a retarding effect. And the rotatory momentum thus stolen from the sun is added, in accordance with a *pro ratâ* principle of distribution, to the tangential momenta of the various planets concerned in the theft. There can be little doubt, therefore, that all the planetary orbits, both primary and secondary, are steadily enlarging, and that this process must go on until that synchrony between revolution and rotation now witnessed in our moon becomes universal, unless it is previously checked by the cessation of tidal phenomena. As between the earth and moon, for example, the ultimate result of the whole process must be the lengthening of the terrestrial day until it corresponds with a lunar month, so that the earth and moon will move in relation to each other just as if joined together by a rigid rod. This result will actually be realized unless forestalled by the completed refrigeration of the earth, which will put an end to the tidal friction. In like manner the sun's rotation must diminish until equilibrated with the motions of the planets, unless this result is forestalled by the completed refrigeration of the sun. And in all cases, so long as the process goes on, there must be a tendency, however slight, for the planets to recede from the sun.

The action of this set of circumstances, however, though hitherto no doubt predominant, is strictly limited in duration. Sooner or later an equilibration of motions will be reached, and this receding tendency will cease to be manifested. It is quite otherwise with the opposing set of circumstances which we have now to consider. We have now to contemplate a cause which operating from the very outset, and still insidiously operating, will continue to operate long after the process just described has come to an end. Each year's discoveries show more and more conclusively that the interplanetary spaces are filled with matter. The existence of some interplanetary and interstellar matter is indeed a necessary condition for the transmission of light and other forms of radiance. Now wherever a body moves through a material medium, it meets with resistance; it imparts motion to the medium, and loses motion in so doing. If the body is a planet like Jupiter, weighing a couple of septillions of tons, and rushing along at the rate of eight miles per second through an ether far lighter than the air left in an exhausted receiver, the resistance will be inconceivably small, I admit. Still there will be resistance, and long before the end of time, this resistance will have eaten up all the immense momentum of the planet. A Hindu, wishing to give expression to his idea of the duration of hell-fire, said that if a gauze veil were to be brushed against the Himalaya mountains once in a hundred million centuries, the time required for thus wearing away the whole rocky range would measure the torments of the wicked. One marvels at such a grandiose imagination; but the realities of science beggar all such attempts at giving tangible shape to infinitude. The resistance of an ethereal medium may work its effects even more slowly than the Hindu's veil, yet in time the effects must surely be wrought. Either the planets are moving in an absolute vacuum—a supposition which is incompatible with the transmission of heat and light—or else the resistance of the medium must tend to diminish their angular velocities.[1]

In the absence of any counteracting agencies—and, after the cessation of the process above described, none such are assignable—this loss of tangential momentum must ultimately bring all the planets into the sun, one after another, beginning with Mercury and ending with Neptune. Here the concentration of matter appears to have reached its limit. But what must now happen?

Let us note that the tangential momentum lost by the planet is lost only relatively to its distance from the sun. As the planet draws nearer to the sun, its lost tangential momentum is replaced, and somewhat more than replaced, by the added velocity due to the increased gravitative force

[1] See Balfour Stewart, *The Conservation of Energy*, p. 96.

exerted by the sun at the shorter distance. But this newly-added momentum is all needed to maintain the planet at its new distance from the central mass, and can never be available to carry it back to the old distance. It is thus that Encke's comet moves more and more rapidly as it approaches the sun, into which it appears to be soon destined to be drawn. For these reasons the earth, which now moves at the rate of 18 miles per second, would attain a velocity of 379 miles per second when in the immediate neighbourhood of the solar mass. Hence when at last the planet strikes the sun, it must strike it with tremendous force. In a collision of this sort, the heat generated by the earth and sun alone would suffice to produce a temperature of nearly nine million degrees Fahrenheit. Without pursuing the argument into further detail, it is obvious that the integration of the whole solar system, after this fashion, would be followed by the complete disintegration of the matter of which it is constituted. After the reunion of the planets with the sun, the next stage is the dissipation of the whole mass into a nebula.

If we now go back for a moment to the beginning, and ask what antecedent form of energy could have generated the motion of repulsion which sustained our genetic nebula at its primitive state of expansion, the reply must be that nothing but a rapid evolution of heat could have generated such a motion of repulsion. And if we ask whence came this rapid evolution of heat, we may now fairly surmise that it was due to some previous collision of cosmical bodies; arrested molar motion being incomparably the most prolific known source of heat. Thus we get a glimpse of some preceding epoch of planetary evolution, from the final catastrophe of which emerged the state of things which we now witness.

We have here reached the very limit of scientific inference. For note that, since the greater part of the potential energy represented by the primitive expansion of our solar nebula has been transformed into heat and radiated away, and is not represented by any form of motor energy now stored up in the solar system, it follows that the sudden transformation of the penultimate molar motions of the planets into heat cannot result in the production of another nebula so large as the one from which our present system has been evolved. In seeking to trace out the implications of this conclusion, we at once arrive at an impassable barrier, which is only shifted, but not overthrown, when we consider the results of the probable ultimate conflict between our own system, thus disintegrated, and other sidereal systems belonging to our galaxy. In order to give a complete account of the matter, we ought to know what has become of all this motor energy which we have been so prodigally pouring away, in the shape of radiant heat, into the interstellar spaces. Is the equivalent of this motor energy ever to be restored, or is the greater part of it forever lost in the abysses of infinite space? Before we can answer such a question, we need to know whether the interstellar ether, which is the vehicle for the transmission of molecular motion, is definitely limited in extent, or practically infinite; and we need to take into the account the dynamic relations, not only of our entire galactic system, but of other stellar systems, if such there are, beyond the utmost ken of the telescope. Here science fails us. Astronomy, the simplest and clearest of the sciences, becomes, when treated on this great scale, the most difficult and obscure. An infinity and an eternity confront us, the secrets of which we may not hope to unravel. At the outermost verge to which scientific methods can guide us, we can only catch a vague glimpse of a stupendous rhythmical alternation between eras of Evolution and eras of Dissolution, succeeding each other "without vestiges of a beginning and without prospect of an end."

## CHAPTER VI.

### THE EVOLUTION OF THE EARTH.

In treating of Evolution in general, it was shown how organic bodies are, by a peculiar concurrence of conditions, enabled to lock up a great deal of motion within a small compass, so that permanent redistributions of structure and function can be effected. From the decisiveness with which this peculiar advantage possessed by organic bodies was indicated, it might have been surmised that in the case of inorganic aggregates an attempt to trace the secondary phenomena of differentiation and integration would prove illusory, owing to the absence of this concurrence of conditions. In many inorganic bodies it is true that there does not go on to any notable extent that secondary redistribution which results in increase of heterogeneity. The evolution of a cloud, a rock, or a crystal, is little more than an integration of matter attended by dissipation of motion. In the evolution of the solar system, on the other hand, we have witnessed an increase in heterogeneity, definiteness, and coherence that is very marked, though by no means so prominent as in the case of organic evolution. This increase in determinate multiformity, such as it is, is due to the special mechanical principle that in any rotating system of particles, regarded as practically isolated, a steady concentration, entailing increased rotatory velocity, must end in the segregation of the equatorial zone from the rest of the system. This principle is exemplified, on a diminutive scale, in the artificial evolution of a system of oil-globules, whereby M. Plateau has imitated the evolution of the planets. To the resulting equilibration between gravity and the centrifugal tendency at the place where the detachment occurred, is due the permanence and definiteness of the structural differentiation. Owing to these conditions, and to its enormous size, implying great power of condensation along with the very slow dissipation of the heat generated by the condensation, the integration of our genetic nebula has been compatible with the retention of much relative motion of parts. And here accordingly, as in all cases where there is a considerable retention of internal motion, the secondary rearrangements characteristic of Evolution have been conspicuously manifested.

In the evolution of our earth, regarded by itself, we have also to notice a very decided progress in determinate multiformity, even without taking into the account that specialized group of terrestrial phenomena which we distinguish as organic. Here there have been two conditions favourable to the retention of enough motion to allow considerable secondary rearrangement of parts. In the first place, the great size of the earth has prevented it from parting too rapidly with the heat generated during its condensation; and since the early formation of a solid, poorly-conducting crust, the loss from radiation would seem to have been very gradual. The importance of this circumstance may best be appreciated by remembering the very different career of the moon, as indicated in the foregoing chapter. The disappearance of igneous and aqueous agencies on the moon implies the cessation of structural rearrangement there at this early date;[1] and when we sought for an explana-

[1] This statement must be taken, however, with some qualification. See above, p. 380.

tion of this state of things, we found an adequate explanation in the rapid loss of heat which the small size of the moon has entailed. It is not likely, therefore, that the moon can ever have been the theatre of a geologic and organic development so rich and varied as that which the earth has witnessed.[1]

In the second place, the following chapter will show that the chief circumstance which has favoured terrestrial heterogeneity has been the continuous supply of molecular motion from the sun. To this source may be traced all the aqueous phenomena, save the tides, which concur in maintaining the diversity of the earth's surface. And having thus seen how a complex geologic evolution is rendered possible, we shall further discern that organic evolution also—that highly specialized series of terrestrial events—is rendered possible by the same favouring circumstance.

[1] An example of the too hasty kind of inference which is often drawn in discussing the question of life upon other planets, may be found in a recent lucid and suggestive pamphlet by Prof. Winchell, entitled "The Geology of the Stars." "The zoic age of the moon," says the author, "was reached while yet our world remained, perhaps, in a glowing condition. Its human period was passing while the eozoön was solitary occupant of our primeval ocean." More careful reflection will probably convince us that, with such a rapid succession of geologic epochs, the moon can hardly have had any human period. For the purposes of comparative geology, the earth and the moon may be regarded as of practically the same antiquity. Now, supposing the earliest ape-like men to have made their appearance on the earth, say during the Miocene epoch, we must remember that at that period the moon must have advanced in refrigeration much farther than the earth. Supposing organic evolution to have gone on with equal pace in the two planets, it might be argued that the moon would be fast becoming unfit for the support of organic life at about the time when man appeared on the earth. Still more, it is a fair inference from the theory of natural selection, that upon a small planet there is likely to be a slower and less rich and varied evolution of life than upon a large planet. On the whole, therefore, it does not seem likely that the moon can ever have given rise to organisms nearly so high in the scale of life as human beings. Long before it could have attained to any such point, its surface is likely to have become uninhabitable by air-breathing organisms. Long before this, no doubt, its surface air and water must have sunk into its interior, and left it the mere lifeless ember that it is. The moon would thus appear to be not merely an extinct world, but a partially aborted world; and the still smaller asteroids are perhaps totally aborted worlds. Nevertheless, from the earth down to the moon, and from the moon down to an asteroid, the differences are at bottom only differences of degree; though the differences in result may range all the way from a world habitable by civilized men down to a mere dead ball of planetary matter. An interesting example, if it be sound, of the continuity of cosmical phenomena.

Let us now proceed to note two or three conspicuous features of geologic evolution, remembering that in so doing we are but following out a portion of the phenomena of planetary evolution discussed in the preceding chapter. There is no demarcation in the series of phenomena, save that which we arbitrarily introduce for convenience of study and exposition. The process of integration of matter and dissipation of motion which we have just witnessed in the solar nebula as a whole, we have now to witness in that segregated portion of it which we call our earth, and we have to observe how here also indeterminate uniformity has been succeeded by determinate multiformity.

In the formation of a solid crust about the earth, there appeared the first conspicuous geologic differentiation; resulting not only in increased heterogeneity, but in increased definiteness, as the crust gradually solidified. For not only did the planet thus acquire a more definite figure, but also a more definite movement; since the solidification of the crust must have diminished the oblateness of the spheroid, thus gradually reducing the disturbance known as precession. Next with the deposit of water in the hollow places of this crust, there came the differentiation between land, sea, and atmosphere; and this differentiation became more marked as vast quantities of carbonic acid, precipitated in this primeval rain, left the atmosphere purer, and purified also the ocean by segregating its contained lime. At the same time that this vast condensation of ocean-water from pre-existing steam constituted a secondary integration attendant upon the earth's loss of molecular motion, the further thickening of the solid crust began to entail other more local integrations. As Mr. Spencer points out, while the earth's crust was still very thin, there could be neither deep oceans nor lofty mountains nor extensive continents. Small islands, barren of life, washed by shallow lakes, void of animate existence, and covered with a dense atmosphere, loaded with carbonic acid and aqueous vapour, must have characterized the surface of our planet at this primeval epoch. But as the ever thickening crust slowly collapsed about its contracting contents, mountain ridges of considerable height could be gradually formed, islands could cohere over wider and wider spaces, and deeper basins would permit the accumulation of large bodies of water. Numerous integrations of islands into continents, and of lakes into oceans, would thus occur, making the differentiation of land and sea more distinct and definite. The integration of continents and the rise of mountain chains in different directions must have enlarged the areas of denudation, and thus rendered possible the integration of masses of detritus into extensive sedimentary strata. Differences of watershed and river-drainage thus caused added variety to the resulting geologic formations; and these, crumbling into soil of more or less richness, afterwards impressed differences upon vegetation, and thus indirectly upon animal life. Yet again, the thickening of the crust must have added to the definite heterogeneity of the surface by its effect upon volcanic phenomena. While the crust was still thin, the angry waves of liquid matter imprisoned beneath must have continually burst through volcanic vents, suddenly vaporizing large quantities of surface-water, and causing phenomena similar to those now witnessed upon Saturn and Jupiter. As the crust thickened, these volcanic agencies were more and more restrained: craters became restricted to certain localities where the crust was less thick than elsewhere, and earthquake waves began to run, as at present, along definite lines. Those well-regulated earthquake pulses which raise continents and ocean-floors at the rate of a few inches or feet per century, now began to increase the definite heterogeneity of the surface. To the long rhythms of elevation and subsidence thus produced have been due countless differentiations in the directions of ocean-currents and continent-axes, in watershed, in the composition of sedimentary strata, and in climate. And to all these may be added the metamorphosis of sedimentary rocks by volcanic heat, and the seismic shoving up of strata at various angles.

All these geologic phenomena are thus seen to be classifiable as differentiations and integrations of the earth's superficial matter, caused by the continuous integration of the earth's mass with its attendant dissipation of molecular motion. We may next note that meteorologic phenomena are similarly classifiable. Before the solidification of its crust, our planet must have been comparatively homogeneous in temperature, owing to the circulation which is always maintained in masses of heated fluid. The surface-portions must, however, have been somewhat cooler than the interior, and this difference would be rendered more definite by the formation of the crust, and by the subsequent separation of the ocean from the gaseous atmosphere. As the contour of land and sea became more definite and more permanent, differences in temperature between different parts of the surface must likewise have become more decided. Nevertheless the chief cause of climatic differentiations—the inclination of the earth's axis—did not begin to produce its most conspicuous effects until a later period. As long as our planet retained a great proportion of its primitive heat, there could have been little difference between winter and summer, or between the temperature at the poles and at the equator. But when the earth had lost so much heat that its external temperature began to depend chiefly upon the supply of solar radiance, then there commenced a gradual differentiation of climates. There began to be a marked difference between summer and winter, and between arctic, temperate, and tropical zones. And now also the distribution of land and sea began to produce climatic effects, owing to the fact that solar radiance is both absorbed and given out more rapidly by land than by water. Areas of the earth's surface where sea predominated began now to be distinguished from areas where land predominated, by their more equable temperature. And because the amount of solar radiance retained depends upon the density of the atmosphere, there ensued differences of climate between mountains and valleys, between table-lands and low-lying plains. Here too the increased heterogeneity was attended by increased definiteness and permanence of climatic relations. For the thermal variations, depending on the earth's rhythmic change of position with reference to the sun, set up atmospheric currents in definite directions and of tolerably regular recurrence. Sundry of these currents, swayed by the earth's rotatory momentum, became specialized as trade-winds and monsoons; while in the ocean there went on a similar specialization, as exemplified in the constant course of the Gulf Stream and other marine currents. The definiteness of the total result, as well as its heterogeneity, may be well illustrated by any map of isothermal lines; bearing in mind, as we must, that during long periods these lines shift only within narrow limits.

Among the various portions of our earth's surface, moreover, evolution has brought about a climatic interdependence. The dependence of terrestrial temperature upon the supply and distribution of solar radiance, has entailed a further dependence of local temperatures upon one another. For example the warm temperature of southern Europe is largely dependent on the hot dry winds which blow from Sahara, and which powerfully assist in melting the glaciers of the Alps. If Sahara were to be submerged—as indeed it has been at a recent epoch—these dry winds would be replaced by cooler winds charged with vapour, which would condense into snow on the Alps, and thus enlarge the glaciers already formed there, instead of melting them away. Thus the climate would be changed throughout Europe, and the direction of winds would be altered over a still larger area of the globe. If Lapland and the isthmus of Panama were to subside at the same time, so that icebergs could float through the Baltic to the coast of Prussia, while the Gulf Stream would be diverted into the Pacific Ocean, the climate of Europe might become glacial. Yet either the submergence of Greenland, or the elevation of the East Indian Archipelago into a continuous continent, would perhaps suffice to neutralize all these agencies, and restore the genial warmth. In such climatic relations we see vividly illustrated that kind of integration which brings the condition of each part of an aggregate into dependence upon the condition of all the other parts.

It is now sufficiently proved that the development of the earth, like the development of the planetary system to which it belongs, has been primarily an integration of matter and dissipation of motion, and secondarily a change from indefinite homogeneity with relative isolation of parts to definite heterogeneity with relative interdependence among parts. But our survey of telluric evolution is as yet far from complete. While enough has been said concerning the redistributions of matter which have gone on over the face of the globe, nothing has been said concerning the far more wonderful and interesting redistributions of the molecular motion which the earth is continually receiving from the sun. Here, as already briefly hinted, we have the chief source of terrestrial heterogeneity. In the chapter on the Law of Evolution, it was observed, as a general truth, that homogeneous forces incident upon a heterogeneous aggregate undergo differentiation and integration. We shall now find this general truth beautifully exemplified in the history of the surface of our planet. At a remote era in that history, the differentiation and integration of solar radiance began gradually to constitute the most important part of the complex process of terrestrial evolution. We have now to show how this has been done; and we shall find it desirable to introduce the subject with an inquiry into the Sources of Terrestrial Energy.

## CHAPTER VII.

### THE SOURCES OF TERRESTRIAL ENERGY

At the outset we may state broadly that all terrestrial energy is due either to direct gravitative force, or to the arrest of the centripetal motion produced by gravitative force, either in the earth or in the sun. In other words, the entire series of terrestrial phenomena is the complex product of the earth's internal heat, combined with solar radiance, and with direct gravitative force exercised by the moon and other planets.

Beginning with the smallest and least conspicuous of these sources of energy, a mere allusion will suffice for the effects wrought upon the earth by its companion planets through the medium of their tidal action upon the sun. That the phenomena of the aurora borealis, as well as the periodic variations in the position of the magnetic needle, are dependent upon the solar spots, is now a well-established doctrine; and it seems not unlikely that we shall ere long succeed in tracing out other dependences of this sort,—as is shown, for example, in Mr. Meldrum's investigation of the relations between sun-spots and rainfall. And whatever may be the final explanation of the phenomena of sun-spots, there can be little doubt that the periodicity of these phenomena is conditioned by the positions of the various planets, and especially of the giants Jupiter and Saturn. But these inter-relations, though they may be much more important than is as yet suspected, need not now detain us. Such further effects as may be wrought upon the earth by polarized light sent from the other planets, and by radiance from remote stellar systems, may be left out of the account. Nor need we do more than allude to the moon's gravitative force as the chief cause of the oceanic tides, with their resultant geologic phenomena. Passing over all these circumstances, we come to the still unexpended energy represented by the earth's internal heat, concerning which we need only say that it is the cause of the geologic phenomena classed as igneous. Volcanic eruptions, earthquake shocks, elevations and subsidences of continents and ocean-floors, metamorphoses of sedimentary rocks, boiling springs, fractures of strata, and formations of metallic veins, are the various manifestations of this form of terrestrial energy.

But all these grand phenomena must be regarded as immeasurably inferior in variety and importance to those which are due to the transformation of solar radiance. These must be described with somewhat more of detail. First, with the exception of the changes wrought by the tides, all the geologic phenomena classed as aqueous are manifestations of transformed solar energy. Pulses of molecular motion proceeding from the sun are stored as reserved energy in masses of aqueous vapour raised from the sea. This energy is again partly given out as the vapour is condensed into rain and falls to the ground. The portion which remains is expended in the transfer of the fallen water through the soil, till it collects in rivulets, brooks, and rivers, and gradually descends to the ocean whence solar radiance raised it, bearing along with it divers solid particles which go to form sedimentary strata. The wind which blew these clouds into the colder regions where they consolidated into rain-drops, was set in motion by solar energy,—since all winds are caused by the unequal heating of different parts of the earth's surface.

Molar motion stored up in these vast masses of moving air is given out not only in the driving of clouds, but also in the raising of waves on rivers and oceans; and it is still further expended in the wearing away of shores and indentation of coast-lines which these waves effect. All the energy thus manifested by rains and rivers, winds and waves, is transformed solar radiance. And in like manner, if asked whence came the molar motion exhibited in the transfer of vast masses of sea-water along definite lines, as in the Gulf Stream and other marine currents, we may safely answer—whatever view we adopt as to the details of these movements—that it was originally due to the heat which so rarefied this water as to make it yield to the pressure of adjacent colder and denser water. And this heat came to the earth in the solar rays. Thus all movements of gaseous, liquid, and solid matter upon the earth's surface, except volcanic and tidal movements, are simply transformations of the heat which is generated by the progressive integration of the sun's mass.

But this is not the end of the matter. Our last sentence implicitly included the phenomena of life among those due to solar radiance, since the phenomena of life, whatever else they may be, are certainly included among the complex movements of gaseous, liquid, and solid matters, which occur upon the earth's surface. Let us note some of the various ways in which molecular motion, sent from the sun, is metamorphosed into vital energy.

The seed of a plant, buried in the damp earth, grows by the integration of adjacent nutritive materials, but the energy which effects this union consists in the solar undulations by which the soil is warmed. Diminish, to a certain extent, the daily supply of radiance, as in the long arctic and the short temperate winters, and the seed will refuse to grow. Though nutritive material may be at hand in abundance, there is no molecular motion which the seed can absorb When the seed grows and shoots up its delicate green stalk, tipped with a pair of leaflets, these leaflets begin to absorb and transform those more rapid waves of the sunbeam, known as light and actinism. That the plant may continue to grow, by assimilating carbon and hydrogen, it is necessary for the leaf-molecules to decompose the carbonic acid of the atmosphere, and for the molecules of the rootlets to decompose the water which trickles through the ground. But before this can be done, the molecules of leaf and rootlet must acquire motor energy,—and this is supplied either directly or indirectly by the sunbeam. The slower undulations, penetrating the soil, set in motion the atoms of the rootlet, and enable them to shake hydrogen-atoms out of equilibrium with the oxygen-atoms which cluster about them in the compound molecules of the water. The swifter undulations are arrested by the leaves, where they communicate their motor energy to the atoms of chlorophyll, and thus enable them to dislodge adjacent atoms of carbon from the carbonic acid in which they are suspended. And these chemical motions, going on at the upper and lower extremities of the plant, disturb the equilibrium of its liquid parts, and thus inaugurate a series of rhythmical molar motions, exemplified in the alternately ascending and descending currents of sap. And lastly these molar motions, perpetually replenished from the same external sources, are perpetually expended in the molecular integration of vegetable cells and fibres. Thus all the energy stored up in the plant, both that displayed in the chemical activities of leaves and rootlets, and that which is displayed in circulation and growth, is made up of transformed sunbeams. The stately trunk, the gnarled roots, the spreading branches, the rustling leaves, the delicately-tinted blossoms, and the tender fruit, are all—as Moleschott no less truly than poetically calls them—the air-woven children of light.

In remote geologic ages untold millions of these solar beams were occupied in separating vast quantities of carbon from the dense atmosphere, and incorporating it in the tissues of innumerable forests. Charred by slow heat, and gradually petrified, this woody tissue became transformed into coal, which now, dug up from its low-lying beds and burned in stoves and furnaces, is compelled to give up the radiance which it long ago purloined from the sun. When placed under the engine boiler, these transformed sunbeams are again metamorphosed into molar motions of expanding vapour, which cause the rhythmic rise and fall of the piston, and drive the running-gear of the machine-shop or propel the railway-train. In such wise it may be shown that the various agencies which man makes subservient to industrial purposes, are nothing but variously differentiated sunbeams. The windmill is driven by atmospheric currents which the sun set in motion. The water-wheel is kept whirling by streams raised by the sun to the heights from which they are rushing down. And the steam-engine derives its energy from modern or from ancient sunbeams, according as its fires are fed by wood or by coal.

But the solar energy stored up by vegetables is given out not only in such mechanical processes, but also in the vital activities of the human beings whose needs such processes supply. The absolute dependence of animal upon vegetal life is illustrated in the familiar fact that animals cannot directly assimilate inorganic compounds. The inorganic water which we drink is necessary to the maintenance of life; but it percolates untransformed through the tissues and blood-vessels, and it quits the organism in the same chemical condition in which it entered it. And although minute quantities of the salt which we daily eat, and of the carbonates and iodides of iron which we sometimes take as tonics, may perhaps undergo transformation in the tissues; it is none the less true that the substance of our tissues can only be repaired by means of the complex albuminous molecules which solar energy originally built up into the tissues of vegetables. Herbivorous animals in each of the great classes, feed directly upon vegetable fibre, and so rearrange its molecules that the resultant tissues are more highly nitrogenous than those from which they were formed. More active carnivorous animals derive from the enormous chemism latent in these nitrogenous fabrics the vital energy displayed in their rapid bounds and in their formidable grip. But the energies which imprisoned this tremendous chemical force in the complex molecules which the animal assimilates, were at first supplied by sunbeams. Metamorphosed originally into the static energy of vegetable tissue, this sun-derived power is again metamorphosed into the dynamic energy which maintains the growth of the animal organism. And from the same primeval source comes the surplus energy, which after the demands of growth or repair have been satisfied, is expended in running, jumping, flying, swimming, or climbing, as well as in fighting with enemies and in seizing and devouring prey.

Besides these indirect and doubly-indirect methods in which animals differentiate solar energy, there are ways in which the metamorphosis is directly effected. To cite Dr. Carpenter's conclusions, as epitomized by Mr. Spencer:—"The transformation of the unorganized contents of an egg into the organized chick, is altogether a question of heat: withhold heat and the process does not commence; supply heat and it goes on while the temperature is maintained, but ceases when the egg is allowed to cool. . . . In the metamorphoses of insects we may discern parallel facts. Experiments show not only that the hatching of their eggs is determined by temperature, but also that the evolution of the pupa into the imago is similarly determined; and may be immensely accelerated or retarded according as heat is artificially supplied or withheld." The phenomena thus briefly cited are to be classed under the general head of organic stimulus; and in a wide sense, one might almost say that all stimulus is the absorption of vital energy which was originally solar. Sunlight stimulates animals indirectly, as in the case of actiniæ which are made more vivacious when neighbouring sea-weed, smitten by sunbeams, pours oxygen into the water in which they move; and also in the case of hard-worked men who gain vigour from the judicious use of vegetable narcotics. The waves of motor energy which the human organism absorbs in whiffs of tobacco-smoke, are but a series of pulsations of transformed sunlight.[1] But animals are also directly stimulated by the solar rays, as in the cases of insects which begin to fly and crawl in early summer, and of hybernating mammals which emerge from their retreats at the approach of warm weather. By its stimulating effect on the retina, and thence on the medulla oblongata, sunlight quickens the breathing and circulation in higher animals, and thus facilitates the repair of tissue. In the night we exhale less carbonic acid than in the daytime. Again the stunted growth and pale sickly faces of men and women who live in coal-mines, or in narrow streets and dark cellars, are symptoms traceable to anæmia, or to a deficiency of red globules in the blood. Whence it seems not improbable that the formation of red globules, like the formation of sap in plants, may be in some way directly assisted by solar undulations.

Mysteriously allied with the vital phenomena of nutrition, innervation, and muscular action, are the psychical phenomena of feeling and thought. Though (as previously hinted and as I shall hereafter endeavour to prove) the gulf between the phenomena of consciousness and all other phenomena is an impassable gulf, which no future extension of scientific

[1] As the poet-philosopher Redi says of wine:—

> "Si bel sangue è un raggio acceso
> Di quel Sol che in ciel vedete;
> E rimase avvinto e preso
> Di più grappoli alla rete."
>
> *Bacco in Toscana; Opere*, tom. i. p. 2.

knowledge is likely to bridge over; it is nevertheless unquestionable both that every change in consciousness is conditioned by a chemical change in ganglionic tissue, and also that there is a discernible quantitative correspondence between the two parallel changes. Let us glance for a moment at certain facts which will serve to illustrate and justify these propositions.

Those changes of consciousness which are variously classified as thoughts, feelings, sensations, and emotions, cannot for a moment go on save in the presence of certain assignable physical conditions.

The *first* of these conditions is complete continuity of molecular cohesion among the parts of nerve-tissue. A nerve which is cut does not transmit sensori-motor impulses; and even where the continuity of molecular equilibrium is disturbed, without overcoming cohesion, as in a tied nerve, there is no transmission. It is in the same way that pressure on the cerebrum instantly arrests consciousness when a piece of the skull is driven in by a blow, and slowly arrests it when coma is produced by congestion of the cerebral arteries. Now the need for complete continuity of molecular equilibrium, both in the white and in the grey tissue, is a fact of no meaning unless a molecular rearrangement is an indispensable accompaniment of each change in consciousness.

*Secondly*, the presence of a certain amount of nutritive material in the cerebral blood-vessels is essential to every change in consciousness; and upon the quantity of material present depends, within certain limits, the rapidity of the changes. While rapid loss of blood causes fainting, or total stoppage of conscious changes, it is also true that lowered nutrition, implying deficiency of blood, retards the rate and interferes with the complication of mental processes. In a state of extreme anæmia not only does thinking go on slowly, but the manifold compounding and recompounding of conscious changes, which is implied in elaborate quantitative reasoning, cannot go on at all. Now the need for the constant presence of nutritive material is a meaningless fact unless each change in consciousness is dependent upon a molecular transfer between the nutritive material and the nerve-substance.

*Thirdly*, the maintenance of conscious changes requires the presence of certain particular materials in the blood, and the absence, in any save the smallest proportions, of certain other materials; while there are yet other materials upon the presence of which the rate and complication of conscious changes largely depend. The familiar fact that consciousness cannot for an instant continue unless oxygen is in contact with the grey tissue of the cerebrum, is alone sufficient to prove that no conscious change is possible, save as the accompaniment of a chemical change. On the other hand, the presence of carbonic acid or of urea in considerable quantities retards the rate and prevents the elaboration of thinking; and in still larger quantities it puts an end to consciousness. And in similar wise the effects of alcohol, opium, and hemp, as well as of that Siberian fungus whose inhaled vapour makes a straw in the pathway look too large to be jumped over, show us most vividly how immediate is the dependence of complex mental operations upon chemical changes.

*Fourthly*, the fact that the vigour and complexity of mental manifestations bear a marked ratio to the weight of the brain, to the amount of phosphorus contained in its tissue, and to the number and intricacy of the fine sinuous creases in the grey surface of the hemispheres, shows plainly that changes in consciousness are conditioned both by the amount and by the arrangement of nerve-material.

*Fifthly*, we may see a like significance in the facts that the amount of alkaline phosphates excreted by the kidneys varies with the amount of mental exertion; and that emotional excitement so alters the composition of the blood that infants have been poisoned by milk secreted by their frightened or angry mothers. And lastly may be cited the beautiful experiments of Prof. Lombard, in which the heat evolved by the cerebrum during the act of thinking was not only detected but measured, and found to vary according to the amount of mental activity going on.

These, though the most conspicuous, are but a few among the facts which force upon the physiologist the conclusion that there is no such thing as a change in consciousness which has not for its correlative a chemical change in nervous tissue. Hence we may the better understand the significance of familiar facts which point to a quantitative correlation between certain states of consciousness and the outward phenomena which give rise to them. A bright light, as measured by the photometer, produces a more vivid state of consciousness than a dim light. Substances which the thermometer declares to be hot are, under normal circumstances, mentally recognized as being hot. The consciousness of a sound varies in vividness with the violence of the concussions to which the sound is due. And bodies which are heavy in the balance excite in us correlative sensations of strain when we attempt to move them. Conversely the molar motions by which our states of feeling are revealed externally, have an energy proportional to the intensity of the feeling; witness the undulations indicative of pain, which, beginning with a slight twitching of the facial muscles, may end in spasmodic convulsions of the whole body. And of like import is the fact that gentle emotions, like slight electric and narcotic stimuli, agreeably quicken the heart's contractions; while violent emotions, suddenly awakened, may stop its beating as effectually as a stroke of lightning or a dose of concentrated prussic acid.

The bearings of such facts as these upon our theories of mental phenomena will be duly considered in future chapters.

At present we have only to regard them as furnishing conclusive evidence that the phenomena which are subjectively known as changes in consciousness, are objectively correlated with molecular motions of nerve-matter which are seen, in an ultimate analysis, to be highly differentiated forms of solar radiance. Waves of this radiance, speeding earthward from the sun at the rate of more than five hundred trillions per second, impart their motor energy to the atoms which vibrate in unison in the compound molecules of the growing grass. Cattle, browsing on this grass, and integrating portions of it with their tissues, rearrange its molecules in more complex clusters, in which the tremendous chemical energy of heat-saturated nitrogen is held in equilibrium by the aid of these metamorphosed sunbeams. Man, assimilating the nitrogenous tissues of the cow, builds up these clusters of molecules, with their stores of sun-given and sun-restrained energy, into the wondrously complex elements of white and grey nerve-tissue, which incessantly liberating energy in decomposition, mysteriously enable him to trace and describe a portion of the astonishing metamorphosis.

When one takes a country ramble on a pleasant summer's day, one may fitly ponder upon the wondrous significance of this law of the transformation of energy. It is wondrous to reflect that all the energy stored up in the timbers of the fences and farmhouses which we pass, as well as in the grindstone and the axe lying beside it, and in the iron axles and heavy tires of the cart which stands tipped by the roadside; all the energy from moment to moment given out by the roaring cascade and the busy wheel that rumbles at its foot, by the undulating stalks of corn in the field and the swaying branches in the forest beyond, by the birds that sing in the tree-tops and the butterflies to which they anon give chase by the cow standing in the brook and the water which bathes her lazy feet, by the sportsmen who pass shouting in the distance as well as by their dogs and guns ; that all this multiform energy is nothing but metamorphosed solar radiance, and that all these various objects, giving life and cheerfulness to the landscape, have been built up into their cognizable forms by the agency of sunbeams such as those by which the scene is now rendered visible. We may well declare, with Prof. Tyndall, that the grandest conceptions of Dante and Milton are dwarfed in comparison with the truths which science discloses. But it seems to me that we may go farther than this, and say that we have here reached something deeper than poetry. In the sense of illimitable vastness with which we are oppressed and saddened as we strive to follow out in thought the eternal metamorphosis, we may recognize the modern phase of the feeling which led the ancient to fall upon his knees, and adore—after his own crude, symbolic fashion—the invisible Power whereof the infinite web of phenomena is but the visible garment.

## CHAPTER VIII.

### THE BEGINNINGS OF LIFE.

Amid the chaos of ideas concerning vital phenomena which prevailed until quite recent times, it was hardly strange that organisms, even of a high order of complexity, should have been supposed to be now and then directly evolved from lifeless matter, under favourable circumstances. Every reader of ancient literature will remember how Aristæus succeeded in replacing his lost swarm of bees; and the sanction thus accorded by so erudite a poet as Virgil to the popular belief in the generation of insects from putrescent meat, is good evidence that the impossibility of such an occurrence had not yet been suspected, or at least had never been duly appreciated. Still more important is the testimony of Lucretius—who, as Prof. Huxley well says, "had drunk deeper of the scientific spirit than any other poet of ancient or modern times except Goethe"—when he alludes to the primordial generation of plants and animals by the universal mother Earth. It is, however, straining words somewhat beyond their usual meanings to call such speculations "scientific." They were the product of an almost total absence of such knowledge as is now called scientific. It was possible to infer that such highly organized creatures as hymenopterous insects, suddenly appearing in putrescent meat, were spontaneously generated there, only because so little was definitely known about the relations of organisms to one another and to the inorganic world. Accordingly with the very beginnings of modern biological knowledge, and with the somewhat more cautious and systematic employment of induction characteristic of the seventeenth century, the old belief in spontaneous generation was called in question. By a series of very simple but apt experiments, in which pieces of decaying meat were protected from maggots by a gauze covering, the illustrious Redi proved, to the satisfaction of everyone, that the maggots are not produced from the substance of the meat, but from eggs deposited therein by flies. So conclusive were these experiments that the belief in spontaneous generation, which had hitherto rested chiefly upon phenomena of this sort, was almost universally abandoned, and the doctrine that every living thing comes from some living thing—*omne vivum ex vivo*—received that general acceptance which it was destined to retain down to the present time. With the progress of biological knowledge, as the complex structures and regular modes of growth of the lower animals began to be better understood, and as the microscope began to disclose the existence of countless forms of life infinitesimal in size but complicated in organization, many of which were proved to be propagated either by fission or by some kind of germination, the doctrine *omne vivum ex vivo* became more and more implicitly regarded as a prime article of faith, and the hypothesis of spontaneous generation was not merely scouted as absurd, but neglected as unworthy of notice.

Philosophical theories conspired with observation and experiment to bring about this result. The doctrine *omne vivum ex vivo* consorted well with the metaphysical hypothesis of an *archæus* or "vital principle," by means of which Stahl and Paracelsus sought to explain the dynamic phenomena manifested by living organisms. In those days when it was the fashion to explain every mysterious group of

E E 2

phenomena by imagining some entity behind it, the activities displayed by living bodies were thought to be explained when they were called the workings of a "vital principle" inherent in the living body, but distinct from it and surviving unchanged amid its manifold alterations. If a stone falls to the ground, that is a manifestation of gravitative force; but if a stream of blood come rushing through a capillary tube and certain compound molecules of albuminous matter are taken from it and retained by the adjacent tissue, then, according to the vitalistic theory, the "vital principle" is at work. During life this "principle" continues to work; but at death it leaves the organism, which is then given up to the mercy of physical forces. Such was the theory of life which was held by many physiologists even at a time within the recollection of persons now living; and it doubtless still survives in minds uninstructed in modern science. So long as this doctrine held undisputed sway, the belief that all life proceeds from life was not likely to be seriously impugned. For whence, save by derivation from some other "principle" like unto itself, could this mysterious "vital principle" arise? Besides all this, the Doctrine of Evolution had not yet been originated; all things were supposed to have been created at once in their present condition; and, as no need was felt of explaining scientifically the origin of the highest organisms, so there was no disposition to inquire into the origin of those lowest in the scale. A series of separate creative acts was supposed to account for the whole.

Strengthened by these metaphysical conceptions, the doctrine *omne vivum ex vivo* remained in possession of the field for two centuries Phenomena apparently at variance with it—such as the occasional discovery of animalcules in closed vessels—were disposed of by the hypothesis, devised by Spallanzani, that the atmosphere is full of invisible germs which can penetrate through the smallest crevices. This hypothesis is currently known as "panspermatism," or the "theory of omnipresent germs," or (less cumbrously) as the "germ-theory."

Now, as concerns the germ-theory, to which appeal is unhesitatingly made whenever the question of spontaneous generation is discussed, it must be admitted to be extremely plausible, yet we must not forget that it has never been actually demonstrated: it has not been proved that the germ-theory can do all that its advocates require it to do. It may well be the case that the air is everywhere full of germs, too small to be seen, which are capable of giving rise to all the organisms of which there is any question in the controversy about spontaneous generation: nevertheless this has not been rigorously demonstrated. The beautiful researches of Prof. Tyndall have indeed proved that the atmosphere is everywhere filled with solid particles, in the absence of which it would not be luminous; and it is fair to suppose that among these particles there are always to be found some which are the germs of monads and bacteria. Still this can hardly be taken for granted; and Dr. Bastian is right in reminding us that it is reasoning in a circle to assume the presence of germs that cannot be detected, merely because there is no other way of accounting for the presence of monads and bacteria in accordance with the doctrine of Redi.

For in all discussions concerning spontaneous generation it should be borne in mind that the doctrine *omne vivum ex vivo* is itself on trial for its life, and cannot be summoned to the witness-box. The very point to be ascertained is whether this doctrine, which is admitted to hold good in the case of all save the lowest forms of life, holds good also of these. The doctrine rests entirely upon induction; and while, in many cases, it is legitimate to infer a universal proposition from a limited induction of instances, it is not legitimate to do so in the present case. For the fact that innumerable highly specialized types of animal and vegetal life are kept up solely by generation *ex vivo*, can in nowise prove that other living things, which are nearly or quite destitute of specialization, may not have their ranks recruited by a fresh evolution from not-living materials. Along with the absence of specialized structure, it may turn out that there is an absence of other characteristics once supposed to be common to all living things.

This will be more clearly understood as we proceed to consider the change which the last half-century has wrought in the theories of life with which Redi's doctrine has hitherto been implicated. The hypothesis of a "vital principle" is now as completely discarded as the hypothesis of phlogiston in chemistry, or as the Ptolemaic theory in astronomy: no biologist with a reputation to lose would for a moment think of defending it. The great discoveries concerning the sources of terrestrial energy, illustrated in the foregoing chapter, have made it henceforth impossible for us to regard the dynamic phenomena manifested by living bodies otherwise than as resulting from the manifold compounding of the molecular forces with which their ultimate chemical constituents are endowed. Henceforth the difference between a living and a not-living body is seen to be a difference of degree, not of kind,—a difference dependent solely on the far greater molecular complexity of the former. As water has properties that belong not to the gases which compose it, so protoplasm has properties that do not belong to the inferior compounds of which it is made up. The crystal of quartz has a shape which is the resultant of the mutual attractions and repulsions of its molecules; and the dog has a shape which is ultimately to be explained in the same way, save that in this case the process has been immeasurably more complex and indirect. Such, in brief, is the theory by which the vitalistic doctrine of Stahl has been replaced. Instead of a difference in kind between life and not-life, we get only a difference of degree, so that it again becomes credible that, under favouring circumstances, not-life may become life.

In the next place the overthrow of the dogma of fixity of species, and the consequent general displacement of the Doctrine of Creation by the Doctrine of Evolution, have made the scientific world familiar with the conception of the development of the more specialized forms of life from less specialized forms; and thus the development of the least specialized forms of life from the most complex forms of not-life ceases to seem absurd, and even acquires a sort of probability. And finally, the researches of geologists, showing that our earth's surface was once "melted with fervent heat," and confirming the theory of the nebular origin of our planet, have rendered it indisputable that there must once have been a time when there was no life upon the earth; so that certainly at some time or other, though doubtless not by a single step but by a number of steps, the transition from not-life to life must have been made. Hence the doctrine *omne vivum ex vivo*, as now held, means neither more nor less than that every assemblage of organic phenomena must have had as its immediate antecedent some other assemblage of phenomena capable of giving rise to it: in other words, the doctrine has become little more than a specialized corollary from the persistence of force. In the case of all save the lowest organisms, the only antecedent phenomenon capable of giving rise to the organism in question has been inductively proved to be some other organism. But in the case of the lowest organisms it is theoretically possible that the requisite antecedent may in some instances be an assemblage of unorganized materials; and it remains for induction to show whether this possibility is ever actually realized or not, under existing terrestrial conditions.

Such being the modification which modern discoveries have imposed upon the doctrine *omne vivum ex vivo*, it need hardly be added that the hypothesis of spontaneous generation has undergone a no less important change. The theory that an organism which is to any extent specialized in structure can arise directly from a union of unorganized elements is ruled out of court. Such a conception, though it might be harmonized with the hypothesis of special creations, is utterly condemned by the Doctrine of Evolution. So long as it was possible to believe that enormously complex birds and mammals were somehow conjured into existence, like Aladdin's palace, in a single night, by a kind of enchantment which philosophers sought to dignify by calling it "creative fiat," it might well have seemed possible for animalcules to be spontaneously generated in air-tight flasks, or even for maggots to arise *de novo* in decaying meat. Such a view might have been logically defensible, though it was not the one which actually prevailed. But now, in face of the proved fact that thousands of years are required to effect any considerable modification in the specific structures of plants and animals, it has become impossible to admit that such specific structures can have been acquired in a moment, or otherwise than by the slow accumulation of minute peculiarities. Hence "spontaneous generation" can be theoretically admitted only in the case of living things whose grade of composition is so low that their mode of formation from a liquid solution may be regarded as strictly analogous to that of crystals. And when the case is thus stated it becomes obvious that the phrase "spontaneous generation" is antiquated, inaccurate, and misleading. It describes well enough the crude hypothesis that insects might be generated in putrefying substances without any assignable cause; but it is not applicable to the hypothesis that specks of living protoplasm may be, as it were, *precipitated* from a solution containing the not-living ingredients of protoplasm. If such an origination of life can be proved, none will maintain that it is "spontaneous," since all will regard as the assignable cause the chemical affinity exerted between the enormously complex molecules which go to make up the protoplasm. No one speaks of "spontaneous crystallization"; and the ideas suggested by the use of the word "spontaneous" are such as to detract seriously from its availableness as a scientific term. We need a phrase which shall simply describe a fact, without any admixture of hypothesis; and we may cordially recommend, as such a phrase, Dr. Bastian's *archebiosis*, which, without violence to etymology, may be said to mean "life in its beginning,"—or, more freely, "beginning of life."

With these preliminaries, the precise question now at issue between the believers in "spontaneous generation" and their opponents may be stated as follows:—*Can archebiosis be made to occur at the present day by artificial means?* Or, to be still more accurate, *Has archebiosis actually been made to occur at the present day by artificial means?* Is it possible for the experimenter, without any assistance from life already existing, to obtain living things, merely by bringing together the chemical constituents of protoplasm, under suitable physical conditions? Or, granting the possibility, can it be proved that living things have actually been thus obtained? To this twofold question there are returned diverse answers. On the one hand, Dr. Bastian maintains that himself and other experimenters have actually seen archebiosis artificially brought about. On the other hand, it is likely to be maintained by most competent critics that, while there may be no good reason for denying the possibility of such a triumph of experiment, we have not yet sufficient proof that it has been really achieved.

It should not be forgotten that the decision of the more general question of the origin of life on the earth's surface does not depend upon the way in which this special controversy is decided. While it is true that the success of experiments like those of Dr. Bastian would furnish conclusive inductive proof of archebiosis, it is also true that their complete failure can in no wise be cited in evidence against the doctrine. On the one hand, the artificial production of living things, by giving us ocular testimony to the beginnings of life, would no doubt enlighten us considerably as to the physical and chemical conditions under which life originates; and it is, therefore, highly desirable that experimenters should be able to construct living protoplasm in the laboratory, just as it was desirable, a few years ago, that chemists should be able to produce such organic compounds as alcohol, sugar, and urea,—substances which until lately were thought to be, for some mysterious reason, inaccessible to human art, but which are now constructed with ease. But on the other hand, even the demonstrated impossibility of producing living things artificially would not weigh a grain in the scale against the doctrine that archebiosis may now occur, and must at some time have occurred, in the great laboratory of nature. That an evolution of organic existence from inorganic existence must at some time have taken place, is rendered certain by the fact that there was once a time when no life existed upon the earth's surface. That such evolution may even now regularly take place, among such living things, for instance, as the *Bathybius* of Haeckel—a sort of albuminous jelly growing in irregular patches on the sea-bottom —is perhaps not impossible. But that such evolution has been known to take place in air-tight flasks containing decoctions of hay, and has moreover resulted in the formation of organisms like vibrios and fungus-spores, is quite another proposition, which the assertor of archebiosis is in no way bound to maintain, and with the fate of which he need not feel himself vitally concerned.

The question of "spontaneous generation," then, is but a part, and not the most essential part, of the question as to the origin of life; and we need not be surprised at finding among Dr. Bastian's opponents such an avowed evolutionist as Prof. Huxley. Practically, moreover, the question at issue between the advocates of "spontaneous generation" and their antagonists is even narrower than appears from the above statement of it. As practically conducted, the dispute is confined to the question whether certain particular low forms of life—known as vibrios, bacteria, torulæ, and monads—which appear in putrescence or in fermentation, are produced by archebiosis, or are propagated from germs conveyed in the atmosphere.

If Dr. Bastian's position with reference to this question is destined to become substantiated, his work may perhaps mark an epoch in biology hardly less important than that which was inaugurated by Mr. Darwin's "Origin of Species." Unfortunately, the kind of proof which is needed for Dr. Bastian's main thesis is much more difficult, both to obtain and to estimate properly, than the kind of proof by which the theory of natural selection has been substantiated. In the latter case what was needed was some principle of interpretation which should account for the facts of the classification, embryology, morphology, and distribution of plants and animals, without appealing to any other agencies than such as can be proved to be actually in operation; and it is because the theory of natural selection furnishes such a principle of interpretation that it has met with such ready acceptance from the scientific world.[1] On the other hand, the fate of the theory of archebiosis, in the shape in which it is held by Dr. Bastian, depends upon the issue of a series of experiments of extraordinary delicacy and difficulty,—experiments which are of value only when performed by scientific experts of consummate training, and which the soundest critic of inductive methods must find it perilous to interpret with confidence, unless he has had something of the training of an expert himself. For however easy it may seem to the uninitiated to shut up an organizable solution so securely that organic germs from the atmosphere cannot even be imagined capable of gaining access to it, this is really one of the most arduous tasks which an experimenter has ever

[1] I am here anticipating the argument of the two following chapters.

had set before him. Yet to such rigour of exclusion is the inquirer forced who aims at settling the question by the direct application of the Method of Difference. And thus the question at issue is reduced to that unpromising state in which both parties to the dispute are called upon to perform the apparently hopeless task of proving a negative. When living things appear in the isolated solution, the adherents of the germ-theory are always able to point out some imaginable way in which germs might have got in. On the other hand, when the panspermatists adduce instances in which no living things have been found, the believers in archebiosis are able to maintain that the failure was due, not to the complete exclusion of germs from without, but to the exclusion of some other physical condition essential to the evolution of living matter. And from this closed circle of rebutting arguments there seem at present to be no means of egress.

But in so far as the interpretation of Dr. Bastian's experiments is intended to throw light upon the beginnings of life on the earth, there is a manifest anomaly in the use of such liquid menstrua as the infusions of hay, turnip, beef, or urine, which Dr. Bastian ordinarily employs. Whatever archebiosis may occur in such media can hardly be like the process by which living things first came into existence; since the existence of the beef or turnip implies the previous existence of organisms high in the scale. The positive detection of archebiosis in these and similar menstrua will, of course, have an interest of its own; but, as Mr. Spencer well says, "a tenable hypothesis respecting the origin of organic life must be reached by some other clew than that furnished by experiments on decoction of hay and extract of beef." To meet this objection Dr. Bastian has in some experiments used only inorganic substances, like phosphate of soda, and the oxalate, tartrate, or carbonate of ammonia, in which the elements essential to the formation of protoplasm are present.

Yet in such menstrua as these he believes that he has found even fungus-spores "spontaneously" generated.

The contrast here vividly brought before us draws attention to what would seem to be one of the weakest points in Dr. Bastian's theory. It is a long way from tartrate of ammonia and phosphate of soda to the spores of a fungus. It seems too long a way to be traversed in a few days or weeks amid merely the simple conditions which exist within a closed flask. A fungus-spore is not mere shapeless protoplasm. In it, as in the bacterium and the vibrio, there is a visible specialization of structure, albeit a slight specialization. These infusoria are "lowest organisms," no doubt: still they are really organisms and not merely masses of organic matter. They have forms which are more or less persistent; and in this fact is to be seen the strongest of the objections which may be urged *à priori* against Dr. Bastian's views. For organic form is a circumstance into which heredity largely enters; and where we find organisms even so simple as the jointed rods which are called vibrios, it is difficult, on theoretical grounds, not to accredit them with a regular organic parentage. Such considerations cannot weigh against a crucial experiment; but in the present state of the question they are entitled to serious attention. Dr. Bastian argues, with great ingenuity, that just as crystals, growing in a liquid menstruum, take on shapes that are determined by the mutual attractions and repulsions of their molecules, so do these colloidal bodies, which we call monads and bacteria, arising by "spontaneous generation" in liquid menstrua, take on forms that are similarly determined. The analogy, however, is not exact. I am not disposed to deny that the shape of a bacterium, or indeed of a wasp, a fish, a dog, or a man, is due, quite as much as the shape of a crystal of snow or quartz, to the forces mutually exerted on each other by its constituent molecules. But it must be remembered that in the case of an organism, the direction of these forces depends, in a way not yet explained, upon the directions in which they have been exerted by ancestral organisms. In other words a set of definite tendencies has been acquired during the slow evolution of organic life; and it may well be doubted that, even in the case of the bacterium, a tendency toward the formation of single or double nuclei can have been gained during the evolution of a single generation of individuals. For in colloidal matter, as such, there is no definite tendency toward the formation of nuclear spots, such as are seen in bacteria. It is a main characteristic of colloids, as contrasted with crystalloids, not to have any specific form. It is, therefore, hard to believe that, during the decomposition of some saline liquid, the freed elements not only recombine into a colloid, but even go so far as to take on the specific shape of a bacterium or vibrio, When any such succession of phenomena appears to occur, it clearly points to the ill-understood but imperative fact of heredity through a long past.

Until this difficulty is either cleared away by trustworthy deduction, or overridden by some crucial experiment, I do not think that the advocates of "spontaneous generation" can be said to have made out their case; and such an abstruse question is here opened that it is not likely soon to be settled.

For the present, in representing to ourselves how life may have originated upon the earth, we are reduced to a few most general considerations. However the question may eventually be decided as to the possibility of archebiosis occurring at the present day amid the artificial circumstances of the laboratory, it cannot be denied that archebiosis, or the origination of living matter in accordance with natural laws, must have occurred at some epoch in the past. That life has not always existed upon the earth's surface is certain; and the following considerations will show that in its first appearance there need not have been anything either sudden or abnormal.

When our earth, refusing to follow in their retreat the heavier portions of the solar nebula, began its independent career as a planet, its surface was by no means so heterogeneous as at present. We may fairly suppose that the temperature of that surface cannot have been lower than the temperature of the solar surface at the present time, which is estimated at three million degrees Fahrenheit, or some fourteen thousand times hotter than boiling water. At such a temperature there could have been no formation of chemical compounds, so that the chief source of terrestrial heterogeneity did not exist; while physical causes of heterogeneity were equally kept in abeyance by the maintenance of all things in a gaseous state. We have now to note how the mere consolidation and cooling of this originally gaseous planet must have given rise to the endless variety of structures, organic as well as inorganic, which the earth's surface now presents. The origination of life will thus appear in its proper place, as an event in the chemical history of the earth. Let us see what must have been the inevitable chemical consequences of the earth's cooling.

In a large number of cases heat is favourable to chemical union, as in the familiar instance of lighting a candle, a gas-jet, or a wood-fire. The molecules of carbon and oxygen, which will not unite when simply brought into juxtaposition, nevertheless begin rapidly to unite as soon as their rates of undulation are heightened by the intense heat of the match. In like manner the phosphoric compound with which the end of the match is equipped refuses to take up molecules of atmospheric oxygen, until its own molecules receive an increment of motion supplied by the arrested molar motion of the match along a rough surface. So oxygen and hydrogen do not combine when they are simply mingled together in the same vessel; but when sufficiently heated they explode, and unite to form steam. In these, and in many other cases, a certain amount of heat causes substances to enter into chemical union. But it is none the less true that an enormous supply of heat implies such violent molecular undulation as to render chemical union impossible. Since the mode of attractive force known as chemism acts only at infinitesimal distances, the increase of thermal undulation, which at first only causes such a molecular rearrangement as to allow mutually-attracting molecules to rush together, must at last cause such a separation of particles that chemism will be unable to act. This inference from known laws of heat is fully verified by experiment, in the case of all those compounds which we can decompose by such thermal means as we have at command. Speaking generally, the most complex compounds are the most unstable, and these are the soonest decomposed by heat. The highly complex organic molecules of fibrine and albumen are often separated by the ordinary heat of a summer's day, as is witnessed in the spoiling of meat. Supersalts and double salts are decomposed at lower temperatures than simple salts; and these again yield to a less amount of heat than is required to sunder the elements of deutoxides, peroxides, etc. The protoxides, which are only one degree more complex than simple elements, withstand a still higher temperature, and several of them refuse to yield to the greatest heat which we can produce artificially. No chemist, however, doubts that a still greater heat would decompose even these.

We may thus picture to ourselves the earth's surface as at the outset composed only of uncombined elements, of free oxygen, hydrogen, nitrogen, carbon, sulphur, etc., and of iron, copper, sodium, and other metals in a state of vapour. With the lowering of this primitive temperature by radiation, chemical combinations of greater and greater heterogeneity became gradually possible. First appeared the stable binary compounds, such as water and the inorganic acids and bases. After still further lowering of temperature, some of the less stable compounds, such as salts and double salts, were enabled to appear on the scene. At a later date came the still more heterogeneous and unstable organic acids and ethers. And all this chemical evolution must have taken place before the first appearance of living protoplasm. Upon these statements we may rest with confidence, since they are immediate corollaries from known properties of matter.

When it is asked, then, in what way were brought about the various chemical combinations from which have resulted the innumerable mineral forms which make up the crust of the globe, the reply is that they were primarily due to the unhindered working of the chemical affinities of their constituent molecules as soon as the requisite coolness was obtained. As soon as it became cool enough for oxygen and hydrogen to unite into a stable compound, they did unite to form vapour of water. As soon as it became cool enough for double salts to exist, then the mutual affinities of simple binary compounds and single salts, variously brought into juxtaposition, sufficed to produce double salts. And so on, throughout the inorganic world.

Here we obtain a hint as to the origin of organic life upon the earth's surface. In accordance with the modern dynamic theory of life, we are bound to admit that the higher and less stable aggregations of molecules which constitute protoplasm were built up in just the same way in which the lower and more stable aggregations of molecules which constitute a single or a double salt were built up. Dynamically, the only difference between carbonate of ammonia and protoplasm, which can be called fundamental, is the greater molecular complexity and consequent instability of the latter. We are bound to admit, then, that as carbonic acid and ammonia, when brought into juxtaposition, united by virtue of their inherent properties as soon as the diminishing temperature would let them; so also carbon, nitrogen, hydrogen, and oxygen, when brought into juxtaposition, united by virtue of their inherent properties into higher and higher multiples as fast as the diminishing temperature would let them. until at last living protoplasm was the result of the long-continued process.

While by following such considerations as these into greater detail the mode in which protoplasm must have arisen may by and by be partially comprehended, it is at the same time true that the ultimate mystery—the association of vital properties with the enormously-complex chemical compound known as protoplasm—remains unsolved. Why the substance protoplasm should manifest sundry properties which are not manifested by any of its constituent substances, we do not know; and very likely we shall never know. But whether the mystery be for ever insoluble or not, it can in no wise be regarded as a solitary mystery. It is equally mysterious that starch or sugar or alcohol should manifest properties not displayed by their elements, oxygen, hydrogen and carbon, when uncombined. It is equally mysterious that a silvery metal and a suffocating gas should by their union become transformed into table-salt. Yet, however mysterious, the fact remains that one result of every chemical synthesis is the manifestation of a new set of properties. The case of living matter or protoplasm is in nowise exceptional.

In view of these considerations it may be held that the evolution of living things is a not improbable concomitant of the cooling down of any planetary body which contains upon its surface the chemical constituents of living matter. It may perhaps turn out that we can no more reproduce in the laboratory the precise groups of conditions under which living matter was first evolved than we can obtain direct testimony as to the language and civilization of our pre-historic ancestors. But, just as it is conceded to be possible, by reasoning upon established philological principles, to obtain some trustworthy results as to the speech and culture of the pre-historic Aryans, so it must be admitted that, by reasoning upon known facts in physical science, we may get some glimpse of the circumstances which must have attended the origin of living aggregations of matter. By following out this method new light will no doubt eventually be thrown upon the past history of our planet, and a sound basis will be obtained for conjectures regarding the existence of living organisms upon some of our neighbour worlds.

In this account of the matter we have completed, so far as is needful for the purposes of this work, our exposition of the evolution of the earth. Combining the results obtained in the three foregoing chapters, we may contemplate in a single view the wonderful advance in determinate multiformity which has resulted from the integration of the earth's matter, with the accompanying dissipation of its internal motion. We have witnessed this process of evolution as manifested in geologic and meteorologic phenomena; we have followed the wondrous differentiations and integrations of the molecular motion which the cooling and consolidating earth has received from the centre of our system; and finally, from that very cooling and consolidation upon which all the foregoing phenomena are dependent, we have shown that there must naturally have ensued a progressive chemical heterogeneity, resulting at last in the genesis of compounds manifesting those properties which we distinguish as vital. Thus the continuity in cosmic evolution is grandly exhibited, and we see more clearly than ever that between the various provinces of natural phenomena there are no sharp demarcations. As the geologic development of the earth is but a specialized portion of the whole development of the solar system,—a portion which we separate from the rest and assign to a special science, solely for convenience of study; so the development of living matter is but a specialized portion of the whole development of the earth, and it is only for reasons of convenience that the formation of primeval protoplasm is assigned to a different science from that which deals with the formation of limestone or silica. Though as we advance from a lower grade of heterogeneity to a higher grade, we encounter differences of property or of functional manifestation which we may broadly classify as differences of kind, the conclusion is nevertheless forced upon us that such differences of kind are ultimately reducible to differences of degree, and that at bottom there is no break whatever in the continuity of the process of Evolution.

It is not pretended, however, that these considerations fulfil all the requirements of a scientific explanation of the genesis of life. Essentially sound as I believe them to be, they do but point out the direction in which an explanation is to be sought. A complete explanation of the origin of life must include not only a statement of the general conditions under which life originated, such as I have here attempted to offer, but also a statement of the specific combination of circumstances which gave rise to such an event. If Dr. Bastian's theory of archebiosis can be inductively established, it may possibly help us to such a statement. But the considerations above adduced make it probable that a wider view of the case is needful than is implied in Dr. Bastian's researches. It seems likely that the genesis of living matter occurred when the general temperature of the earth was very different from what it is in the present day; and in order to engage in a profitable course of experimentation, we must first seek to determine, and then to reproduce if possible, all the requisite conditions associated with that general difference in temperature. Whether this can be done, still remains to be seen. That the problem seems hopeless to-day might have been to Comte a sufficient reason for condemning it as vain and profitless. But the history of stellar astronomy may teach us to beware of thus hastily judging the capacity of the future by that of the present. Till within a few years it would have seemed to the wisest man incredible that we should ever be able to determine the direct approach or recession of a star. Yet, from a quarter least expected, a flood of light has been shed upon this most difficult problem. As the doe, in the old fable, keeping her sound eye landward, was at last shot by archers passing in a boat, so Nature has here been forced to render up her secret in the most unlooked-for way. Through the amazing results obtained by spectrum analysis it has turned out that the heavier difficulty has become the lighter one, and that the direct approach or recession of a star, which affords no parallax, is actually easier to measure than its thwart-motion which affords parallax! In like manner the specific solution of the problem of the origin of life need not be despaired of, nor need we wonder if it come from some quite unsuspected quarter.

Meanwhile the considerations above alleged will enable us to put the grand phenomenon of the genesis of life into its proper place among the phenomena of telluric evolution. The gulf between the geologic phase of the process and the biologic phase is so far bridged for us that we may approach the study of the latter without misgivings. In the following chapter I shall enumerate the reasons which compel us to accept the doctrine of the derivation of the more complex forms of life from less complex forms; and because of the interest which just now attaches to the question, I shall make more explicit mention of the opposing doctrine of special creations than its own merits would otherwise justify.

# CHAPTER IX

## SPECIAL-CREATION *or* DERIVATION?

WHATEVER may be said in condemnation or approval of the method of estimating the worth of men and women by an inquiry into their pedigrees, it cannot be denied that there is often much value in such a method of estimating the worth of current ideas. Obviously a theory which was framed in a barbarous age, when men were alike unfamiliar with the conceptions of physical causation and uniformity of law and ignorant of the requirements of a valid scientific hypothesis, and which has survived until the present day, not because it has been uniformly verified by observation or deduction, but because it has been artificially protected from critical scrutiny by incorporation with a system of theological dogmas assumed to be infallible,—obviously such a theory is at the outset discredited by its pedigree. A presumption is at once raised against it, which a critical examination may indeed do away with, but which for the moment cannot fail to have some weight with a jury of inquirers familiar with the history of human thinking. On the other hand a theory is *à priori* accredited by its pedigree when it is framed in a cultivated age by thinkers familiar alike with the special phenomena which form its subject-matter and with the requirements of scientific hypothesis in general; and when, in spite of theological or sentimental prejudice, it so thrives under the most rigorous critical scrutiny that each successive decade enlists in its support a greater and greater number of the most competent investigators of nature. I do not say that such an *à priori* presumption should ever be taken as decisive in favour of any hypothesis. I say only that such considerations do have their weight, and ought to have their weight, in determining the general state of mind which we bring to the discussion of the relative merits of two theories so different in their pedigrees as are the two theories which we are now about to examine. If, with my eyes closed upon all the significant facts which bear upon the question of the origin of species, I were required to decide between two hypotheses, of which the one was framed in an age when the sky was supposed to be the solid floor of a celestial ocean, while the other was framed in an age when Lagrange and Laplace were determining the conditions of equilibrium of the solar system, I should at once decide, on general principles, in favour of the latter. And on general principles I should be quite justified in so deciding.

Happily, however, we are not called upon to render a decision, upon this or upon any other scientific question, with our eyes shut. In the present chapter we have to examine two opposing hypotheses relating to the origination of the multitudinous complex forms of animal and vegetal life which surround us. And of these two opposing hypotheses we shall find it not difficult to show that the one is discredited, not only by its pedigree and not only by the impossible assumptions which it would require us to make, but also by every jot and tittle of the scientific evidence, so far as known, which bears upon the subject; while the other is not only accredited by its pedigree, and by its requiring us to make no impracticable assumptions, but is also corroborated by all the testimony which the patient interrogation of the facts of nature has succeeded in eliciting. The former hypothesis, originating in the crude mythological conceptions of the ancient Hebrews, and uncritically accepted until the time of Lamarck and Goethe, in deference to a tradition which invested these mythological conceptions with a peculiar and unwarranted sacredness, is known as the Doctrine of Special Creations. The latter hypothesis, originating in the methodical study of the phenomena of organic life, held by a large number of biologists during the first half of the present century, and of late years accepted by nearly all, may be called the Doctrine of Derivation.

In describing the special-creation hypothesis, we are confronted by an initial difficulty, due to the enormous change which has occurred in men's habits of thinking since the mythopœic age when it first gained currency. The Hebrew writer, indeed, presents us with a concrete picture of the creation of man, according to which a homogeneous clay model of the human form is, in some inconceivable way, at once transmuted into the wonderfully heterogeneous combination of organs and tissues, with all their definite and highly specialized aptitudes, of which actually living man is made up. But I suppose there are few scientific writers at the present day who would be found willing to risk their reputation for common-sense by attempting to defend such a conception. The few naturalists who still make a show of upholding the special-creation hypothesis, are very careful to refrain from anything like a specification of the physical processes which that hypothesis may be supposed to imply. When overtly challenged, they find it safest to shrink from the direct encounter, taking refuge in grandiloquent phrases about "Creative Will" and the "free action of an Intelligent Power," very much as the cuttle-fish extricates itself from a disagreeable predicament by hiding in a shower of its own ink. But, however commendable such phrases may be when regarded as a general confession of faith, they are much worse than useless when employed as substitutes for a scientific description of facts. They only serve to encourage that besetting sin of human thinking, which accepts a play upon words as an equivalent for a legitimate juxtaposition of valid conceptions.

When translated, however, from the dialect of mythology into the dialect of science, the special-creation hypothesis asserts that the untold millions of organic molecules of which an adult mammal is composed all rushed together at some appointed instant from divers quarters of the compass, and, spontaneously or in virtue of some inexplicable divine sorcery, grouped themselves into the form of an adult organism, some of them arranging themselves into infinitely complicated nerve-fibres and ganglionic cells, others into the wonderfully complex contractile tissue of muscles, while others again were massed in divers convoluted shapes, as lungs, intestines, blood-vessels, and secreting glands. Or, if a different form of statement be preferred, at one moment we have a background of landscape, with its water and its trees, its sands and its herbage, and at the next succeeding moment we have in the foreground an ox or a man, or, according to another view, a herd of oxen and a group of men, and all this without any assignable group of physical antecedents intervening! He who can believe that St. Goar, of Trèves, transformed a sunbeam into a hat-peg, or that men were once changed into werewolves by putting on an enchanted girdle, or that Joshua and Cardinal Ximenes constrained the earth to pause in its rotation, will probably find no difficulty in accepting such a hypothesis to account for the origin of men and oxen. To persons in such a stage of culture it is no obstacle to any hypothesis that it involves an assumption as to divine interposition which is incapable of scientific investigation and uninterpretable in terms of human experience. It can hardly be denied, however, that any hypothesis which involves such an assumption is at once excluded from the pale of science, and relegated to the regions of mythology, where it may continue to satisfy those to whom mythologic interpretations of natural phenomena still seem admissible, but can hardly be deemed of much account by the scientific inquirer.

On the other hand, according to the doctrine of derivation, the more complex plants and animals are the slowly modified descendants of less complex plants and animals, and these in turn were the slowly modified descendants of still less complex plants and animals, and so on until we converge to those primitive organisms which are not definable either as animal or as vegetal, but which in their lowest forms are mere shreds of jelly-like protoplasm, such as the spontaneous combination of colloidal clusters of organic molecules might well be capable of originating under appropriate conditions, after the manner pointed out in the preceding chapter. The agencies by which this slow derivation of higher from lower forms has been effected are agencies such as are daily seen in operation about us; namely, individual variation, adaptation to environing circumstances, and hereditary transmission of individual peculiarities. Obviously such a hypothesis is not only highly credible in itself, since it only alleges that the growth of a complex organism from a simple globule of protoplasm, which is accomplished in every case of individual evolution, has also been accomplished during the evolution of an immensely long series of individuals; but it is also a purely scientific hypothesis, since it appeals to no agencies save such as are known to be in operation, and involves no assumptions which cannot, sooner or later, be subjected to a crucial test.

These preliminary considerations show how strong is the legitimate presumption in favour of the theory of derivation. But the case is not to be dismissed upon these summary, though forcible, considerations. To the general reasons here assigned for preferring the theory of derivation to the theory of special creations, a scientific survey of the phenomena will add a number of special reasons. Four kinds of arguments in favour of the hypothesis of derivation are furnished respectively by the Classification of plants and animals, by their Embryology, by their Morphology, and by their Distribution in space and time. I shall devote the present chapter to the consideration of these four classes of arguments; reserving for the following chapter the explanation of the agencies which have been at work in forwarding the process of development.

I. The facts which are epitomized in tabular classifications of animals and plants, are so familiar to us that we seldom stop to reflect upon their true significance. And in any bald statement of them which might here be made, the impression of triteness would perhaps be so strong as to prevent that significance from being duly realized, save by the student of natural history. To present in the strongest light the evidentiary value of these facts, I shall therefore have recourse to an analogous series of facts in a quite distinct science, where the significance of the classification is illustrated by the known history of the phenomena which are classified. Like the sciences of zoology and botany, the science of philology is pre-eminently a classificatory science, using the method of comparison as its chief implement of inductive research. And philology, at least so far as the study of the Aryan languages is concerned, has been carried to such a high degree of scientific perfection, as regards the accuracy of its processes and the certainty of its results, that we may safely gather from it such illustrations as suit our present purpose.

The various Aryan or Indo-European languages are demonstrably descended from a single ancestral language, in the same sense in which the various modern Romanic languages are all descended from the vulgar Latin of the Western Empire. By slow dialectic variations in pronunciation, and in the use of syntactical devices for building up sentences, these languages have been imperceptibly differentiated from a single primeval language, until they are now so unlike that not one of them is intelligible, save after careful study, to the speakers of another. The minute variations of which the cumulative result is this manifold unlikeness, have not proceeded at haphazard; but they have all along been determined by certain phonetic conditions, which have been so thoroughly generalized, that philologists can now occasionally reconstruct extinct words, after a fashion somewhat similar to that in which Prof. Huxley would, I presume, reconstruct an extinct animal upon seeing one of its fossilized bones or teeth.

But what now chiefly concerns us is the fact that all existing Aryan languages are the modified descendants of a common progenitor. Bearing this in mind, let us note sundry features of the classification of these languages. In the first place, it is impossible to arrange them in any linear series which will truly represent their relations to each other. In some respects Sanskrit is nearest the original type, in other respects it is Lithuanian which shows the least departure, in other respects it is Old Irish, and in yet others it is Latin. Even if we decide to make a compromise, and to begin with Sanskrit, as being on the whole the least modified of these languages, we cannot stir many steps without getting into difficulties. Suppose we say Sanskrit, Lithuanian, Old Irish, Latin, Old Slavic, Zend, Greek, Gothic, Old German. See now what we have been doing! We have indeed got Old Irish and Latin close together, as they ought to be, and we have done right in putting Gothic and Old German side by side; but we have been obliged to thrust in half a dozen languages between Sanskrit and Zend, and between Latin and Greek there is a similar unseemly divorce. When we come to take in the later dialects, the confusion becomes still more hopeless. If after Sanskrit we put in Prakrit and Pali, Urdu and Bengali, and a dozen other derivatives, we must then jump back to Latin, for instance, and after following along through Italian, Spanish, French, and their sister-dialects, jump back again to some ancient language. Obviously this is violating all the requirements of proper classification, which consists in putting nearest together those objects which are nearest alike.

In view of these and other kindred difficulties, philologists have long since agreed to arrange the Aryan family of languages in divergent and re-divergent groups and sub-groups, along lines which ramify like the branches, branchlets, and twigs of a tree. Let us trace the pedigree of the French and English languages, according to this principle of classification as elaborated by Schleicher, remembering that while other philologists have objected to some of the details of the classification,[1] all agree, and must agree, in the fundamental principle. Starting, then, from the Aryan mother-tongue, we first encounter two diverging lines of development, represented by two extinct phases of language which we may call the South Aryan and North Aryan. Following the progress of the South Aryan, we find it diverging on the one hand into Indo-Iranian, and on the other hand into the parental form of the Hellenic, Italic, and Keltic languages. Neglecting the other branches, and following only the Italic, we find the divergent forms of this exemplified in Umbrian, Oscan, and Latin; and again, following the career only of the latter branch, we arrive at French and its kindred Romanic dialects. On the other hand, as we follow the North Aryan line, we find it first dividing into Teutonic and Slavo-Lettish. Neglecting the latter, we observe the Teutonic again diverging into Gothic, Old Norse, and Old German. Following only the latter of these, we may observe it bifurcating into High and Low German, from the latter of which is derived the English which we speak.

[1] Indeed it is possible that the primary division should be into Eastern and Western, or European and Asiatic, rather than Northern and Southern Aryan. But the future decision of this question will not alter the principle upon which the classification is founded and which it is here cited to exemplify.

Now if we take a general survey of this family-tree, we find that kindred words in languages down near the trunk resemble each other closely, while kindred words in languages high up on the twigs have often well-nigh lost all traces of their primitive family-likeness. To be sure we can still recognize the English *daughter* in the Sanskrit *duhitr*, but such strong resemblances are not usual, and it is only too easy to look at a page of Sanskrit without realizing its kinship with English. But to show how the likeness diminishes as we recede from the original source, let us consider two English words—one of which has come to us by natural descent, through the North Aryan line, while the other has come to us, by adoption, from the South Aryan stock. No two words could well be more unlike than the words *pen* and *feather*. Of these the latter is a purely English word, while the former is a word we have adopted from the Latin. Now great as is the difference between these two words, it very nearly disappears when we have recourse to their Old Aryan prototypes *pata-tra* and *pat-na*. *Pat* is a word designating flight. *Pata-tra* and *pat-na* are words designating a wing, or instrument used in flying. In the course of the North Aryan development *pata-tra* becomes *fath-thra* and finally *feather*, just as *patar* becomes *father*, in accordance with a general tendency of the Teutonic toward aspirating the hard mutes of the old language; while on the other hand, in the course of the South Aryan development *pat-na* became first *pes-na* and then *pen-na*, in accordance with a general tendency of the Latin toward the assimilation of contiguous consonants. Who but a linguist, knowing the history of the words, and familiar with the general principles of phonetic change, would suspect that words apparently so distinct as *pen* and *feather* could be referred so nearly to a common origin? Or consider the French *larme* and the English *tear*. These words are demonstrably descended from the same ancestral form *dakru-ma*. But while the South Aryan form has undergone one kind of change into the Latin *lacru-ma*, and thence into the French *larme*; the North Aryan form has undergone another kind of change into the Old German *tagr*, and thence into the English *tear*.

Thus in general, as we go backward in time, we find the lines of linguistic development drawing together. Between the various Low-Dutch dialects spoken along the north coast of Germany, the differences are hardly great enough to interfere with mutual intelligibility. Again, between Portuguese and Spanish the differences are so small that one who is well acquainted with Spanish can often get the sense of many pages in a Portuguese book without having specially studied the latter language. But German and Spanish have few mutually intelligible words in common, and their differences in idioms and in structure of sentences are no less conspicuous. While it might be possible to maintain that Dutch and Platt-Deutsch, or that Portuguese and Spanish, are only dialects of the same language, no one would hesitate about calling Teutonic and Romance quite different forms of language. Yet we need only go back far enough to find the demarcation quite as obscure in the one case as in the other; for Teutonic and Romance began as the northern and southern dialects of the same Old Aryan language. In similar wise we may say that, even with the keenest linguistic instinct, it would be difficult to decipher a line of modern Persian by reason of its kinship with modern Greek; while yet it is undeniable that the Persian spoken by the officers of Xerxes was strikingly similar to the Greek spoken by Demaratos and Leonidas.

In citing this example from the phenomena of language, I do not cite it as direct testimony in favour of the theory of derivation in biology. Because *tear* and *larme* can be traced back to a common form, it does not follow that the pig and the horse have a common ancestor. Yet, while the linguistic parallel is by no means available as direct testimony in a biological question, it has nevertheless a logical value so important that zoologists as eminent as Haeckel and philologists as profound as Schleicher have not failed to insist upon it. What we see exemplified in these linguistic phenomena, is *the way in which a classification must be framed in all cases where we have to express complex genetic relationships.* We see that where a multitude of objects are associated by a common genesis, we cannot classify them in a linear series, but only in groups and sub-groups, diverging from a common trunk, like the branches and twigs of what we very aptly term a "family-tree." And on the general principles of hereditary relationship, we see that objects near the common trunk will depart less widely from the primitive ancestral type, and will therefore resemble each other more closely, than objects far up on the ends of the branches. A comparison of the different races of Aryan men would bring out the same results as the comparison of their languages. After making all allowances for the intermixture of the Aryans with divers aboriginal races in Europe and Asia, it remains generally admitted that every Aryan language is spoken by men who are predominantly Aryan in blood. Now it would be impossible to arrange Hindus, Greeks, Italians, Russians, Germans, and English, in any linear series. We can only divide and subdivide, arranging them in groups that diverge and re-diverge. Such must always be the case when we have to deal with phenomena due to hereditary relationship; and wherever we find a set of objects thus arranged in groups within groups, converging at the bottom and diverging at the top, we have the very strongest possible *primâ facie* ground for asserting hereditary relationship.

Coming now to our main thesis, we can begin to appreciate the strength of the evidence in favour of the derivation-theory, which is furnished by the classification of animals, as effected by Cuvier and Von Baer, and still further elaborated by Huxley and Haeckel. Previous to Cuvier, many eminent naturalists endeavoured to arrange the animal kingdom in a series of lineally ascending groups. The illustrious Lamarck did so; and the result was that he placed oysters and snails higher up than bees and butterflies. Blainville did better, having come as near as possible to surmounting insurmountable obstacles; but he nevertheless is forced to put cirrhipeds and myriapoda above the cuttle-fish. It was a great step in advance when Cuvier showed that there are at least four distinct types of animal structure, and that no linear series can be framed; although Prof. Agassiz undoubtedly transgressed the limits of scientific inquiry, when he attempted to explain the coexistence of these distinct types by resuscitating from its moss-covered tomb the Platonic theory of Ideas, and impressing it into the service of natural theology. Nevertheless in his remarkable "Essay on Classification," Prof. Agassiz more than atones for these metaphysical aberrations by the conclusiveness with which he shows the impossibility of making a linear classification of animals. In such a series, the lowest of vertebrates, the unintelligent amphioxus, would rank above the wonderfully-organized crabs, ants, and butterflies. The degraded lepidosiren would take precedence of the salmon; and the lowly-organized duck-bill, as being a mammal, would be placed above the parrot and the falcon. Or if we attempted to escape these difficulties by ranking our animals in a series according to their general complexity of organization, neglecting their typical differences of structure, our whole classification would be thrown into senseless confusion. Parrots and honey-bees would be thrust in among mammals, and not only classes, but even orders, and perhaps families, of annulosa would have to be divided, to make room for intrusive echinoderms and mollusks.

In view of these difficulties, as Prof. Huxley and Prof. Haeckel have shown, the only feasible manner of arranging the animal kingdom is in a number of diverging or branching lines, like the boughs and twigs of a tree. Starting from the amœba and its kindred, which are neither animal nor vegetal in character, we encounter two diverging lines of development represented respectively—according to Haeckel's surmise—by those protists with harder envelopes which are the predecessors of the vegetable kingdom, and those protists with softer envelopes which are the forerunners of the more mobile animal type of organization.[1] Confining our attention to animals, we meet first with the cœlenterata, including sponges, corals, and medusæ, characterized by the union of masses of amœba-like units, with but little specialization of structure or of function. Beside these lowly forms, but not immediately above any one of them, we find echinoderms starting off in one direction, worms or annuloida in a second, and molluscoida in a third. Following the first road, we stop short with echinoderms. But on the second, we find annuloid worms succeeded by articulata, or true annulosa, which re-diverge in sundry directions, reaching the greatest divergence from the primitive forms in the crabs, spiders, and ants. On the third road, we find the molluscoid worms diverging into mollusks and vertebrates. On the one hand, through the bryozoa we are gradually led to the true mollusks, while on the other hand the tunicata, of which the ascidian or "pitcher" (the primitive "tadpole" of unscientific ridiculers of Darwinism) is the most familiar form, lead us directly to the vertebrates.[2] At first the vertebrata are all

[1] Though I leave this sentence as it was written three years ago, it must not be understood as an unqualified endorsement of Prof. Haeckel's attempt to erect a third kingdom—of Protists—comprising such organisms as are neither distinctively animal nor vegetable. There is something to be said in behalf of such an arrangement, provided no attempt be made to draw a hard and fast line between the protistic and the two higher kingdoms; and I suppose that no follower of Haeckel is likely to make such an attempt. Since a bacterium or a vibrio is clearly not an animal, and clearly not a vegetable, while it is clearly a living thing, there would seem to be some convenience in having a region to which to assign it. I should, however, regard this "region" of protists, or lowest organisms, as not strictly a "kingdom," but rather as the indefinite border-land between the animal and vegetal worlds on the one hand and the realm of inorganic existence on the other.

[2] Kowalewsky has discovered some wonderful likenesses between the embryonic development of the ascidian and that of the amphioxus or lowest

fishes, if such mollusk-like creatures as the amphioxus can strictly be included among fishes; but presently here too the lines begin to diverge, and we encounter reptiles and birds on the one hand, and mammals on the other, all three being related to fishes through the remarkable structures of living and extinct batrachia.

Such, as stated with crude brevity, is the classification of animals most in accordance with our present knowledge. Now from first to last, the farther we trace any one line of development, the more widely we find it diverging from other lines which originated in the same point. The higher insects and crustaceans are not at all like worms; but the myriapoda, the lower crustaceans, and the caterpillars of higher insects, are like worms. Viewed at the upper ends of the scale, the mollusks are widely different from the vertebrates: viewed at the lower end, the difference almost vanishes—the amphioxus being closely similar in structure to the ascidians, whose embryos present rudiments of a vertebral column. No two animals could well be more strikingly unlike than a wren and an elephant; yet the lowest known mammal, the

known vertebrate. Of all the "missing links," the assumed absence of which is so persistently cited by the adherents of the dogma of fixity of species, the most important one would here appear to have been found; for it is a link which connects the complex and highly-evolved vertebrate with a very lowly form which passes its natural existence rooted plant-like to the soil, or rather to the sea-bottom. The ascidian cannot, indeed, be regarded as typifying the direct ancestors of the vertebrata. It is a curiously aberrant and degraded form, and its own progenitors had doubtless once "seen better days." In its embryonic state it possesses a well-marked vertebral column, and it behaves in general very much as if it were going to grow to something like the amphioxus. But it afterwards falls considerably short of this mark. Already in early life its vertebræ begin to become "rudimentary" or evanescent; and when fully matured, it stops swimming about after its prey, and, striking root in the sub-marine soil, remains thereafter standing, with its broad pitcher-like mouth ever in readiness to suck down such organisms floating by as may serve for its nutriment. That vertebræ should be found in the embryo of such an animal is a most interesting and striking fact. It would seem to mark the ascidian as a retrograded offshoot of those primitive forms on the way toward assuming the vertebrate structure, of which the more fortunate ones succeeded in leaving as their representative the amphioxus.

Australian duck-bill, possesses many bird-like characteristics. In the man and the oak, we get perhaps the widest possible amount of divergence between organisms; yet at the bottom of the animal and vegetal kingdoms, we find creatures like the amœba and protococcus, which cannot be classified as either animal or vegetal, because they are as much one as the other.

Moreover, as we go back in time, we find the lines of development, now so widely distant from each other, continually drawing together. As a general rule, extinct animals are less specialized than surviving animals; and the same is true of plants. The ancient animal departed less widely from the general type of the class or sub-kingdom to which he belonged than the modern animal. The monotremata, which of all mammals are the least remote from reptiles and birds, are at the same time the oldest. In the teleosts or true fishes the differential characteristics of the vertebrate type are more strongly pronounced than in the older selachians, to which order belongs the shark. Far back, in secondary times, we find lizards strongly resembling fishes, and other saurian creatures which differ little from birds. Confining our attention to any particular group, such as that which embraces the ruminants and pachyderms, we find the hipparion of the Eocene epoch less specialized than either of his later kindred, the horse, ass, zebra, and quagga; while the gap between such dissimilar animals as the pig and the camel is to a great extent filled by transitional forms found in various tertiary strata.

Again, it hardly needs stating that, as we proceed from a general survey of any group of animals or plants to a survey of the sub-groups of which it is made up, we find the differences constantly growing less numerous and less fundamental. The differences between the ox and the lion are many and important; but between the various members of the order carnivora, between the lion and the wolf or the bear, the differences are less. As we descend another step, and compare lions with lynxes, jaguars, leopards and cats, which belong to the same family, we find the points of divergence fewer and less characteristic. Between wild and domestic cats there is still less difference ; while between the various breeds of the domestic cat the distinctions are limited to superficial characteristics of size, colour, and general intelligence. Hence, in classifying contemporary organisms of high development, naturalists are never in doubt as to the class, or order, and but seldom as to the family ; while they are not unfrequently in doubt as to the genus, and are continually disputing as to the species or variety to which a given form belongs. As we descend in the scale of development, and go back in geologic time, the determination of genera becomes more and more difficult. Doubts frequently arise with reference to family, order, and class. And at last even the sub-kingdom becomes doubtful, as is strikingly shown by the difficulty in classifying the lowly animals provisionally grouped by Cuvier as radiata, when contrasted with the ease with which naturalists distinguish the higher sub-kingdoms.

Now all this complex arrangement of organisms in groups within groups, resembling each other at the bottom of the scale and differing most widely at the top, is just the arrangement which, as we have seen, must result from genetic relationship ; and upon any other theory than that of derivation it is utterly inexplicable. If each species has been separately created, no reason can be assigned for such an arrangement,—unless perchance someone can be found hardy enough to maintain that it was intended as a snare and a delusion for human intelligence. The old opponents of geology, who strove to maintain at whatever cost the scientific credit of the Mosaic myth of the creation, asserted that fossil plants and animals were created already dead and petrified, just for the fun of the thing. Manifestly those persons take a quite similar position, who pretend that God created separately the horse, ass, zebra, and quagga, having previously created a beast enough like all of them to be their common grandfather. Indeed, so powerful is this argument from classification that it has always seemed to me sufficient by itself to decide the case in favour of the theory of derivation. In my own case, the facts presented in Prof. Agassiz's "Essay on Classification" went far toward producing conviction before the publication of Mr. Darwin's work on the "Origin of Species," where the significance of such facts is clearly pointed out and strongly insisted upon.

II. An equally powerful argument is furnished by the embryonic development of organisms. As Von Baer long ago pointed out, the germs of all animals are at the outset exactly like each other; but in the process of development each germ acquires first the differential characteristics of the sub-kingdom to which it belongs, then successively the characteristics of its class, order, family, genus, species, and race. For example the germ-cell of a man is not only indistinguishable from the germ-cell of a dog, a chicken, or a tortoise, but it is like the adult form of an amœba or a protococcus, which are nothing but simple cells. Four weeks after conception, the embryos of the man and the dog can hardly be distinguished from each other, but have become perceptibly different from the corresponding embryos of the chicken and tortoise. At eight weeks a few points of difference between the dog and the man become perceptible; the tail is shorter in the human embryo, and the cerebrum and cerebellum have become larger, relatively to the corpora quadrigemina, than in the embryo of the dog; but these differences are less striking than those which separate the two mammals on the one hand from the reptile and bird on the other. At a later stage the human embryo becomes still more unlike that of the dog, acquiring characteristics peculiar to the order of primates to which man belongs

Lastly the fœtus of civilized man, at seven months, is entirely human in appearance, but still has not thoroughly acquired the physical attributes which distinguish the civilized man from the Australian or the negro.

On the evolution-theory these phenomena are explicable as due to the integration or summing-up of adaptive processes, by which modifications slowly acquired through generations of ancestral organisms are more and more rapidly repeated in the embryos. Hence, as Prof. Haeckel has elaborately proved, we must expect to find the phenomena of embryology in complete harmony with the facts of the geological succession of organisms. Observation shows that the harmony is complete; and again, unless we are to suppose that the phenomena of nature have been maliciously arranged with the express purpose of cheating us, we have no choice but to accept that harmony as proof of the truth of the evolution-theory.

Kindred evidence is furnished by the well-known fact that many animals, during their fœtal life, acquire organs like those possessed by adults of allied species, but which, having no functions to discharge, are after awhile absorbed or dwindle into mere rudiments. The mammalian embryo at first circulates its blood through a vascular system like the gills of fishes; afterwards this is replaced by a vascular membrane called the allantois, like the membrane which replaces gills in the development of birds and reptiles. Neither of these structures is useful to the embryo for the purpose of aerating its blood, and there is no possible explanation of their appearance in untold millions of mammals, unless we admit that they are due to inheritance from the amphibious ancestors of the mammalian class. Of like meaning are such facts as the presence of useless teeth in the jaws of fœtal whales, and in the beaks of certain embryonic birds; the rudiments of a pelvis and hind-limbs in many snakes · the wings, firmly fastened under their wing-cases, in insect which do not fly; the cæcum, or blind intestine, and the terminal vertebræ, in man; and the incisor teeth in calves and other ruminants, which never cut through the gum. No explanation can be given of such phenomena, save on the theory of inheritance; for the pompous statement, which we sometimes hear, that such organs have been created "for the sake of symmetry, and in order to complete the scheme of nature," is no explanation at all. As Mr. Darwin pertinently asks, "Would it be thought sufficient to say that because planets revolve in elliptic courses round the sun, satellites follow the same course round their planets, for the sake of symmetry, and to complete the scheme of nature?" Moreover, if we were to rest content with this arbitrary assumption, we must needs confess that the symmetry of nature has been but imperfectly wrought out; for the rudimentary organs which, on this hypothesis, ought always to be present, are often entirely wanting.

In this connection the history of the long exploded hypothesis of Preformation becomes very instructive. The argument is ably presented by Mr. Lewes, in a series of essays on Darwinism, which are still buried among the back numbers of the "Fortnightly Review," but which, it is to be hoped, will presently be reprinted in some more generally accessible form. Mr. Lewes calls attention to the fact that those who still profess to find it incredible that a complex organism should have been developed through long ages and through countless intermediate forms from a unicellular creature like the amœba, nevertheless find nothing incredible in the demonstrated fact that complex organisms are developed in a few weeks or months from minute homogeneous germ-cells. Now it is instructive to note that to the physiologists of a century ago, the latter process of development seemed quite as incredible as the former. The process by which a structureless germ, assimilating nutriment from the blood of the parent organism, becomes gradually differentiated into such an amazingly complex creature as a man or an elephant, was not at that time understood. It seemed utterly incredible that a human infant could have so recently been a simple globule of protoplasm. It was accordingly maintained that, since an infant resembles an adult in most respects save that of size, the original germ must be a minute copy of the infant. From the germ to the adult man there was no increase in complexity, there was only increase in dimensions. As a necessary consequence the germs of each generation were contained within the germs of the next preceding generation; so that in mother Eve were contained the miniature originals of the entire human race, completely shaped in every feature, and shut up one within another, like a series of Chinese boxes!

This hypothesis now strikes us as superlatively absurd. But it has been upheld by some of the greatest biologists who have ever lived,—by Swammerdamm, Haller, Bonnet, Réaumur, and Cuvier,—and to my mind it is less grotesque than the hypothesis of special creations. But what now concerns us is the fact that the doom of the latter hypothesis is inevitably involved in the destruction of the former. For not only may it be forcibly argued "that we can no more understand the appearance of a new organism which is not the modification of some already existing organism, than we can understand the sudden appearance of a new organ which is not the modification of some existing structure;" but there was yet another deadly weapon lying concealed amid the mass of evidence with which Wolff and Von Baer overthrew the preformation theory. Why this roundabout method, above described, in which the germs of the higher organisms are seen to develope? Why does a mammal begin to develope as if it were going to become a fish, and then, changing its course, act as if it were going to become a reptile or bird, and only after much delay assume the peculiar characteristics of mammals? The human embryo, for example, begins with gill-like slits on each side of the neck, up to which the arteries run in arching branches, as in a fish; the heart is at first a simple pulsating chamber, like the heart of the lowest fishes; at a later period there is a movable tail considerably longer than the legs; the great toe projects sideways from the foot, like the toes of adult monkeys and apes; and, during the sixth month, the whole body is covered very thickly with hair, extending even over the face and ears, everywhere, indeed, save on the lower sides of the hands and feet, which are also bare in the adult forms of other mammals. In like manner, the tadpole of the black salamander, which is not born until it is fully formed, and which never swims, nevertheless has gills as elaborately feathered as those which, in the tadpoles of other salamanders, are destined for use. Treatises on embryology are crowded with just such facts as these. Now why is it that, in all cases, before a complex organism "can attain the structure which distinguishes it, there must be an evolution of forms which distinguish the structures of organisms lower in the series"? "None of these phases have any adaptation to the future state of the animal; many of them have no adaptation even to its embryonic state." On the hypothesis that each species of organisms was independently built up by a Divine Architect, how are we to explain these circuitous proceedings? "What," asks Mr. Lewes, "should we say to an architect who was unable, or being able was obstinately unwilling, to erect a palace except by first using his materials in the shape of a hut, then pulling it down and rebuilding them as a cottage, then adding storey to storey and room to room, not with any reference to the ultimate purposes of the palace, but wholly with reference to the way in which houses were constructed in ancient times? What should we say to the architect who could not directly form a museum out of bricks and mortar, but was forced to begin as if going to build a mansion; and after proceeding some way in this direction, altered his plan into a palace and that again into a museum? Yet this is the sort of succession on which organisms are constructed." It is out of this very uncomfortable corner that metaphysical naturalists have sometimes attempted to slip, by gravely asserting that Nature is obliged to work tentatively! Thus we see that the habit of personifying Nature may sometimes be made to serve an argumentative purpose. When theologians are molested by uncomfortable questions concerning the existence of phenomena which seem incompatible with the perfect wisdom of an anthropomorphic Deity, they are wont to ascribe them to the Devil. It must be acknowledged that metaphysical naturalists practise a more graceful, though not a more candid, method of evasion, when they erect Nature (spelled with a capital) into a person distinct from phenomena, and coolly ascribe to her the shortcomings which they dare not lay to the account of a personal Deity.

Viewed in the light of a scientific logic, this argument from embryology, like the argument from classification, seems powerful enough, when taken alone, to decide the case in favour of the derivation theory. As already hinted, these phenomena are in general explicable by the Doctrine of Evolution. But to the special-creation hypothesis they are unmanageable stumbling-blocks. Even without any profound knowledge of embryology, one may readily see that if the tadpoles of the black salamander were anciently born as tadpoles, and swam in the water, they may still retain their exquisite gills while nourished to a later stage of development in the maternal organism. But on the opposite theory the existence of these gills is meaningless.

III. The equally significant facts of morphology may be more concisely presented. Why, unless through common inheritance, should all the vertebrata be constructed on the same type? Structurally considered, man, elephant, mouse, ostrich, humming-bird, tortoise, snake, frog, crocodile, halibut, herring, and shark, are but different modifications of one common form. It is a familiar fact that the arms of men and apes, the fore-legs of quadrupeds, the paddles of cetacea, the wings of birds, and the breast-fins of fishes are structurally identical, being developed from the same embryonal rudiments. Externally there is but little resemblance between the human hand and the hoof of a horse; yet anatomy shows that the horse's hoof is made up of claws or fingers firmly soldered together. Turning to the annulosa, we find that all insects and crustaceans—dragon-flies and mosquitoes as well as crabs and shrimps—are composed of just twenty segments. "What now," asks Mr. Spencer, "can be the meaning of this community of structure among these hundreds of thousands of species filling the air, burrowing in the earth, swimming in the water, creeping about among the sea-weed, and having such enormous differences of size, outline and substance, that no community would be suspected between them? Why, under the down-covered body of the moth and under the hard wing-cases of the beetle, should there be discovered the same number of divisions as in the calcareous framework of the lobster?" But two answers are possible. We may either say, with the Mussulman, "it so pleased Allah, whose name be exalted;" or we may honestly acknowledge the scientific implication that such community of structure is strong evidence in favour of community of origin.

IV. The facts of geographical distribution and geological succession are likewise in complete harmony with the development theory. On the hypothesis of special creations, no good reason can be given why the extinct animals found in any geographical area should resemble, both in general structure and in special modifications, the animals which now live in the same area. Thus the fossil mammals of Australia are chiefly marsupials, allied in structure to the marsupials which now inhabit that continent; the extinct mammals of South America closely resemble living sloths, armadillos and ant-eaters. 'I was so much impressed with these facts" says

Mr. Darwin, "that I strongly insisted, in 1839 and 1845, on this wonderful relationship in the same continent between the dead and the living. Prof. Owen has subsequently extended the same generalization to the mammals of the Old World. We see the same law in this author's restorations of the extinct and gigantic birds of New Zealand. We see it also in the birds of the caves of Brazil. Mr. Woodward has shown that the same law holds good with sea-shells. Other cases could be added, as the relation between the extinct and living land-shells of Madeira; and between the extinct and living brackish-water shells of the Aralo-Caspian Sea."

It has indeed been urged, by upholders of the special-creation hypothesis, that these striking resemblances may be explained by supposing each species to have been created in strict adaptation to the conditions of life surrounding it. That is to say, God has continued to create edentata in South America and marsupials in Australia, because these two continents are best fitted for the comfortable maintenance respectively of edentata and of marsupials. Stubborn facts, however, are opposed to this theory of the methods of Divine working. The assumption that each species is best adapted to its own habitat is refuted by such facts as the now rapidly progressing extermination of native animals and plants in New Zealand by European organisms lately carried there. Cow-grass, thistles, dock, and white clover flourish more vigorously in New Zealand than in England, and within a few years have almost displaced the native grasses; while the native rats and flies are fast disappearing before the rats and flies imported from Europe. The assumption is still more strikingly refuted by a comparison of the forms of life which inhabit Australia with those which inhabit the southern extremities of Africa and South America. These three tracts of land are very similar in their physical conditions, and yet, as Mr. Darwin has observed, it would be impossible to point out three faunas and floras more strikingly dissimilar. If the distribution of organisms were miraculously determined in accordance with their fitness to their surrounding conditions, the fauna of South America in latitude 35° ought to resemble the fauna of Australia in the same latitude more closely than it resembles the fauna of South America in latitudes north of 25°. The case is just the reverse. Again there is no appreciable difference between the conditions of existence in the seas east and west of the isthmus of Panama; and, according to the assumption of the special-creationists, their marine faunas ought to be almost exactly alike. In fact no two marine faunas are more completely distinct. Hardly a fish, mollusk, or crustacean is common to the eastern and western shores. This is because the isthmus, though narrow, is impassable for marine organisms. On the other hand, wherever groups of organisms are not prevented by impassable barriers from spreading over wide tracts of country or of sea, we find distinct but closely-allied species widely spread and living among the most diverse conditions. The inference is obvious that the population of different zoological and botanical areas is due to migration, and not to special creation. Where organisms have a chance to migrate, they migrate, and became adapted, by slight specific changes, to the new circumstances which they encounter. But where there is a barrier between one area and another, there we find complete diversity between the inhabitants of the two areas, although there is no reason for such diversity, save the impossibility of getting across the barrier. Of like meaning is the fact that batrachians and terrestrial mammals are never found indigenous upon oceanic islands. As Mr. Darwin observes, "the general absence of frogs and toads from oceanic islands cannot be accounted for by their physical conditions; indeed it seems that islands are peculiarly well fitted for these animals; for frogs have been introduced into Madeira, the Azores, and Mauritius, and have multiplied so as to become a nuisance. But as these animals and their spawn are known to be immediately killed by sea-water, there would be great difficulty in their transportal across the sea, and therefore on my view we can see why they do not exist on any oceanic island. But why, on the theory of creation, they should not have been created there, it would be very difficult to explain." That terrestrial mammals cannot cross the sea is obvious; but bats and birds. which can fly, are found on many oceanic islands. In an admirable essay on the migrations of organisms, considered with reference to the Darwinian theory, Prof. Moritz Wagner has collected many similar examples. From personal observations in North Africa, in Western Asia, in Hungary, and in America, this veteran naturalist educes the general conclusion that the limits within which allied species are found, are determined by impassable natural barriers. Coleoptera with their wings fastened down under their wing-cases, are specifically different on the opposite shores of small rivers; while butterflies and hymenoptera range over large tracts of inland country, but are stopped by such obstacles as the Straits of Gibraltar. On opposite sides of the Andes, the conditions of existence differ but little, while on the north and south sides of the Caucasus the difference in climate is extreme. Yet the Andes are much the more difficult to cross; and accordingly the fauna which they separate are much more unlike than the fauna separated by the Caucasus. In like manner the Galapagos Islands, situated some six hundred miles from the South American continent, possess a fauna which, with the exception of a few birds, is generically distinct from all other faunas. Yet though generically distinct, it is South American in type, and most resembles the fauna of Chili, the nearest mainland. Furthermore, among the animals living on the different islands of the group, we find specific diversity along with generic identity. So also Madeira "is inhabited by a wonderful number of peculiar land-shells, whereas not one species of sea-shell is peculiar to its shores." Similar relations are found universally to hold between the organisms which inhabit oceanic islands and those which inhabit neighbouring continents.

These facts of geographical distribution, when taken in connection with the facts of geological succession above mentioned, speak very emphatically in favour of the derivation theory. That theory affords a satisfactory explanation for this entire class of facts, while the special-creation hypothesis is incompetent to explain a single one of them. They are, moreover, in perfect harmony with the prominent facts of morphology, of embryology, and of classification; so that the evidence furnished by the four classes of facts taken together becomes truly overwhelming.

When in the next chapter we come to consider the speculations and discoveries of Mr. Darwin, we shall see that the case in favour of derivation is even stronger than as here presented; for we shall see that certain agencies are unceasingly at work, with the long continuance of which the absolute stability of specific forms is incompatible. But, as between the two hypotheses of special creation and of derivation, the arguments already brought forward are far more than sufficient for a decisive verdict. The presumption raised at the outset against the Doctrine of Special Creations is even superfluously confirmed by the testimony of facts. Not only is this doctrine discredited by its barbaric origin, and by the absurd or impossible assumptions which it would require us to make; but it utterly fails to explain a single one of the phenomena of the classification, embryology, morphology, and distribution of extinct and living organisms. While, on the other hand, the Doctrine of Derivation is not only accredited by its scientific origin and by its appealing to none but verifiable processes and agencies, but it affords an explanation for each and all of the above-mentioned phenomena.

I think we may, therefore, without further ado, consign the special-creation hypothesis to that limbo where hover the ghosts of the slaughtered theories that were born of man's untutored intelligence in early times. There we may let it abide, along with the vagaries of the astrologists, the doctrine of signatures, the *archæus* of Paracelsus, the *elixir vitæ* of the alchemists, and the theory of perpetual motion. The space which we have here devoted to it is justified by the vividness with which the discussion has brought before us the contrast between mythology and science, between Anthropomorphism and Cosmism. But in the chapters which are to follow, the question of its merits or demerits will no longer concern us.

END OF VOL I.

# OUTLINES OF COSMIC PHILOSOPHY.

*VOLUME II.*

# OUTLINES OF COSMIC PHILOSOPHY
## BASED ON THE DOCTRINE OF EVOLUTION, WITH CRITICISMS ON THE POSITIVE PHILOSOPHY

BY

JOHN FISKE

*L'univers, pour qui saurait l'embrasser d'un seul point de vue, ne serait, s'il est permis de le dire, qu'un fait unique et une grande vérité.* — D'ALEMBERT

Καὶ τὸ ὅλον τοῦτο διὰ ταῦτα Κόσμον καλοῦσιν, οὐκ ἀκοσμίαν. — PLATO

6400

IN TWO VOLUMES

VOLUME II.

EIGHTEENTH EDITION

BOSTON AND NEW YORK
HOUGHTON, MIFFLIN AND COMPANY
The Riverside Press, Cambridge
1898

# CONTENTS.

## PART II. (Continued.)

## *SYNTHESIS.*

### CHAPTER X.

PAGE
NATURAL SELECTION . . . . . . . . . . . . . . . . . . . 3

### CHAPTER XI.

TWO OBJECTIONS CONSIDERED . . . . . . . . . . . . . . . 32

### CHAPTER XII.

ADJUSTMENT, DIRECT AND INDIRECT . . . . . . . . . . . . 50

### CHAPTER XIII.

LIFE AS ADJUSTMENT . . . . . . . . . . . . . . . . . . 67

### CHAPTER XIV.

LIFE AND MIND . . . . . . . . . . . . . . . . . . . . 73

### CHAPTER XV.

THE COMPOSITION OF MIND . . . . . . . . . . . . . . . 98

## CHAPTER XVI.

PAGE
THE EVOLUTION OF MIND . . . . . . . . . . . . . . . . 133

## CHAPTER XVII.

SOCIOLOGY AND FREE-WILL . . . . . . . . . . . . . . . . 164

## CHAPTER XVIII.

THE EVOLUTION OF SOCIETY . . . . . . . . . . . . . . . . 191

## CHAPTER XIX.

ILLUSTRATIONS AND CRITICISMS . . . . . . . . . . . . . . 225

## CHAPTER XX.

CONDITIONS OF PROGRESS . . . . . . . . . . . . . . . . 255

## CHAPTER XXI.

GENESIS OF MAN, INTELLECTUALLY . . . . . . . . . . . . . 285

## CHAPTER XXII.

GENESIS OF MAN, MORALLY . . . . . . . . . . . . . . . . 324

# PART III.

## *COROLLARIES.*

## CHAPTER I.

THE QUESTION RESTATED . . . . . . . . . . . . . . . . 367

## CHAPTER II.

ANTHROPOMORPHIC THEISM . . . . . . . . . . . . . . . . 381

## CHAPTER III.

PAGE
COSMIC THEISM . . . . . . . . . . . . . . . . . . . . 411

## CHAPTER IV.

MATTER AND SPIRIT . . . . . . . . . . . . . . . . . . 432

## CHAPTER V.

RELIGION AS ADJUSTMENT . . . . . . . . . . . . . . . . 452

## CHAPTER VI.

THE CRITICAL ATTITUDE OF PHILOSOPHY . . . . . . . . . . . 473

E. S.
4/17/'02.

# PART II.

## *SYNTHESIS.*

### (CONTINUED.)

"Die Thätigkeit des Organismus ist bestimmt durch seine Receptivität und umgekehrt. Weder seine Thätigkeit noch seine Receptivität ist an sich etwas reelles, Realität erlangen beide nur in dieser Wechselbestimmung. Thätigkeit und Receptivität entstehen also zugleich in einem und demselben untheilbaren Moment, und nur dieses Simultaneität von Thätigkeit und Receptivität constituirt das Leben. In den entgegengesetzten Richtungen, die durch diese Entgegensetzung entstehen, liegt das Princip für die Construction aller Lebenserscheinungen." — SCHELLING, *Erster Entwurf*. 1799.

## CHAPTER X.

### NATURAL SELECTION.

In that most delightful of printed books, the "Conversations of Goethe with Eckermann and Soret," there is an amusing anecdote which shows how distinctly the great master realized the importance of the question of the origin of species. The news of the French Revolution of July, 1830, had just reached Weimar and set the whole town in commotion. In the course of the afternoon, says Soret, "I went around to Goethe's. 'Now,' exclaimed he to me, as I entered, 'what do you think of this great event? The volcano has come to an eruption; everything is in flames, and we have no longer a transaction with closed doors!' 'Terrible affair,' said I, 'but what could be expected under such outrageous circumstances, and with such a ministry, otherwise than that the whole would end with the expulsion of the royal family?' My good friend,' gravely returned Goethe, 'we seem not to understand each other. I am not speaking of those creatures there, but of something quite different. I am speaking of the contest, so important for science, between Cuvier and Geoffroy Saint-Hilaire, which has just come to an open rupture in the French Academy!'" At this unexpected turn of the subject poor Soret knew not what to say, and for some minutes, he tells us, his thoughts were quite at a standstill.

The anecdote well illustrates the immeasurable superiority of Goethe over Comte in prophetic insight into the bearings of the chief scientific question of the immediate future. While Comte was superciliously setting aside the problem of man's origin, as a problem not only insoluble but utterly devoid of philosophic value even if it could be solved, the great German poet and philosopher was welcoming the outbreak of this famous contest on questions of pure morphology, as conducive to the speedy triumph of the development theory, for which he himself had so long been waging battle. But events were hastening that triumph even more rapidly than Goethe could have anticipated. In December 1831, only a few weeks before Goethe was laid in the grave, Mr. Darwin set out upon that voyage around the world, in the course of which he fell in with the facts which suggested his theory of the origin of species. The history of the investigation is a memorable one,—worth noting for the illustration it gives of the habits of a truly scientific mind. On his return to England, in 1837, Mr. Darwin began patiently to collect all kinds of facts which might be of use in the solution of the problem,—"how is organic evolution caused?" It was only after seven years of unremitting labour that he went so far as to commit to manuscript a brief sketch of his general conclusions, of which the main points were communicated to his friends Sir Charles Lyell and Dr. Hooker. A less wise and sober speculator than Mr. Darwin would now at once have rushed into print. A thinker less thoroughly imbued with the true scientific spirit would probably have suffered from not publishing his views, and profiting by the adverse criticisms of contemporary observers. It is a striking illustration of Mr. Darwin's patience and self-restraint that he continued fifteen years longer to work assiduously in testing the weak and strong points of his theory, before presenting it to the public. And it is an equally interesting illustration of his thoroughly scientific temperament that, after so many years of solitary labour, he should have been so little carried away by the fascinations of his own hypothesis as to foresee clearly all the more valid objections which might be urged against it. After a careful perusal of the recent literature of the subject, and especially of the skilful work of Mr. St. George Mivart, it still seems to me that the weightiest objections which have yet been brought to bear on the Darwinian theory are to be found in Chapters VI.—IX. of Mr. Darwin's own work, where they are elaborately and in most cases conclusively answered. To such a marvellous instance of candour, patience, and sobriety, united with the utmost boldness of speculation, the history of science can show but few parallels.

In 1858, a fortunate circumstance caused Mr. Darwin to break his long silence, and to give to the public an exposition of the results of his researches. Mr. Wallace, who had been for several years engaged in studying the natural history of the Malay Archipelago, had arrived at views concerning the origin of species quite similar to Mr. Darwin's, and in 1858 he sent Mr. Darwin an essay on the subject, which in August of the same year was published in the Journal of the Linnæan Society. Sir Charles Lyell and Dr. Hooker now earnestly advised Mr. Darwin to publish his own views; and in 1859 the memorable treatise on the "Origin of Species" was given to the world.

It would, however, be incorrect to rate Mr. Wallace's merits, in the discovery of the law of natural selection, so high as Mr. Darwin's. They do not stand on precisely the same level, like Adams and Leverrier with reference to the discovery of the planet Neptune. Mr. Wallace, indeed, thought out independently all the essential points of the theory, and stated it in a way which showed that he understood its wide-reaching importance; but being a much younger man than Mr. Darwin, and having begun the investigation at a much later date, he by no means worked it out so elaborately. Nor is it likely that, with an equal length of time at his command, he could have succeeded in producing a work comparable in scientific calibre to the "Origin of Species." His lately published collection of essays, while showing unusual powers of observation and rare acuteness in the application of his theory to certain special classes of phenomena, nevertheless furnishes convincing proof that in breadth and depth of scientific attainment, as well as in philosophic capacity, he is very far inferior to his great coadjutor. In his preface, indeed, Mr. Wallace hastens to acknowledge, with a modest self-appreciation as rare as it is admirable, and especially rare in such cases, that his strength would have been quite unequal to the task which Mr. Darwin has accomplished.

As Prof. Haeckel somewhere observes, it was quite fortunate for the progress of science that Mr. Darwin received such a stimulus to the publication of his theory; since otherwise he might perhaps have gone on several years longer, observing and experimenting in seclusion. The almost immediate acquiescence of the majority of naturalists in Mr. Darwin's views, shows that in 1859 the scientific world was fully prepared for them. The flimsiness of the special-creation hypothesis was more or less clearly perceived by a large number of biologists, who were only withheld from committing themselves to the derivation theory by the circumstance that no satisfactory explanation of the *process* of development had been propounded. No one had assigned an adequate cause for such a phenomenon as the gradual evolution of a new species; and sundry attempts which had been made in this direction were so obviously futile as to excite both distrust and ridicule. Lamarck, for example, placing an exaggerated stress upon an established law of biology, contended that "desires, by leading to increased actions of motor organs, may induce further development of such organs," and that, consequently, animals may become directly adapted through structural changes to changes in their environment. We shall see, as we continue the discussion, that such directly adaptive changes really take place; but Lamarck ill understood their character, and indeed could not have been expected to understand it, since in his day dynamical biology was in its earliest infancy.[1] By insisting on volition as a chief cause of adaptive change, the illustrious naturalist not only left the causes of vegetable variation unexplained, but even in the zoological department laid open the way for malicious misrepresentations which the uninstructed zeal of theological adversaries has gladly transferred to the account of Mr. Darwin. Some time ago a clergyman in New York, lecturing about Darwinism, sarcastically alluded to "the bear which took to swimming, and so became a whale." Had this worthy person condescended to study the subject about which he thought himself fit to enlighten the public, he would soon have discovered that his funny remark is not even a parody upon any opinion held by Mr. Darwin. In so far as it is applicable to any opinion ever held by a scientific writer, it may perhaps be accepted as a parody, though at best a very far-fetched and feeble one, of the hypothesis of Lamarck.

It is now time to explain what the Darwinian theory is. At the outset we may observe that while it is a common error to speak of Mr. Darwin as if he were the originator of the derivation theory, the opposite error is not unfrequently committed of alluding to him as if he had contributed nothing to the establishment of that theory save the doctrine of natural selection. Mr. Mivart habitually thus alludes to him. In fact, however, Mr. Darwin's merits are twofold. He was the first to marshal the arguments from classification,

[1] Lamarck also tried to explain organic development metaphysically, as the continuous manifestation of an "inherent tendency" toward perfection.

embryology, morphology, and distribution, and thus fairly to establish the fact that there has been a derivation of higher forms from lower; and he was also the first to point out the *modus operandi* of the change. The first of these achievements by itself would have entitled him to associate his name with the development theory; though it was only by the second that the triumph of the theory was practically assured. Just as, in astronomy, the heliocentric theory was not regarded as completely established until the forces which it postulated were explained as identical with forces already known, so the development theory possessed comparatively little value as a working hypothesis so long as it still remained doubtful whether there were any known or knowable causes sufficient to have brought about the phenomena which that theory assumed to have taken place. It was by pointing out adequate causes of organic evolution that Mr. Darwin established the development theory upon a thoroughly scientific basis.

As Lyell explained all past geologic phenomena as due to the slow action of the same forces which are still in action over the earth's surface and beneath its crust, so Mr. Darwin, in explaining the evolution of higher from lower forms of life, appeals only to agencies which are still visibly in action. Whether species, in a state of nature, are changing or not at the present time, cannot be determined by direct observation, any more than the motion of the hour-hand of a clock could be detected by gazing at it for one second.[1] The entire period

[1] "If we imagine mankind to be contemplated by some creature as short-lived as an ephemeron, but possessing intelligence like our own—if we imagine such a being studying men and women, during his few hours of life, and speculating as to the mode in which they came into existence; it is manifest that, reasoning in the usual way, he would suppose each man and woman to have been separately created. No appreciable changes of structure occurring during the few hours over which his observations extended, this being would probably infer that no changes of structure were taking place, or had taken place; and that from the outset, each man and woman had possessed all the characters then visible—had been originally formed with them. This would naturally be the first impression."—Spencer, *Principles of Biology*, vol. i. p. 338.

which has elapsed since men began to observe nature systematically, is but an infinitesimal portion of the period requisite for any fundamental alteration in the characteristics of a species. But there are innumerable cases in which species are made to change rapidly through the deliberate intervention of man. In the course of a few thousand years, a great number of varieties of plants and animals have been produced under domestication, many of which differ so widely from their parent-forms that, if found in a state of nature, they would be unhesitatingly classified as distinct species, and sometimes as distinct genera. Modifications in the specific characters of domesticated organisms are the only ones which take place so rapidly that we can actually observe them; and it therefore becomes highly important to inquire what is the agency which produces these modifications.

That agency is neither more nor less than *selection*, taking advantage of that slight but universal variation in organisms implied by the fact that no two individuals in any species are exactly alike. If man, for example, wishes to produce a breed of fleet race-horses, he has only to take a score of horses and select from these the fleetest to pair together: from among the offspring of these fleet pairs he must again select the fleetest; and thus, in a few generations, he will obtain horses whose average speed far exceeds that of the fleetest of their undomesticated ancestors. It is in this and no other way that our breeds of race-horses have been produced. In this way too have been produced the fine wools of which our clothing is made. By selecting, generation after generation, the sheep with the finest and longest wool, a breed of sheep is ultimately reared with wool almost generically different from that of the undomesticated race. In this and no other way have the different races of dogs—the greyhound, the mastiff, the terrier, the pointer, and the white-haired Eskimo—been artificially developed from two or three closely allied varieties of the wolf and jackal. The mastiff and blood-hound are more than ten times as large as the terrier, and, if found in a state of nature, they would perhaps be classed in distinct genera, like the leopard and panther, whose differences are hardly more striking. Yet the ancestral races from which these dogs have been reared differed but slightly from each other. The different breeds of dogs vary in the number of their toes, teeth, and vertebræ, in the number and disposition of their mammæ, in the shape of their zygomatic arches, and in the position of their occiputs; although dogs have not been selected with reference to these peculiarities, about which uninstructed men neither know nor care, but only with reference to their speed, fleetness, strength, or sagacity. In the case of domestic pigeons, where man has been to a great extent actuated by pure fancy in his selections, the divergences are still more remarkable. All domestic pigeons are descended from a single species of wild pigeon; yet their differences, even in bony structure, in the internal organs, and in mental disposition, are such as characterize distinct genera, and to describe them completely would require a large volume. Pigs, rabbits, cows, fowl, silk-moths, and hive-bees furnish no less instructive evidence; and the development of the peach and the almond from a common stock, and of countless varieties of apple from the sour crab, may be cited, out of a hundred examples, to show what prodigies artificial selection has accomplished in the modification of vegetal organisms.

Now Mr. Darwin's great achievement has been to show that a similar process of selection, going on throughout the organic world without the knowledge or intervention of man, tends not only to maintain but to produce adaptive alterations in plants and animals. The process is a simple one, when once we have the clew to it. All plants and animals tend to increase in a high geometrical ratio. The old problem of the nails in the horse's shoe teaches us what an astounding affair is a geometrical rate of increase; but when we consider the reproductive capacity of insects and plants, the nails in the horse's shoe are left nowhere. When Arctic travellers tell us that the minute protococcus multiplies so fast as to colour blood-red many acres of snow in a single night, such a rate of increase appears astonishing. But it is a mere trifle compared to what would happen if reproduction were to go on unchecked. Let us take the case of a plant which yields one hundred seeds yearly, and suppose each of these seeds to reach maturity so as to yield its hundred offspring in the following year: in the tenth year the product would be one hundred quintillions[1] of adult plants! As this is one of those figures before which the imagination stands hopelessly baffled, let us try the effect of an illustration. Supposing each of these plants to be from three to five inches in length, so that about twenty thousand would reach an English mile, the total length of the number just mentioned would be equal to five million times the radius of the earth's orbit. The ray of light, which travels from the sun to the earth in eight minutes, would be seventy-six years in passing along this line of little plants! And in similar wise, it might be shown of many insects, crustaceans, and fishes, that their unchecked reproduction could not long go on without requiring the assimilation of a greater quantity of matter than is contained in the whole solar system.

We may now begin dimly to realize how prodigious is the slaughter which unceasingly goes on throughout the organic world. For obviously, when a plant, like the one just cited, maintains year by year a tolerable uniformity in its numbers, it does so only because on the average ninety-nine seeds perish prematurely for one that survives long enough to produce other seeds. A single codfish has been known to lay six million eggs within a year. If these eggs were all to become adult codfishes, and the multiplication were to

[1] According to the American system of numeration. One hundred thousand trillions, according to the English system.

continue at this rate for three or four years, the ocean would not afford room for the species. Yet we have no reason to suppose that the race of codfishes is actually increasing in numbers to any notable extent. With the codfish, as with animal species in general, the numbers during many successive generations oscillate about a point which is fixed, or moves but slowly forward or backward. Instead of a geometrical increase with a ratio of six millions, there is practically no marked increase at all. Now this implies that out of the six million embryo codfish a sufficient number will survive to replace their two parents, and to replace a certain small proportion of those contemporary codfishes who leave no progeny. Perhaps a dozen may suffice for this, perhaps a hundred. The rest of the six million must die. We may thus understand what is meant by the "struggle for existence." Battles far more deadly than those of Gettysburg or Gravelotte have been incessantly waged on every square mile of the earth's life-bearing surface, since life first began. It is only thus that the enormous increase of each species has been kept within bounds. Of the many offspring produced by each plant and animal, save in the case of those highest in the scale, but few attain maturity and leave offspring behind them. The most perish for want of sustenance, or are slain to furnish food for other organisms. There is thus an unceasing struggle for life—a competition for the means of subsistence—going on among all plants and animals. In this struggle by far the greater number succumb without leaving offspring, but a few favoured ones in each generation survive and propagate to their offspring the qualities by virtue of which they have survived.

Thus we see what is meant by "Natural Selection." The organisms which survive and propagate their kind are those which are best adapted to the conditions in which they live; so that we may, by a legitimate use of metaphor, personify Nature as a mighty breeder, selecting from each generation those individuals which are fleetest, strongest, most sagacious, lions with supplest muscles, moths with longest antennæ, mollusks with hardest shells, wolves with keenest scent, bees with surest instinct, flowers with sweetest nectar,—until, in the course of untold ages, the numberless varieties of organic life have been produced by the same process of which man now takes advantage in order to produce variations to suit his own caprices.

Between natural selection and selection by man there is, however, one important difference. Selection by man tends to produce varieties adapted to satisfy human necessities or inclinations, and it has no direct reference to the maintenance of the species. Such abnormities as the pouter and tumbler pigeons could not be sustained in a state of nature; and hence, when domesticated animals are turned loose, they are apt to revert to something like their ancestral type,[1] else they are exterminated by races better adapted to wild life. But natural selection, working with the sternest of methods, saves from the general slaughter only those individuals which can best take care of themselves, and thus maintains each species in adaptation to its environment. The wonderful harmonies in the organic world, which a crude philosophy explained as the achievement of creative contrivance, are therefore due to the continued survival of the fittest and the continued slaughter of the less adapted plants and animals.

Now if the geography and meteorology of the earth were ever-constant, if the nature of the soil, the amount of moisture, the density of the atmosphere, and the intensity of solar radiance were everywhere to remain forever unaltered, and if each race of plants and animals were always to remain confined to one limited area, the survival of the fittest would simply maintain unaltered any given aspect of the beings constituting the organic world. All variations on either side

[1] This fact, which has often been alleged by superficial critics as an obstacle to the Darwinian theory, is thus in reality implied by that theory.

of the well-adjusted mean would be incessantly cut off by natural selection, and species would be immutable. It is needless to say that no such state of things has ever existed. Constant change has been the order of things ever since our planet first became fit to support organic life. No part of the earth's surface is now, or ever has been, at rest. Continents are rising and sinking, seas are growing deeper and shallower, soils are constantly altering in chemical composition, rivers are ever changing their beds, solar radiance is ever gaining or losing in intensity, according to the earth's ever-varying position in space, the density and moisture of the air are continually increasing and diminishing, and every species of plant and animal is continually pressing upon the limits of the area within which it is confined. All these changes are going on to-day, and have been going on during millions of ages. Though so slight as to be recognized only by the most careful observation during the period covered by human history, these changes have during longer periods sufficed to submerge every continent and perhaps to make dry land of every sea and ocean on the face of the globe. They have raised mountains like the Andes and the Himalayas at the rate of a few inches per century; they have converted extensive tropical swamps into the desert of Sahara; they have repeatedly covered Europe and North America with glaciers; and they have hidden beneath solid rocks vast treasures of carbon stealthily purloined from the dense atmosphere of an older age.

Since such changes have ever been going on, it follows that organisms have been unable to remain constant and live. A race of animals or plants in which no individuals ever varied would sooner or later inevitably be exterminated, leaving no progeny to fill its place. Observation shows, however, that there is no such race. The members of each species are ever slightly varying, but, so long as the environment remains constant, natural selection prevents the variations from accumulating on either side of the mean which is most advantageous to the species. When the environment changes, if certain variations on one side of the established mean tend to bring the individuals which manifest them into closer adaptation to the new environment, these individuals will survive in the struggle for life, and thus the average character of the species will be slightly altered. No two bears have just the same amount of hair, no two moths have just the same length of proboscis, no two antelopes are exactly matched in fleetness. Now if increasing cold renders a thicker covering useful to the bear, or if the lengthening of a flower-calyx, due to a slight change in soil or quantity of sunlight, renders a longer proboscis useful to the moth, or if the immigration of a carnivorous animal makes it necessary for antelopes often to run for their lives, then in each generation the thickest-coated bears, the longest-tongued moths, and the fleetest antelopes will survive. Every individual variation in the direction of a heavier coat, a longer sucker, or a structure better adapted for fleeing will give its owner the advantage in the incessant struggle for life, and these peculiarities will be oftenest inherited, while individuals which do not vary, or which vary in the wrong direction, will have to migrate or die.[1]

The student of natural history, who realizes, however dimly, the prodigious complexity of the relations of the various species of animals and plants to each other, will perceive that the amount of variation thus preserved and enhanced must in the course of long ages become enormous. If a grain of sand were each year added to an ant-heap, it would in course of time become as large as Chimborazo. But these changes, directly caused by natural selection, are greatly

[1] It is thus one of the great merits of the theory of natural selection, that it accounts for the phenomena of *extinction* of species,—which formerly could only be accounted for by the gratuitous and utterly indefensible hypothesis of periodical catastrophes or cataclysms.

aided and emphasized by other changes indirectly produced by correlation of growth, and also by what is called the law of use and disuse. By correlation of growth, or internal equilibration, we mean the effect produced upon any part of the organism by change in a related or neighbouring part. Let us suppose that it becomes advantageous to some feline animal, like the ancestor of the lion, to have large and powerful jaws. Since no two of our leonines would have jaws of exactly the same size and strength, natural selection would preserve all the strong-jawed individuals, while the weak-jawed individuals would succumb in the struggle for life. In the course of many generations our race of leonines would possess on the average much larger and stronger jaws than at the period at which we began to consider it. But greater weight of jaw entails increased exertion of the muscles which move the jaw, so that these muscles, receiving more and more blood, will become permanently increased in size and power. The portions of the skull into which the jaw-bones fit will likewise receive an extra strain, and will consequently increase in rate of nutrition and grow to a larger size, so that the shape of the whole head will be altered. This increased weight of the head, and the increasingly violent activity of the muscles which move the jaws, entails a greater strain upon the vertebræ which support the head, and upon the cervical muscles which move it from side to side. The heightened nutrition of these bones and muscles will add to their weight, so that the shoulders and chest will be affected. There will be a tightening of the tendons, and probably a perceptible alteration in the relative lengths of the different bones and muscles throughout the anterior part of the body; and these changes, altering the animal's centre of gravity, will inevitably cause other compensating changes in the rest of the body. The legs, shoulders and haunches will be modified. Alterations in the weights bearing upon the chest will affect the growth of the lungs and the aeration of the blood. And the stomach, intestines, and various secreting glands will respond to the requirements of all these nutritive changes. While, lastly, such deep-seated variations cannot fail to influence the nervous system of the animal, and to modify somewhat its temperament and its modes of life.

To illustrate the effects of use and disuse, let us reconsider the antelopes, of whom natural selection has so long preserved the swiftest and most quickly frightened individuals that they now rank among the fleetest and most timid of mammals. If all the lions and other swift carnivora of Africa were to become extinct, so that antelopes would no longer have to run for their lives, the slower and less easily alarmed individuals would begin to be preserved in as great numbers as the swifter and more timid ones, so that by and by the average speed and timidity of the race would be diminished. In all this we see merely the effects wrought by unaided natural selection. But it is a fundamental law of biology that functions are maintained at their maximum only through constant exercise. Freed from savage enemies, our antelopes would less frequently use the muscles concerned in running, and would less often exercise the mental faculties concerned in the rapid perception of approaching danger. Inevitably, therefore, they would, after several generations, diminish in speed, and become less alert and less timid. Here we see the effects of what is called the law of use and disuse. But to these we should also have to add the effects of correlation of growth. Decrease in speed, involving decrease in muscular tonicity, and rendering possible the assimilation of less concentrated food, would seriously modify the nutrition of the entire organism. The digestive tract would probably be enlarged, and larger and lazier bodies could not fail to be produced, both by the direct influence of the nutritive processes, and because natural selection would no longer necessitate the slaughter of all clumsy-bodied individuals. Thus in course of time the breed of antelopes would become so thoroughly altered as to constitute a distinct species from their graceful, swift, and timid ancestors. It is in just these ways that New Zealand birds, freed by insular isolation from the attacks of mammalian enemies, have grown large and clumsy, and have lost the power of flight which their partly-aborted wings show that they once possessed.

By the same kind of illustration we may form a rough notion of the way in which a single species bifurcates into two well-defined species. Suppose a race of ruminants to have been living in Africa before the introduction of carnivora, and suppose that, for sundry reasons, the vitality of the race was but little affected by moderate variations in the sizes of its individuals, so that while some were comparatively light and nimble, others were comparatively large and clumsy. Now introducing upon the scene the common ancestor of the lion and the leopard—by immigration either from Asia or from some other adjacent territory now submerged—let us note some probable features of the complex result. First, as regards the attacked ruminants, it is likely that in course of time the lightest and swiftest individuals, habitually taking refuge in flight, would have greatly increased both in fleetness and in timidity; the largest and most clumsy of the species, unable to save themselves by fleeing, would often be forced to stand and fight for their lives, and would thus ultimately have gained in size, strength, and courage; while those who were neither nimble enough to get out of the way nor strong enough to fight successfully would have all been killed off. And thus, after a while, by perpetual destruction of the means and preservation of the extremes, we should get two kinds of ruminant as different from one another as the antelope which escapes by his fleetness and cautious timidity, and the buffalo which boldly withstands the lion and not unfrequently conquers or repulses him. Secondly, let us observe what must have been going on all the while with the attacking carnivora. The lighter and less powerful of these would find manifest advantage in crouching amid dense foliage and springing down upon unwary victims passing below. The larger and more powerful individuals would more frequently roam about the open country, attacking the larger ruminants and giving chase to the nimbler ones, and would thus increase in strength and fleetness. And thus there would be initiated such differences of size and habit as characterize the leopard and the lion.

It must be borne in mind that this is a purely hypothetical illustration, which does not pretend to give a complete account of the complex process. I have no idea that the differentiation between antelopes and buffaloes, or between lions and leopards, was accomplished in any such straightforward way as this. But while unduly simplifying the case, the illustration is undoubtedly sound in principle. No doubt the lion is so strong and so swift because only the strongest and swiftest lions have been able to prey at once upon buffaloes and upon antelopes. No doubt the antelope is so swift and so timid because only the swiftest and most quickly-frightened antelopes have been enabled to get away from the lion, and to propagate their kind. And no doubt in the process above described, we get a partial glimpse of some of the essential incidents in the past careers of these races.

All the foregoing illustrations unite in enforcing the conclusion that the direct and indirect effects of natural selection are by no means limited to slight or superficial changes in organisms. The student of physiology well knows that no change, however seemingly trivial, which ensures the survival of the organism in its fierce struggle for existence, can fail in the long run to entail so many other changes as to modify, more or less perceptibly, the entire structure. Even such a slight change as an increased thickness of the woolly coat of a mammal may, by altering the excretory power of the skin, affect the functions of the lungs, liver, and kidneys, and thus indirectly increase or diminish the size of the animal, which in turn will modify its speed, its muscular development, its mental faculties, and its habits of life.

Having thus briefly indicated the capacity of the theory of natural selection for explaining the most general phenomena of organic variation, let us in conclusion observe how admirably it explains certain special phenomena, which do not otherwise admit of scientific explanation. For evidence of the signal success with which Mr. Darwin has explained such otherwise unaccountable facts as the dimorphism of certain flowers, the existence of neuters or sterile females among bees and ants, the odoriferous glands in mammals, the calcareous shells of mollusks, the heavy carapace of the tortoise, the humps of the camel, the amazingly complicated contrivances through which orchidaceous plants are fertilized by insects, the slave-making instinct of certain ants, the horns of male ruminants, and countless other phenomena; for all this, I must refer to Mr. Darwin's various works. From the mass of phenomena to which the theory of natural selection has been satisfactorily applied, I will only select as an illustration the case of colour, in the animal and vegetal kingdoms.

Until after the publication of Mr. Darwin's speculations, the colours of plants and animals had never been made the subject of careful and philosophical study. So far as any hypothesis was held concerning these phenomena, it was the vaguely conceived hypothesis that they are due to the direct action of such physical conditions as climate, soil, or food. But there are fatal objections to such an explanation. When Dr. Forbes Winslow, in his work on the "Physiological Influence of Light," tells us that "the white colour of animals inhabiting the polar regions is attributable to the absence of intense sunlight," it is an obvious objection that the polar regions are not pre-eminent for darkness. Though within the limits of the arctic circle the sun is below the horizon for six months together, it is none the less for the other six months above the horizon; and though its slanting rays do not cause excessive heat in the summer, the prolonged glare of light, intensified by reflection from the snow and ice, is described as peculiarly intolerable. The summer ought to tan the polar bears as much as the winter can bleach them. And to this it may be added that the Eskimos and Greenlanders, living under the polar circle, are not bleached. Several other facts, alike incompatible with the direct action of physical agencies, are mentioned by Mr. Wallace. While wild rabbits, for instance, are always tinted grey or brown, the same rabbits, when domesticated, give birth to white and black varieties, though there has been no change either in climate or in food. The case is the same with domestic pigeons. But even supposing that the most general features of animal colouring could be explained on this hypothesis—which they cannot be—there would still remain the more remarkable cases of tree-frogs, which resemble bark, and of the so-called leaf-butterflies, which when at rest are indistinguishable from leaves; and the existence of such cases is a stumbling-block in the way of all theories save the theory of natural selection.

For according to the theory of natural selection each species of animals will be characterized by that shade of colour which is most advantageous to the species in the struggle for existence. Now, as Mr. Wallace observes, "concealment is useful to many animals, and absolutely essential to some. Those which have numerous enemies from which they cannot escape by rapidity of motion, find safety in concealment. Those which prey upon others must also be so constituted as not to alarm them by their presence or their approach, or they would soon die of hunger." In striking harmony with this general principle, we find that the great majority of animals are so coloured as best to escape notice, and that animals which are not protectively coloured are animals whose habits of life are such as to enable them to dispense with secrecy. The polar bear is white, as the California bear is grey and the Hindustan bear black, because with a coat thus coloured it can best escape notice and secure its prey. The polar hare has a permanent coat of white; but the alpine hare, the arctic fox, and the ermine, which do not live amid perpetual snow, have coats that are white in the winter only. Arctic owls, falcons, and buntings are coloured snowy white; and the ptarmigan is white in winter, while "its summer plumage so exactly harmonizes with the lichen-covered stones among which it delights to sit, that a person may walk through a flock of them without seeing a single birds" In the sandy deserts of Northern Africa, all birds, without exception, all snakes and lizards, and all the smaller mammals, are of a uniform sandy colour. The camel is tinted like the desert in which he lives, and the same is true of the antelope and the Australian kangaroo. The tawny lion, says Mr. Wallace, "is a typical example of this, and must be almost invisible when crouched upon the sand or among desert rocks and stones." His brother, the tiger, "is a jungle animal, and hides himself among tufts of grass or of bamboos, and in these positions the vertical stripes with which his body is adorned must so assimilate with the vertical stems of the bamboo, as to assist greatly in concealing him from his approaching prey. How remarkable it is that besides the lion and tiger, almost all the other large cats are arboreal in their habits, and almost all have ocellated or spotted skins, which must certainly tend to blend them with the background of foliage; while the one exception, the puma, has an ashy brown uniform fur, and has the habit of clinging so closely to a limb of a tree, while waiting for his prey to pass beneath, as to be hardly distinguishable from the bark."[1] Such nocturnal animals as owls, goat-suckers, mice, bats, and moles are dusky-coloured. In tropical forests, where the trees are laden with green foliage all the year round, we find brilliant green

[1] Wallace, *Natural Selection*, pp. 49, 53.

pigeons and parrots; while the northern snipe resembles the marshy vegetation in which it lives, and the woodcock, with its variegated browns and yellows, is inconspicuous among the autumn leaves.[1] Arboreal iguanas are tinted leafy green; and out of many species of tropical tree-snakes there is but one which is not green, and this kind conceals itself during the daytime in holes. Flat fish, like the skate and flounder, are coloured like the gravel beneath them. Fishes which live among gorgeous coral reefs are magnificently tinted. The brilliant red hippocampi of Australia dwell among sea-weed of the same colour. And numerous other examples from the vertebrate sub-kingdom are given by Mr. Wallace, from whose remarkable essay the examples here given are culled.

Before going farther, let us note how completely these interesting phenomena are in harmony with the theory of natural selection. The variability of the hues of domestic animals descended from a monotonously-coloured wild species, shows that there is no direct physiological necessity for the production of animals of a single given style of colouring. But it is tolerably obvious that in the struggle for existence the most conspicuous among those animals which serve as food for others will be the soonest detected, killed, and eaten; while in general the most conspicuous carnivorous animals will be the most easily avoided, and hence will be the most likely to perish for lack of sustenance. And while it is not universally true of the higher animals, as it is of the lower animals and plants, that a much greater number perish than survive, the destruction of life is nevertheless so great that the fate of each creature must often depend upon apparently trivial circumstances. The explanation would therefore be satisfactory, even if protective shades

[1] The general principle is well stated by Emerson, in this pretty quatrain:

> "He took the colour of his vest
> From rabbit's coat and grouse's breast;
> For as the wild kinds lurk and hide,
> So walks the huntsman unespied."

of colouring could be regarded as circumstances of slight importance,—which they cannot.

Since, therefore, it is natural selection which keeps up the protective hues of animals, by killing off all save the least conspicuous individuals, we may understand why it is that animals which have for several generations been domesticated no longer retain, without considerable deviation, their protective style of colouring. Freed from the exigencies of wild life, there is no longer an imperious need for concealment, and hence the unfavourably coloured individuals survive like the rest, and variety appears among members of the same species. In the cat family, which appears to have been originally arboreal, there is a strong tendency to the production of stripes and spots. In the lion, which is not arboreal, and in the puma, owing to the peculiarity above mentioned, these variegated markings have been almost wholly weeded out by natural selection.[1] But in the domestic cat, along with these spots and stripes which occasionally show its blood-relationship with the leopard and tiger, we more often meet with colours not paralleled among the wild species; now and then we see cats which are coal-black or snowy white. Cows, horses, sheep, dogs, and fowl, furnish parallel examples. Thus too we may understand why the sable and the Canadian woodchuck retain their brown fur during the winter; for the one can subsist on berries, and is far more agile than any of its foes, while the other lives in burrows by the riverside and catches small fish that swim by in the water. And thus we may understand why it is that in the case of birds which build open nests, the female is dull coloured like the nest; while on the other hand, the females of birds which build domed nests are often as brightly coloured as the males.

[1] The variegated marking usually appears, however, in lion-cubs; thus showing that the variegated colouring of the leopard and tiger is relatively primary, while the monotonous colouring of the adult lion is relatively secondary.

Turning now to the insect world, we find a vast abundance of corroborative proof. Among the tiger-beetles examined by Mr. Wallace in the Malay islands, those which lived upon wet mossy stones in mountain brooks were coloured velvet green; others, found for the most part on dead leaves in the forest, were brown; others again, "never seen except on the wet mud of salt marshes, were of a glossy olive so exactly the colour of the mud as only to be distinguished when the sun shone," by casting a shadow. "In the tropics there are thousands of species of insects which rest during the day clinging to the bark of dead or fallen trees; and the greater portion of these are delicately mottled with grey and brown tints, which though symmetrically disposed and infinitely varied, yet blend so completely with the usual colours of the bark, that at two or three feet distance they are quite indistinguishable." Moths, which when resting expose the upper surfaces of their wings, have these dull-coloured. Butterflies, on the other hand, which rest with their wings raised perpendicularly and laid together so as to show only the under surfaces, have the upper surfaces brilliantly coloured, while the exposed under surfaces are dusky and inconspicuous, or even marked in imitation of leaves. Mr. Wallace describes an East Indian butterfly whose wings are superbly tinted with blue and orange: this butterfly is a very swift flyer and is never known to settle save among the dead leaves in the dry forests which it frequents. When settled, with its wings raised, it imitates a shrivelled leaf so perfectly that even the keen eye of the naturalist can hardly detect it. This protective colouring is found throughout the whole immense order to which belong grasshoppers, crickets, and locusts; the most remarkable instance being furnished by the so-called "walking-leaf," to which no description can do justice. On the other hand, hornets, bees, and wasps, which are protected by their stings, are brilliantly but not in general protectively coloured. Bugs and ground-beetles emit a disagreeable, pungent smell, and they are often conspicuously coloured. But the most wonderful of all are the cases of protective mimicry. The heliconidæ are among the most beautiful of South American butterflies. Being never eaten by birds, on account of a nauseous liquid which exudes from them when touched, they are not only very lazy flyers, but have the under sides of their wings as gorgeously tinted as the upper side, so that they can be seen from quite a long distance. From the same cause they are prodigiously numerous, swarming in all the tropical forests. Now it is obvious that if another butterfly, not protected by a disagreeable odour or taste, were to resemble the heliconia in colouring, it would be as efficiently protected as by imitating a dead leaf or dry twig; provided that there were but few of these butterflies among a large number of heliconias. For, as Mr. Wallace says, "if the birds could not distinguish the two kinds externally, and there were on the average only one eatable among fifty uneatable, they would soon give up seeking for the eatable ones, even if they knew them to exist." Now along with the heliconidæ there does, in fact, live a distinct family of butterflies, the pieridæ, most of which are white, and which are anatomically as distinct from the heliconidæ as a lion from a buffalo. But of these pieridæ there is one genus, the leptalis, which exactly resembles the heliconias in external appearance. So close is the resemblance that such expert naturalists as Mr. Bates and Mr. Wallace have been repeatedly deceived by it at the time of capture. Moreover, each species of this genus leptalis is a copy of the particular species of heliconia which lives in the same district. Every band and spot and fleck of colour in the heliconia is accurately reproduced in the leptalis; and besides this, the lazy mode of flight is also imitated. While in point of numbers, we find about one leptalis to a thousand heliconias. Nor is this the only instance. So pre-eminently favoured are these beautiful insects by their disgusting taste, that they are exactly imitated by at least three genera of diurnal moths. In other parts of the world similar phenomena have been noticed. The relationship of the leptalis to the heliconia is repeated in India, in the Philippine Islands, in the Malay archipelago, and in various parts of Africa; the protected insect being, in all these cases, very much less numerous than the insect whose colours it mimics. In similar wise, bees and wasps are often imitated by beetles, by flies and even by moths.

For further details I must refer to Mr. Wallace's essay, which is a singularly beautiful specimen of inductive reasoning. The facts already cited are quite enough to sustain the general conclusion that the colours of animals are in the main determined by the exigencies of the struggle for existence. Where it is for the advantage of an animal to be concealed, as in the great majority of cases, its colour, whether brilliant or sombre, is such as to protect it. But where the animal is otherwise adequately protected—either by its peculiar habits, by a sting, a disgusting odour or taste, or a hard carapace—and where it is not needful for it to be hidden from the prey upon which it feeds, then there is usually no reference to protection in the colour of the animal. In some of these cases, however, a very conspicuous colouring becomes protective—as in the case of the jet-black toad which Mr. Darwin saw in La Plata, which emitted a poisonous secretion, and which, when crawling over the sandy plain, could not fail to be recognized by every passing creature as an object to be avoided.

In many cases the gorgeous tints of the otherwise protected male animal are due to what is called "sexual selection,"—to the continual selection of the more beautiful males by the females. To this cause is due the magnificent plumage of the male bird of paradise; and Mr. Darwin would similarly explain the brilliant colours of many male butterflies. In his work on the "Descent of Man" may be found an account of the elaborate observations which have led to these conclusions. Without feeling it necessary to insist upon the validity of all the special explanations contained in that work, we must admit that the general theory is substantiated by a superabundance of inductive evidence. And when this kind of selection is taken in connection with the need for protective concealment, we have the means of explaining by far the greater part of the colouring found in the animal kingdom.

The colours of the vegetal kingdom have, to a considerable extent, been no less satisfactorily explained. "Flowers do not often need protection, but very often require the aid of insects to fertilize them, and maintain their reproductive powers in the greatest vigour. Their gay colours attract insects, as do also their sweet odours and honeyed secretions; and that this is the main function of colour in flowers is shown by the striking fact that those plants which can be perfectly fertilized by the wind, and do not need the aid of insects, rarely or never have gaily-coloured flowers."[1]

Returning for one moment to the case of animals, which are usually benefited by concealment but sometimes by conspicuousness, let us note Prof. Shaler's ingenious explanation of the rattlesnake's rattle. The existence of this appendage has long been a puzzle to philosophical naturalists, and Darwinians have been repeatedly challenged to account for the formation or preservation by natural selection of an organ assumed to be injurious to the species. The difficulty has lain in the assumption, too hastily made, that the noise of the rattle must be prejudicial to the snake by forewarning its enemies or prey of its presence, and thus giving the enemies time for sudden attack, and allowing the prey to escape. On the theory of natural selection, the preservation of the species must entail the atrophy of such an organ, or, rather, must prevent its origination, unless the

[1] Wallace, *Natural Selection*, p. 262.

damage occasioned by it be more than compensated by some utility not hitherto detected. Prof. Shaler's hypothesis, however, suggests the possibility that this whole speculation is fundamentally erroneous. Far from being injurious to the snake, by serving to warn its prey, it would appear that the rattle may be directly useful by serving as a decoy. Prof. Shaler has observed that the peculiar sound of the rattle is a very close imitation of the note emitted by a certain cicada common in American forests frequented by rattlesnakes; and according to his ingenious suggestion, the bird, hearing the note and thinking to make a meal of the cicada, advances upon its own destruction, becoming the eaten instead of the eater. If this be true, there may be data here for explaining some of the alleged phenomena of fascination, so far as rattlesnakes are concerned; and another case will be added to the numerous cases now on record in which certain animals have acquired, for utility's sake, peculiarities characteristic of totally different species. I should be more inclined, however, to adopt quite a different interpretation of the rattlesnake's rattle. As hinted above, the general law that animals are benefited by concealment has some important exceptions. In many cases, when an animal is especially noxious, it is for his advantage to be conspicuous, that enemies may recognize him at a distance and keep away from him. Thus, as we have seen, while grasshoppers, moths, and butterflies (on the exposed under-surfaces of their wings) are usually so coloured as best to escape notice, on the other hand, bees and wasps, which are protected by their stings, and many beetles, which are protected by a noxious taste or odour, are apt to be conspicuously coloured. And the jet-black toad of La Plata is a still better example. Now a rattlesnake is unquestionably a very noxious animal, and so dangerous to its enemies that they will always do well to keep out of its way. Moreover, the death-wound inflicted by it, though usually very sure. is somewhat slow in operation;

so that in a fierce struggle it will often happen that its action is not prompt enough to preclude a return of compliments fatal to the snake. When a tiger tears open the jugular vein of his enemy, the enemy is placed *hors de combat* at once; but when the rattlesnake has bitten, there is nothing to prevent the foe from employing his few remaining moments in tearing the serpent to pieces. Hence the rattlesnake must be peculiarly benefited by an apparatus which serves as a signal to warn enemies of his presence, and to keep them from attacking him. His more formidable enemies, belonging chiefly to the mammalian class, are certainly intelligent enough to profit by such warning and shun the danger; and as it is plainly for the snake's advantage to avoid even a conflict, it is clear that he is practically helped even less by his terrible bite than by his power of threatening a bite.

This explanation seems to me quite sound in principle. Yet if we adopt it, there is nothing to prevent us from giving due weight also to Prof. Shaler's suggestion. The success with which the note of the cicada is counterfeited by the rattle is a point to be more fully determined by further observation. And if it turns out that the rattle fulfils the double purpose of alarming sundry animals that are hostile and of enticing sundry others that are good for food, it will not be the first case in which it has happened that a structure useful in one way has also become useful in another way. The question is an interesting one, and valuable if only because it reminds us of the danger of reasoning too confidently, from *à priori* premises, about matters the due elucidation of which requires careful study of the details of the every-day life of animals. It is one of the great merits of the theory of natural selection that it has directed so many naturalists, with eyes open, into this fruitful field of inquiry.

It is because it so well illustrates the wealth of suggestiveness in Mr. Darwin's theory, that I have ventured upon this digression. To the general validity of that theory, or even to the validity of the more special hypothesis concerning the uses of concealment or of conspicuousness, the success o. the foregoing explanation is not essential,—since its possible inadequacy may very well be due to the incompleteness of our grasp upon all the details of this particular case. But, returning from this digression to our main thesis, and considering the general significance of the phenomena of colour, we see that, in addition to those most general phenomena of organic life which demand for their explanation the Darwinian theory, there is at least one special class of phenomena which that theory is competent to explain even in minute details. And there are other special classes of phenomena to which it has been applied with equally remarkable success. But when a theory, deduced from the observed general facts of organic life, and invoking no agencies but such as are known to be in operation, is found on trial to account for such an enormous mass of special facts, for which no other valid explanation has been propounded,—we may well say of it, as Laplace said of his own Nebular Hypothesis, that the chances in favour of its being a true explanation are many thousand million to one.

## CHAPTER XI.

### TWO OBJECTIONS CONSIDERED.

WHEN an objection to a complex theory in any department of science is so extremely obvious as to seem at first sight fatal to the theory, it is unwise to urge it in argument until we have very thoroughly considered the matter. Men like Laplace and Goethe, Spencer and Darwin, in framing their theories of evolution, are indeed liable to overlook difficulties which are so unobtrusive as to be detected only after prolonged observation; but they are very unlikely to overlook difficulties which are so conspicuous as to occur at once to the minds of a hundred general readers. When, therefore, a reader of average culture, who has perhaps never seriously bent his mind to the question of the origin of species, and who is very likely unacquainted with the sciences which throw light upon that subject, finds himself immediately confronted by difficulties in a theory which men of the highest learning and capacity have spent a quarter of a century in testing, common prudence should lead him to continue his study until he has made sure that the difficulty is not due to his own ignorance rather than to the shortcomings of the theory. This wholesome caution is too seldom manifested by literary reviewers, many of whom, in criticizing Mr. Darwin's theory without having duly read his works, allege certain objections as being quite obvious to all intelligent people, save to the one-sided speculator who is supposed to have ignored them. In Mr. Darwin's case, this mode of treatment is peculiarly impertinent, since even the less obvious objections to the theory of natural selection were for the most part foreseen and answered in the first edition of the "Origin of Species,"—a book to which, as to an arsenal of scientific facts, one must still resort who would deal intelligently with the latest criticisms directed against the theory.

The most obvious objection to the Darwinian theory is the paucity, or, as it is often incorrectly alleged, the absence, of transitional forms in the various sedimentary strata. This is at first sight a weighty objection against the doctrine of natural selection, according to which the progress has been effected by infinitesimal increments; although it is of no force against the doctrine of derivation, as held by Mr. Mivart, who rejects the maxim *Natura non facit saltum*, and maintains that progress has been effected by sudden jumps, occurring at rhythmical intervals. Mr. Mivart's suggestion, however, cannot be entertained as a scientific hypothesis so long as it alleges no physical agencies competent to effect the sudden jumps from one specific form to another; nor does the comparative paucity of transitional forms in a fossil state afford any reason for our adopting it. A brief consideration will show us that the fact is entirely consistent with the theory of progress by minute variations.

In the first place, let us note that in general intermediate transitional forms must be the soonest killed off in the struggle for existence; and that, especially, where two strains or varieties become further differentiated into true species, it is the extreme forms which multiply at the expense of those which are intercalated between them. Here, as on a former occasion, our comprehension of the argument will be facilitated by a reference to the analogous set of phenomena which occur during the process of linguistic differentiation. It is held by most philologists that all languages in the tertiary or amalgamative stage of development must have previously existed in the secondary or agglutinative stage,—and, at a yet earlier period, in the primary or juxtapositive stage, of which the Chinese is a still living example. Against this view M. Renan has urged the absence or paucity of transitional forms connecting one class of languages with another. Now in answering M. Renan's objection, I have begun by showing, from a consideration of the Romanic dialects, that the difficulty is only imaginary. "A language like Latin, spread over a vast space of country in imperfectly civilized times, inevitably breaks up into a host of local *patois*. Each secluded rustic community has its own style of pronunciation, its own choice of words and syntactical devices, its own method of contracting or otherwise modifying its expressions. And although the inhabitants of any given town can usually communicate with those of the next town, the slight differences accumulate until intercourse between distant places is no longer practicable. In such a state of things we find plenty of transitional dialects, as the Genoese and Provençal between Italian and French, and the Balearic and Catalan between French and Spanish. The Tuscan can understand the Genoese, the Genoese can understand the dweller in Piedmont, the Piedmontese can understand the Vaudois, the Vaudois can understand the Lyonnais, and so on until we come to Paris; but the Tuscan and the Parisian cannot understand each other. Now the progress of civilization in each country tends to kill out the *patois*, elevating that variety of the language which has been made the vehicle of the dominant literature to supremacy over the more provincial forms. Increased facilities of communication, and the growth of large centres of population, and commercial as well as literary activity, end by making the inhabitants of all parts of the country speak and write more and more like those of its intellectual metropolis. And in this way the intermediate dialects slowly disappear, leaving two languages with thoroughly distinct individualities, like Italian and French."[1] Now even here, as I go on to show, the relationships among the dialects have become sufficiently obscured—owing to disappearance of connecting links—to allow M. Raynouard to maintain the paradox that the modern Romanic languages are descended, not directly from the Latin, but from the old Provençal. And in such countries as Hindustan, the processes of divergence, and accompanying obliteration, have gone on to such an extent that Bengali has been mistaken for a non-Aryan language.

Here in the domain of language we see that competition is most severe and destructive between closely allied forms, and that the extremes will vigorously flourish long after the short-lived means have been crushed out of existence. The maxim *In medio tutissimus ibis* does not apply to such cases. We have now to observe that among the phenomena which natural history deals with, a quite similar process goes on. First we may note, with Mr. Darwin, that "as the species of the same genus usually have, though by no means invariably, much similarity in habits and constitution, and always in structure, the struggle will generally be more severe between them, if they come into competition with each other, than between the species of distinct genera. We see this in the recent extension over parts of the United States of one species of swallow having caused the decrease of another species. The recent increase of the missel-thrush in parts of Scotland has caused the decrease of the song-thrush. How frequently we hear of one species of rat taking the place of another species under the most different climates! In Russia the small Asiatic cockroach has every-

[1] "The Genesis of Language, *North American Review*, Oct. 1869, pp 334, 335.

where driven before it its great congener. In Australia the imported hive-bee is rapidly exterminating the small stingless native bee. One species of charlock has been known to supplant another species; and so in other cases. We can dimly see why the competition should be most severe between allied forms, which fill nearly the same place in the economy of nature; but probably in no one case could we precisely say why one species has been victorious over another in the great battle of life."[1]

For our present purpose, however, it is not needful that we should be able to accomplish the latter task, which would require a knowledge of the minutiæ of the organic world such as is not likely to be possessed by anyone for a long time to come. It is enough for us to note that the ordinary process of competition, among organisms as among dialects, tends to kill out the means much sooner than the extremes. Still more clear will this become, if we recur to one of the hypothetical illustrations given in the preceding chapter. It was there shown that, in the case of a group of ruminants hitherto isolated from carnivorous foes, and in which different strains or varieties have begun to establish themselves, a newly-arriving incident force, in the shape of strong and swift carnivora, will at once tend to exterminate all the intermediate forms, while the extremes will not only be indefinitely preserved, but will become yet more widely different from each other. Now this hypothetical case is probably a fair sample of a very large proportion—perhaps the majority—of the cases in which specific variations have been rapidly accumulated and persistently fixed. It is by no means likely that variation has gone on throughout the past with a uniform pace; but there must rather have been immensely long periods of comparative stability, alternating with relatively brief periods, during which newly-introduced sets of circumstances have tended to enhance

[1] *Origin of Species*, 6th edit., p. 59.

and accumulate variations on either side of a hitherto established mean. Such a conclusion is implied by the theory of natural selection, according to which specific variation occurs, not in conformity to some mysterious law of progress uniformly operating, but only in conformity to some more or less conspicuous alteration in the sum-total of the conditions of existence.

It follows, therefore, that in general, when incipient varieties are differentiated into well-marked species, the number of intermediate forms must be immeasurably smaller than the numbers of forms contained in the resulting species to which they serve as the transition. During epochs of rapid divergence, the means may all be extinguished after a few hundred generations, while the generations of the extremes which persist thereafter may be numbered by tens of thousands. Suppose, for example, two great islands separated by a shallow sea. During long ages, while the floor of this intervening sea is constantly rising, the specific changes occurring on either island may be quite few and unimportant, and such fossil records as are left will indicate a general persistence of type. But when in course of time the process of elevation has converted this intervening channel into an isthmus connecting the two islands, there must inevitably ensue a marked change in the conditions of existence in both regions. Extinction will go on at a relatively rapid pace; and, as above illustrated, this extinction must ordinarily result in the disappearance of intermediate forms and the preservation of extremes. After a while this process must result in the establishment of an approximate equilibrium among the forms of life over both areas, such as formerly obtained over each area separately. And thus for a long time to come, the specific changes occurring will again be few and unimportant.

Thus we see graphically illustrated the truth that, in comparison with the myriads of individuals comprising the well-defined species which propagate themselves through long ages with relative stability of character, the number of intermediate individuals which ever come into existence must be relatively small. We have next to note that, even of this relatively small number of individuals, a still smaller relative number are likely to leave after death a permanent fossil record of their existence.

In the first place it is only by a rare combination of circumstances that any plant or animal gets fossilized at all. The chances were nearly infinite against the preservation of any of the very earliest organisms, with their soft and speedily decaying textures. The higher land animals, on the other hand, owe their occasional preservation to the accidents of dying in sheltered caves, or of being covered with blown sand or peat-moss, or of being frozen in Arctic ice. Trees with solid trunks, littoral and marine animals, especially crustaceans and shell-covered mollusks, are more likely to be preserved than other organisms. But, in the second place, the majority of the organisms once fossilized are afterwards destroyed along with the sedimentary strata which contain them. Since there have been several enormously long alternating periods of elevation and of subsidence, it follows that all the older sedimentary strata must have been metamorphosed by volcanic heat. These oldest rocks have sunk to a depth of six or eight miles, down below the ocean-floor, where they have been metamorphosed by the heat of the molten liquid below, and whence they have again been slowly shoved up above water-level, with all traces of their organic contents obliterated. This process must have occurred so many times as to have destroyed all but the later records of life. The title "palæozoic," formerly applied to the Silurian rocks, is a misnomer. It was formerly supposed that there were no fossil-bearing rocks below the Silurian. But within a few years the Cambrian and Laurentian strata have been discovered, carrying us back into an antiquity nearly twice as great as that to which we had reached with the Silurian rocks; and it is now generally admitted that even the Laurentian strata are modern compared with the beginnings of life upon our globe.

But this is not all. Along with the immensely long geologic rhythms, which have thus entailed the periodic metamorphosis of strata, there have been going on minor rhythms, resulting in the alternate deposit and denudation of fossil-bearing strata. Each of the sedimentary strata now surviving was deposited during an epoch of subsidence, and since its elevation to its present position has been more or less denuded. Now it is only during epochs of subsidence that permanent fossil-bearing strata can be deposited. During epochs of elevation the newly-formed sedimentary deposit is rapidly disintegrated by the action of coast-waves; and even those thin deposits which are made during an epoch of subsidence are in the next-recurring epoch of elevation soon worn away. It is thus only the thicker strata deposited during an epoch of subsidence which have preserved for our inspection a few specimens of the organisms living at the time when they were deposited.

But in close juxtaposition to this comes the remarkable fact that the most rapid variation among specific forms must take place during epochs of elevation. For since the only variations preserved by natural selection are those which bring the organism into closer adaptation to its environment; and since in most cases the organic environment of any group of organisms, comprising its enemies, competitors, and prey, is a much more important factor of change than its inorganic environment, comprising climate and soil; it follows that those periods during which groups of organisms, hitherto isolated, are gradually brought into contact with one another, must be the periods most favourable for specific change. The most rapid variation, attended by the greatest frequency of transitional forms, will therefore occur during those epochs of elevation when archipelagos are being converted into continents, and when shallow parts of the sea, hitherto divided by deep channels, are getting practically united together by the diminishing depth of the channel. During such periods it is not only the inorganic agencies of climate and soil which will be altered; the organic environment of each group of organisms will be immensely increased in extent and heterogeneity. The struggle for existence will increase in violence, and there will be an increased amount both of variation and of extinction.

We are thus driven to the remarkable conclusion, not only that each system of fossiliferous strata now remaining has been preceded and followed by systems destroyed as fast as they were formed, but also that the systems thus destroyed coincided with the periods which must have been richest in transitional forms.

But notwithstanding the extreme imperfection of the geological record, and notwithstanding these special difficulties in the way of finding transitional forms, such forms are frequently met with. Indeed it may be asserted, as one of the most significant truths of palæontology, that extinct forms are almost always intercalary between forms now existing. Not only species, genera, and families, but even orders of contemporary animals, apparently quite distinct, are now and then fused together by the discovery of extinct intermediate forms. In Cuvier's time, horse, tapir, pig, and rhinoceros were ranked as a distinct order from cow, sheep, deer, buffalo, and camel. But so many transitional forms have been found in tertiary strata that pachyderms and ruminants are now united in a single order. By numerous connecting links the pig is now seen to be closely united with the camel and the antelope. Similar results relating to the proboscidians, the hyæna family of carnivora, the apes, the horse, and the rhinoceros, have been obtained from the exploration of a single locality near Mount Pentelikos in Greece. Among more than seventy species there discovered, the gradational arrangement of forms was so strongly marked, that the great palæontologist, M. Gaudry, became a convert to Mr. Darwin's theory in the course of the search.[1] Referring for many more such examples to the last edition of Sir Charles Lyell's "Principles of Geology," let me further observe that there has as yet been but little search for fossils save in Europe and North America, and even these areas have by no means been thoroughly explored. Concerning South America much less is known, and the greater portions of Asia, Africa, and Australia are just so much *terra incognita* to the palæontologist. As M. Gaudry observes, a few strokes of the pick-axe at the foot of Mount Pentelikos have revealed to us the closest connecting links between forms which seemed before very widely separated: far closer will such links be drawn when a considerable portion of the earth's surface shall have been thoroughly investigated.

The argument from "missing links," therefore, in so far as it has any validity at all, is an argument which rests entirely upon negative evidence. But negative evidence, as everyone knows, is a very unsafe basis for argument.[2] A

[1] We may also profitably consider the toxodon, found by Mr. Darwin in South America, which is "one of the strangest animals ever discovered. In size it equalled an elephant or megatherium, but the structure of its teeth, as Mr. Owen states, proves indisputably that it was intimately related to the Gnawers, the order which at the present day includes most of the smallest quadrupeds: in many details it is allied to the pachydermata: judging from the position of its eyes, ears, and nostrils, it was probably aquatic, like the dugong and manatee, to which it is also allied. How wonderfully," says Mr. Darwin, "are the different orders, at the present time so well separated, blended together in different points of the structure of the toxodon!"—Darwin, *Voyage of the Beagle*, p. 82. Compare the remarks on the quaternary fauna of Western Europe in Sir John Lubbock's *Prehistoric Times*, 2nd edition, pp. 296–298.

[2] "For instance, the several species of the chthamalinæ (a sub-family of sessile cirrhipeds) coat the rocks all over the world in infinite numbers: they are all strictly littoral, with the exception of a single Mediterranean species, which inhabits deep water, and this has been found fossil in Sicily, whereas not one other species has hitherto been found in any tertiary formation: yet it is known that the genus chthamalus existed during the Chalk period."—Darwin, *Origin of Species*, 6th edit., p. 271.

single item of positive evidence will always outweigh any amount of negative evidence. A single case in which two or three species or genera are demonstrably connected with each other through lineally intermediate forms, is enough to outweigh the case of a thousand species or genera in which no such linear connection has yet been demonstrated. Now there can be no question that *Equus, Hipparion*, and *Anchitherium*, are quite distinct genera; and a comparison of the skeletons of the three leaves it equally unquestionable that the hipparion is simply a more ancient horse, and that the anchitherium is simply a more ancient hipparion. As Prof. Huxley observes, "the process by which *Anchitherium* has been converted into *Equus* is one of specialization, or of more and more complete deviation from what might be called the average form of an ungulate mammal. In the horses, the reduction of some parts of the limbs, together with the special modification of these which are left, is carried to a greater extent than in any other hoofed mammals. The reduction is less and the specialization is less in the hipparion, and still less in the anchitherium; but yet, as compared with other mammals, the reduction and specialization of parts in the anchitherium remain great." [1] But as we go back still farther into the Eocene epoch, we find *Plagiolophus*, a genus intermediate between the horse and the agouti, in which the reduction and specialization of parts is still less. Here, where the exploration has been relatively complete, the intermediate forms are so numerous as to leave no doubt whatever as to the genetic kinship.[2] And similarly of the rhinocerotidæ and hyænidæ

[1] *Critiques and Addresses*, p. 195.

[2] I may add that, in particular, numerous extinct forms intercalary between man and ape are likely to be discovered when we search for them in those parts of the earth where they are likely to exist,—namely, in Africa, Madagascar, South-eastern Asia, and the Malay Archipelago. Such forms are not likely, however, to be directly intermediate between man and the gorilla or the chimpanzee. For these are probably aberrant types, and the connection between man and the anthropoid apes is to be sought much lower down,—

Prof. Huxley says, "it is indeed a conceivable (?) supposition that every species of rhinoceros and every species of hyæna, in the long succession of forms between the Miocene and the present species, was separately constructed out of dust, or out of nothing, by supernatural power; but until I receive distinct evidence of the fact, I refuse to run the risk of insulting any sane man by supposing that he seriously holds such a notion."

It thus appears that the argument from "missing links," which to the general reader may appear so obviously fatal to the Darwinian theory, is to the student of palæontology by no means alarming. Our brief survey of the facts in the case has shown us *first*, that transitional varieties are always likely to have been less numerous in individuals than the well-defined species which they serve to connect; *secondly*, that the geologic eras which have left in the rocks the record of their organic life have been usually the eras in which variation and extinction have been least rapid, and in which accordingly transitional varieties have been least numerous; and *thirdly*, that in spite of all these adverse circumstances, transitional forms have already been discovered in considerable numbers, while it is fair to expect that many more will be discovered when by and by we have come to know the earth's surface more intimately.

Of all the objections which have been urged against the theory of natural selection, this objection, from the paucity of transitional forms, is the least weighty, though probably the most obvious. The second objection which we have to consider, though less immediately obvious, is more weighty; and though there is no reason for regarding it as insuperable, we must admit that it has not yet been entirely disposed of. This objection is implicated with the difference

perhaps near the point of departure of the anthropoid apes from the lower monkeys and lemurs. See the anatomical evidence very well presented in Mr. Mivart's recent work on *Man and Apes*.

between the morphological and the physiological definitions of species, and is usually known as the argument from the infertility of hybrids. As ordinarily stated, indeed, this argument is merely the expression of a sorry confusion of ideas. By a curious misunderstanding the infertility of the mule is often urged as a direct objection to the Darwinian theory. But this is putting the cart before the horse. It is not the infertility of the offspring of the horse and the ass which should be cited as an obstacle to the theory of natural selection, but it is the fertility of the offspring of the carrier-pigeon and the pouter, or of the pouter and tumbler. Morphologically the carrier, the pouter, and the tumbler may well be regarded as distinct species artificially developed from a common wild stock; but so long as mutual infertility is held to be the physiological test by which we are to distinguish between varieties and species, it may be argued that, in spite of their great morphological differences, the carrier and the tumbler are only varieties and not true species. And going a step farther, it may be argued that until the theory of natural selection has accounted for the rise of infertility between races descended from a common stock, it has not completely performed the task of reconciling deduction with observation.

Against the derivation theory in general, this objection has no weight whatever. That races originally fertile together should, after long subjection to different sets of circumstances, become infertile with one another, is *à priori* in the highest degree probable, when we reflect upon the extreme sensitiveness of the reproductive system to changes of habit in the organism as a whole. When we remember that "the constitution of many wild animals is so altered by confinement that they will not breed even with their own females," we need not be surprised that the leopard and the lion, which during many ages have had very different habits of life, will not breed with each other. Nor need we wonder that the horse and the ass, with less important differences in general habit, have become partially infertile together, to such an extent that their offspring are hopelessly barren. Though the *modus operandi* of this change is as yet ill-understood, it is nevertheless a change quite in harmony with what we know concerning the intimate dependence of the reproductive system upon the rest of the organism. And let us not fail to note that it is the achievement of this change in the capacities of the reproductive system which completes the demarcation between two bifurcating species, and finally prevents the indefinite multiplication of intermediate varieties.

But while this objection has no weight as against the theory of derivation in general, it may fairly be urged that the failure to explain the origination of mutual infertility is, for the present at least, a shortcoming on the part of the theory of natural selection. After the conclusive arguments brought up in our ninth chapter, the derivation theory will no longer, in the present work, be regarded as on trial: that the higher forms of life are derived from lower forms, will be taken as proved. But whether the theory of natural selection has completely fulfilled its proposed task of explaining the mode in which such derivation has been brought about, is quite another question. And while admitting the full force of the considerations alleged by Mr. Darwin, in his admirable chapter on Hybridism, it seems to me that there is a gap at this point which further research will be required to fill.[1] As Prof. Huxley reminds us, "it must not be for-

[1] I doubt if the hypothesis of natural selection, taken alone, will afford the solution of this problem. It seems more likely that such considerations will have to enter as are presented in Mr. Spencer's *Principles of Biology*, vol. i. pp. 209-291. Concerning what may be called the "dynamics of heredity," we know as yet but little; but as far as speculation has already gone, Mr. Darwin's theory of pangenesis seems to me decidedly inferior to Mr. Spencer's theory of physiological units. I do not discuss these theories here, because it is not necessary for the general purposes of this work. It may do no harm, however, to remind some of my readers that "pangenesis" is merely

gotten that the really important fact, so far as the inquiry into the origin of species goes, is that there are such things in nature as groups of animals and of plants, whose members are incapable of fertile union with those of other groups; and that there are such things as hybrids, which are absolutely sterile when crossed with other hybrids. For if such phenomena as these were exhibited by only two of those assemblages of living objects, to which the name of species . . . is given, it would have to be accounted for by any theory of the origin of species, and every theory which could not account for it would be, so far, imperfect." [1]

We have now reached a point at which we may pause for a moment to contemplate the theory of natural selection in its logical aspect, and to mark its character as a scientific hypothesis. A moment's inspection will reveal the absurdity of the thoughtless remark—sometimes heard from theologians and penny-a-liners—that the Darwinian theory rests upon purely gratuitous assumptions and can never be submitted to verification. On the contrary, the theory of natural selection, when analyzed, will be found to consist of eleven propositions, of which nine are demonstrated truths, the tenth is a corollary from its nine predecessors, and the eleventh is a perfectly legitimate postulate. Let us enumerate these propositions:—

1. More organisms perish than survive;

2. No two individuals are exactly alike;

3. Individual peculiarities are transmissible to offspring;

4. Individuals whose peculiarities bring them into closest adaptation with their environment, are those which survive and transmit their peculiar organizations;

5. The survival of the fittest thus tends to maintain an equilibrium between organisms and their environments;

a subsidiary hypothesis, with the possible inadequacy of which Mr. Darwin's main theory is in no way concerned.

[1] Huxley, *Lay Sermons*, p. 303.

6. But the environment of every group of organisms is steadily, though slowly, changing;

7. Every group of organisms must accordingly change in average character, under penalty of extinction;

8. Changes due to individual variation are complicated by the law that a change set up in any one part of a highly complex and coherent aggregate, like an organism, initiates changes in other parts;

9. They are further complicated by the law that structures are nourished in proportion to their use;

10. From the foregoing nine propositions, each one of which is indisputably true, it is an inevitable corollary that changes thus set up and complicated must eventually alter the specific character of any given group of organisms;

11. It is postulated that, since the first appearance of life upon the earth's surface, sufficient time has elapsed to have enabled such causes as the foregoing to produce all the specific heterogeneity now witnessed.

It seems to me that this summary fairly represents the logical character of the theory of natural selection. The theory is so strong that no scientific writer is disposed to deny that the process of natural selection has always gone on and must continue to go on. And the inference cannot be avoided that in due course of time the process must work specific variations. The only purely hypothetical portion of the theory is the assumption that past geologic time has been long enough to allow of the total process of evolution by such infinitesimal increments. But concerning this assumption, it is the clear verdict of logic, that if the theory is thoroughly substantiated in all its other portions, we have the right to claim as much time as is needful, provided we do not run counter to conclusions legitimately reached by astronomy, geology, or physics. Now concerning the age of the earth, neither astronomy, nor geology, nor physics, has as yet had anything conclusive to say; and it must be left for future inquiries to give us the quantitative data requisite for settling this point.[1] We cannot yet, indeed, estimate the age of the last great glacial epoch with any approach to accuracy; yet the age which we assign to this epoch must enter as an important factor into our estimates of the antiquity of preceding epochs. But while this point remains undetermined, it may be noted that even the decision which leaves the smallest time for the operation of unaided natural selection can weaken the Darwinian theory only on the assumption that the agency already alleged by that theory has been the sole factor concerned in forwarding organic evolution; and this assumption, though it may have been made by over-confident disciples of Mr. Darwin, has never been made by Mr. Darwin himself. Mr. Darwin is too profoundly scientific in spirit to imagine that, with all his unrivalled patience and sagacity, he has completely solved one of the most intricate problems with which the student of nature has ever been called upon to deal. It is more than likely that future research will disclose other agencies which have cooperated with natural selection in accelerating the diversification of species. Meanwhile the evidence in behalf of the first ten propositions involved in the Darwinian theory is sufficiently strong to make it apparent that a vast amount of specific change must have taken place, and also that natural selection has been a chief factor in producing that change. To the arguments which in our ninth chapter were seen to overthrow the dogma of fixity of species, may now be added the argument that at least one group of clearly-defined agencies is at work, with which, in the long run, the fixity of species must become incompatible. The explanation of the details of specific differentiation may well form the subject of cautious investigation for many generations of observers and

[1] The reader who wishes to see how fallacious all attempts at reaching the age of the earth from astronomico-physical arguments are likely to prove with our present resources, may consult Huxley's *Lay Sermons*, pp. 268 279.

thinkers. But enough has already been explained to draw forth the undeniable Fact of Derivation from the region of mystery in which it was formerly half-hidden, and thus to place the Theory of Derivation upon a thoroughly scientific basis. In expounding the way in which this has been done, we have obtained several useful conceptions, which will not fail to do us good service in future chapters.

## CHAPTER XII.

### ADJUSTMENT, DIRECT AND INDIRECT.

An objection much less obvious than the two considered in the foregoing chapter, is brought up by Mr. Mivart against the theory of natural selection. In the Cuvierian classification, the marsupials were ranked as an order of mammalia, side by side with orders like the carnivora or rodentia. This arrangement is now obsolete. The class of mammals is no longer directly divided into orders, but is first separated into three sub-classes, the monodelphia, didelphia, and ornithodelphia. The latter sub-class, forming the link between mammals and sauroids, is now nearly extinct, being represented only by a single order, containing two genera, the Australian echidna and duck-bill. Leaving these aside, all other mammals, except the marsupials, are comprised within the sub-class monodelphia. The didelphia or marsupials are divided by Prof. Haeckel into eight orders; and between these orders and sundry orders of the higher monodelphia there is a curious parallelism. For example there is an order of edentate marsupials, there is a marsupial order of carnivora, and another of insectivora, and another of rodents, while the kangaroo strongly resembles the sub-order of ruminants, and the opossum is clearly related to the lemurs, or lowest of the primates. It becomes, then, an interesting problem to settle the genetic relationships between the two sub-classes. Did the order of apes descend from the ape-like marsupials, the monodelphian carnivora from the didelphian carnivora, the higher rodents from the marsupial rodents, and so on? If so, it is difficult to see how the pouch should have been lost, and the placenta developed in so many different orders independently: such a number of exact coincidences seem hardly probable. On the other hand, did all the monodelphia descend from one didelphian form? If so, it is strange that the differentiation into orders should have gone on so similarly in the two sub-classes, resulting, for example, in the production of marsupial mice which in general appearance are hardly distinguishable from placental mice.

Birds and reptiles present an equally puzzling cross-relation. Upon no theory are these the direct ancestors of mammals, although the lowest mammals are both bird-like and reptilian in appearance. The duck-bill, belonging to the mammalian sub-class of ornithodelphia, somewhat resembles a lizard with a bird's beak. Embryology shows that the three classes are divergent offshoots from an amphibious or batrachioid ancestor; but the birds and reptiles resemble each other much more closely than either resembles the mammalia, so that Prof. Huxley joins them together in the super-class or province of sauroids. So far all is plain; but when we inquire by what forms the birds and reptiles are linked most closely together, we are met by a difficulty. Birds are divided into two sub-classes: the ostrich, cassowary, emeu, dinornis, etc., are grouped together as *struthious* birds, while all other existing forms belong to the sub-class of *carinate* birds. Now until quite lately it was supposed that all birds were descended from an extinct reptilian form like that ancient reptile, the flying pterodactyl. For the resemblances in structure between the pterodactyls and the carinate birds are striking enough to have suggested an immediate community of origin. Nevertheless, within the past seven years, a much stronger case has been made out in favour of the descent of the struthious birds from large reptilian forms akin to the dinosauria,—of which extinct order the member most commonly known is the gigantic iguanodon. Now here, says Mr. Mivart, is a dilemma just like the one which confronted us in the case of mammals. If all birds started from the pterodactyl, why do the struthious birds so strongly resemble a totally different reptile? If all birds started from a dinosaurus, why do the carinate birds so strongly resemble the pterodactyl? If we try to split the difference, and say that the carinate birds started from the pterodactyl, while the struthious birds started from the dinosaurus, the difficulty is immensely increased. For then the question arises, how could the struthious and the carinate birds, starting from such different points, have come to resemble each other so strongly?

Mr. Mivart is careful to state that these zoological cross-relations do not constitute an obstacle to the theory of evolution. They are difficulties only on the theory that organic evolution has been solely caused by the natural selection of fortuitous variations. To make this more clear, let us provisionally accept one of each of the pairs of alternatives offered by the two cases just described. Let us agree, with Prof. Haeckel, that all the monodelphian mammals have come from one didelphian; and let us agree, with Prof. Huxley, that the kinship between birds and reptiles is closest in the case of the struthious birds and the dinosaurians. Now we are obliged to maintain that the original monodelphian branched off into a dozen or more forms, of which six or seven happen to agree remarkably, in general appearance and in habits of life, with six or seven of the forms into which the original didelphian had at an earlier date branched off. And we are also obliged to maintain that the remarkable shoulder-structure of the pterodactyl, in which it agrees so closely with the carinate birds, was independently evolved and has a purely physiological significance. That is to say, the resemblance of the pterodactyl to carinate birds is a secondary adaptive resemblance, like the less marked resemblance of bats to birds, or like the resemblance of a porpoise to a fish. And this view, which seems to be Prof. Huxley's, is rendered probable by the fact that in wing-structure the pterodactyl differs from birds in much the same way that a bat does.

We are now extricated from our imbroglio with regard to classification, but we are still left confronted with the difficulty of supposing that the natural selection of casual variations can so often have resulted in producing whole orders of closely-resembling animals from distinct ancestral orders. Other facts, brought up by Mr. Mivart, still further increase the apparent difficulty. The most important of all these relate to the development of the higher organs of sense in the three sub-kingdoms of annulosa, mollusks, and vertebrates. Coincidences between the members of any one of these sub-kingdoms and the members of the others, are not to be attributed to community of origin. No naturalist supposes that an annulose animal, or a true mollusk, has ever been developed into a vertebrate. And while the mollusks and vertebrates appear to have diverged from a molluscoid ancestor akin to the still-living ascidians, the annulose sub-kingdom has a totally different pedigree. To discover any likeness between the two great groups, we must follow them back to those remotest ancestors who possessed hardly any distinctively animal characteristics. Bearing all this in mind, it is a striking fact that the eye of the cuttle-fish, which is the highest of mollusks, appears to be constructed like the eyes of vertebrates. It apparently contains not only a similar retina, but also a lens, the choroid and sclerotic tunics, and the vitreous and aqueous humours. Now this coincidence cannot be due to community of inheritance, for the vertebrate and molluscous sub-kingdoms are linked together only at their lowest extremities, and while the lowest vertebrate has an eye far inferior to the one just described, the molluscoid ascidians have merely rudimentary eye-spots. The coincident structures have therefore been independently developed. Again, Mr. Mivart urges that the agreement cannot be explained on the assumption "that the conditions requisite for effecting vision are so rigid that similar results in all cases must be independently arrived at"; for the eyes of the higher insects, which are excellent visual organs, differ very widely in structure from those of the cuttle-fish and the higher vertebrates. Here, therefore, is a difficulty; and it is still further increased if the alleged fact be true, that there is a similarly close correspondence between the auditory structures in the vertebrates and in the cuttle-fish.

In presenting these difficulties I have closely followed Mr. Mivart, whose scientific arguments are usually stated with a clearness and precision which one would gladly see paralleled in the philosophic discussions by which they are supplemented. I have selected these arguments because they seem to me to constitute the strongest portion of the case which Mr. Mivart has brought to bear against the theory of natural selection; and also because by seeing whither they tend, we shall begin to see how the theory of natural selection must be supplemented, before it can become a complete explanation of the phenomena with which it deals.

Now we must at the outset admit that natural selection must act upon every individual variation which is distinctly advantageous or injurious to the species,—always preserving the former and rejecting the latter. This process must equally go on, whether the variation is a mere idiosyncrasy, such as we call fortuitous, or whether it is one that is manifested simultaneously by a large number of individuals, so that it may be traced to causes acting upon them all in common. Now this latter case is the one which must here be taken into the account. If a large number of individuals may simultaneously vary in a given direction, and if this may often happen within the limits of single generations, it is obvious that we have here a factor of specific change not to be lightly passed over. In estimating the effects of natural selection upon a number of variations which are, quite legitimately, taken for granted, we must not forget to generalize the variations in connection with some common cause to which they may be assignable. Now it cannot be denied that in any single generation of organisms variations are very likely to occur, throughout nearly the whole number of individuals, which are due to the direct adaptation of the species to its environing circumstances. When exhibited in the effects wrought upon the human constitution by exposure to changed physical conditions, such variations are known as acclimatization. Within the infinitesimal period of two centuries the English race in America has come to differ perceptibly, though very slightly, from the English race in Europe; and this very slight difference, which cannot be explained by the much overrated hypothesis of the infusion of foreign blood, and which certainly cannot be traced to natural selection, must be almost wholly due to direct adaptation to new physical and social conditions. Of kindred import is the fact that "twenty-nine kinds of American trees all differ from their nearest European allies in a similar manner, having leaves less toothed, buds and seeds smaller, fewer branchlets, etc." So M. Costa states "that young shells taken from the shores of England and placed in the Mediterranean at once altered their manner of growth, and formed prominent diverging rays like those on the shells of the proper Mediterranean oyster." We have seen that the direct action of physical agencies will by no means account for the chief features of colouring in the organic world; yet it appears to be true that members of the same species of birds are more brightly coloured when living in a clear dry atmosphere than when living near the coast. So, too, in the contour of their wings, the various butterflies of Celebes all show parallel divergences, inexplicable by natural selection alone, from kindred species in Java and India. And a host of like facts concerning these insects are cited by Mr. Mivart from Mr. Wallace's essay on the Malayan Papilionidæ. More examples might be cited if this work were intended to be a scientific treatise on Darwinism; but for the comprehension of the present point, in its philosophic bearings, these illustrations will suffice.

Facts of this kind point to the conclusion that an inherent capacity for adaptive changes is possessed by all organisms. And by the phrase "inherent capacity" I do not mean to insinuate the existence of any *occulta vis*, or metaphysical "innate power," of which no scientific account is to be given in terms of matter and motion. An organism is a complex system of forces; even the simplest living patch of protoplasm is a highly complex system, but in the higher organisms the complication of forces is almost infinite, when compared with our limited powers of analysis. Now such a system of forces must, under penalty of overthrow, maintain both its internal equilibrium and its equilibrium with external incident forces. And this double maintenance of equilibrium necessitates a rhythmical redistribution of forces from moment to moment, of which, as was shown in the chapter on rhythm, the result must be continual change. Now the internal equilibration of the forces in the organism with each other, is generalized in the laws of growth, development, and heredity; while the external equilibration of the forces in the organism with environing forces, is generalized in the laws of variation and adaptation. As the result of the former process, all organisms tend to assume certain typical forms, as inevitably as crystals. In the case of the lowest organisms the forms assumed may possibly be due to the operation of chemical polarity similar (though much more involved) to that which gives form to crystals. In all but the lowest organisms the forms assumed are the expression of tendencies due to the cooperation of countless ancestral forces; and such tendencies are now not improperly classified under the head of "physiological polarity,"—provided that nothing more is meant by "polarity" than the ability of certain special groups of forces to work different structural changes in different directions. So much for the internal adaptive process. But now, as the result of the parallel process of external adaptation, it follows that the forms due to the internal process can remain constant only so long as the environment remains unchanged. If the changes in the environment are too great or too sudden to be equilibrated by changes in the distribution of the system of internal forces, the system is overthrown, and the organism perishes. But if the external changes are moderate and gradual, the adjustment of the organism to them by means of internal changes, must result in that kind of organic variation known as direct adaptation. We need not be surprised, therefore, by the parallel variations of whole genera of American trees or Malayan butterflies; nor need we ascribe them, with certain recent writers, to "occult energies" of the metaphysical sort, or to a kind of pantheistic "intelligence" inherent in nature, or to any other agency unrecognizable by science; since the necessity for such parallel variations, wherever whole groups of organisms are exposed to like environing agencies, is a corollary from the fundamental principles of vital dynamics.

We are now in a position to amend quite materially the view thus far taken of the causes of organic evolution. Hitherto we have concerned ourselves too exclusively with the selection of variations, omitting to inquire into the character and mode of origin of the variations selected. But the latter point is no less important than the former. If variations might occur equally in all directions from the average standard, by reason of circumstances so indefinitely compounded as to make them seem fortuitous, then the natural selection of such variations might well be pronounced incapable—save in very rare instances—of working entirely analogous results in organisms so genetically distinct as monodelphians and didelphians, or as vertebrates and mollusks. In other words, natural selection, acting upon such fortuitous individual variations, would tend to produce indefinitely increasing differentiations in many directions. Such differentiations are to be seen in the amazingly elaborate contrivances for the fertilization of orchids, the explanation of which is one of Mr. Darwin's most brilliant achievements. But when it is admitted that a great number of similar adaptive variations must be simultaneously occurring in the same direction, then it is obvious that the natural selection of such variations may often produce analogous results in different genera and families, or even in different orders, classes, or sub-kingdoms. Mr. Mivart alleges the many resemblances between whales and the ancient ichthyosaurians, as hardly explicable on the theory of the selection of fortuitous variations. But when we recollect that the vertebrate structure of mammals is at the outset homologous with that of reptiles, and that direct adaptation must of itself tend to produce similar variations alike in mammals and in reptiles which pass from a terrestrial into an aquatic environment, the resemblance between a whale and an ichthyosaurus ceases to be an enigma. The superficial resemblance of a whale to a fish is a fact of like nature. And in the case of amphibious carnivora, like the seal, direct adaptation to a partially marine environment has aided in producing fish-like limbs, while it has not interfered with the general likeness of the animal to certain families of land carnivora. So in the case of the pterodactyl as compared with carinate birds, we begin with skeletons constructed on the same plan, and we may expect to find that direct adaptation to the necessities of flight will tend to produce similar modifications of the shoulder-structure. But since, before the appearance of pterodactyls, the dermal covering of reptiles was very likely as different from that of birds as it is now, so that a reptilian wing could not be formed by a modification of the dermal covering, we find, naturally enough, the wing of the pterodactyl formed, like that of the bat, by a modification of the skeleton. And this fact seems to justify us in the alternative which we have accepted, that the likeness of the pterodactyl to birds is no proof of immediate kinship, but only of secondary adaptive variation, as in the case of bats. A similar argument applies to the numerous likenesses between the higher mammals and the marsupials. At an ancient epoch the marsupials were a dominant race of animals, extending all over the world. But since they have been almost everywhere exterminated by their hardier monodelphian descendants, there is no difficulty in the view that direct adaptation to similar differences of environment, when aided by natural selection, has brought about a differentiation of the higher mammals analogous to that which had formerly taken place among the marsupials. That six or seven orders of monodelphians should vary in the same direction with six or seven orders of didelphians, is no more surprising than that twenty-nine kinds of American trees should all differ in the same direction from their European congeners. It is certainly far less surprising than would be the simultaneous loss of a pouch and acquirement of a placenta by a host of marsupial genera scattered all over the earth.

Pursuing the argument a step farther, we may begin to understand, in a general way, even the similarity of the eye of a cuttle-fish to the eye of a vertebrate. Utterly unlike a vertebrate in general structure, and so remotely akin that for practical purposes of argument the kinship is of no account,—if a cuttle-fish could be shown to possess numerous points of special resemblance to a vertebrate, the fact would be an obstacle to any theory of the origin of organic forms.

But the only special resemblances which are found to exist, are those between the eyes and the ears. Now these are organs in which such variations as occur must be in a preeminent degree directly adaptive. The eye, for example, contains an optical apparatus of which the function is the concentration of rays of light into a focus upon the retina. Such is the function discharged by the lens, and the vitreous and aqueous humours. Now, while the compound eyes of insects show us that this function can be discharged in more than one way, a brief consideration of the optical conditions in the case would show that it can only be accomplished in a few ways. Not only does the passage of the light directly tend to set up molecular rearrangements in the refracting matter which lies before the retina, but out of those rearrangements there are very few which can assist the focalizing process, so that natural selection, in preserving the best-refracting eyes, would have but very few directions in which to act. The anterior membrane might differentiate into a number of converging lenses, as in the higher annulosa, but if such a differentiation did not occur, it is difficult to see how the needful refraction could be secured, save by the differentiation of the successive strata which we call the aqueous, crystalline, and vitreous humours. This may serve to indicate the course of explanation to be taken. The physical conditions for securing very efficient vision being thus limited, and direct adaptation being such an important factor in the process, it does not seem at all strange that two eyes quite similar in structure should be independently produced. A precisely similar argument will apply to the case of the ear. And the force of these considerations is still further increased when we learn from Prof. Gegenbaur that the resemblances between the eyes of vertebrates and the eyes of cuttle-fishes are only superficial analogies, and not fundamental homologies, as Mr. Mivart's very exaggerated statement might lead one to suppose.

In all these cases, here too briefly summed up, natural selection must of course be regarded as steadily cooperating with direct adaptation. No matter whether individual variations are directly called forth by environing agencies, or are due to internal causes, in our ignorance of which we call them fortuitous, they must equally be the objects of natural selection wherever they influence, in the slightest degree, the individual's chances of survival. Thus the theory of natural selection is not superseded, but supplemented, by the class of considerations here suggested by Mr. Mivart's objections. Ordinarily, if not always, the two processes must go on in concert; and while the frequent occurrence of directly adaptive changes must greatly accelerate the operation of natural selection, on the other hand natural selection, by weeding out all cases of retrograde variation, must complete the work of direct adaptation.

There are, however, some conspicuous instances in which natural selection seems to play either a very subordinate part, or none at all. As we have just been considering eyes and ears, let us once more return to them, to show how certain peculiarities in their structure must be chiefly due to directly adaptive changes. Within the human ear, firmly fastened in the temporal bone, is a spirally-coiled chamber, known as he *cochlea*. Within this chamber there is a very elastic membrane, and on it lie the so-called *fibres of Corti*, which are a series of fibrous filaments placed side by side, with great regularity, so as to present somewhat the appearance of the key-board on a piano. It is now held by physiologists that this row of fibres is really a key-board, and that each fibre is set in vibration only by a particular musical note, exactly as an A-tuning-fork is set vibrating when A is sounded near it, but not when any other note is sounded. The auditory nerve, in passing into the cochlea, branches into an immense number of nerve-filaments, each of which communicates with one of the keys of this ear-piano. So that when A is sounded on a musical instrument, the A-key within the ear vibrates, and transmits its vibrations to a special filament of the auditory nerve. If this view be correct, we have here a truly marvellous instance of differentiation. But now in what way can this structure have ever been useful to human beings in the struggle for life? Doubtless a considerable power of discriminating sounds is useful to any animal, but of what use can it be to distinguish between A and A-sharp? We may safely conclude, I think, that survival of the fittest has played quite a secondary part in this case. The explanation must be sought in the direct effects wrought by auditory vibrations upon the molecular structure of the cochlear fibres. And it is a system of effects which has not even yet been wrought in its present completeness save among highly civilized people, A savage cannot distinguish the slight variations in pitch by which our ears are delighted. And even among ourselves there are ears which can neither in melody discriminate between the ascending and the descending gamut, nor in harmony distinguish between the mellifluous tonic chord and the harsh inversions of the minor ninth. The defect may be compared to that of colour-blindness, although it is probably more common because the ear has been far less thoroughly trained than the eye. Now when we consider how much can be effected by individual training in enabling a moderately good ear to discriminate between quarters, eighths, and smaller fractions of a tone, and bear in mind that this training must consist in the further differentiation of the sensitive cochlear fibres, we have a strong argument in favour of the production of this wonderful structure by direct adaptation alone.

Concerning the human eye I need only say that in the retina it presents a structure closely analogous to the ear-piano just described. The chief layer of the retina is composed of little rods of nerve-tissue, packed closely together like organ-pipes; and it is probable that each of these rods vibrates in unison with a particular ray of light.[1] Here is a case of extreme differentiation just like that witnessed in the ear; and substantially the same argument will apply to it. The survival of a primeval savage in the struggle for life would certainly depend to a considerable extent on his ability to discriminate certain colours as well as outlines by the eye, as also upon his ability to recognize the *timbre* or quality of certain sounds. But the power of distinguishing the delicate shades in a painting of Correggio could be no more useful, from a zoological point of view, than the power of appreciating the most subtle harmonic effects in a symphony of Schumann. For this extreme differentiation there would seem to be no assignable cause save the direct action of luminous waves upon the wonderfully sensitive and responsive nerve-tissue of civilized man.

Were it needful for the further illustration of our position, I might show how Mr. Spencer has proved that the structure of vertebral columns is also primarily due to directly adaptive changes. Many peculiarities in the shapes of plants and animals are probably thus to be explained. And in regard to the hues of organisms—those phenomena which are so beautifully explained by the Darwinian theory—there are some exceptions to be cited. The magnificent tints of many corals, of certain caterpillars, and of the shells of sundry mollusks, must undoubtedly be due to the direct working of such chemical affinities as produce our wonderful aniline dyes, or the rich tints of our American autumn woods.

But passing over all these interesting points, enough has been said to show that there are many phenomena of organic evolution which natural selection, when considered alone, will not suffice to account for. But, with the amendments

[1] This is the opinion of Helmholtz, the greatest living authority; and it is strengthened by Dr. Brown-Séquard's discovery of the number of fibres in the spinal cord which are specialized for the reception of particular sensations.

now agreed upon, there may be framed an outline of a tolerably complete classification of agencies. Let us reduce to a common form of expression the agencies contemplated in this and in the two preceding chapters.

Considered in the widest sense, the processes which we have seen to cooperate in the evolution of organisms are all processes of equilibration or adjustment. From the dynamical point of view, as has been shown in previous chapters, an organism is a complex aggregate of matter, in which permanent structural and functional differentiations and integrations are rendered possible by the fact that it continually receives about as much motion as it expends. Now a state in which expended motion is continually supplied from without, is called a state of *dependent moving equilibrium.* In other words, it is a state in which every change in the distribution of external forces must be met by a change in the distribution of internal forces, in order that the equilibrium may be preserved. This is the case with every organism. Its life is a perpetual balancing of external forces by internal forces. And the complete accomplishment of this end requires also that there shall be a continuous internal equilibration,—a perpetual balancing of forces operative in the different parts of the organism. Thus the career of an organism, or of a group of organisms, consists of two kinds of equilibration, which we may briefly designate as external and internal equilibration. And a moment's consideration will show us that each of these kinds of equilibration may be either direct or indirect. The adjustment of a group of organisms to changing external circumstances is effected partly by such direct adaptations as we have above considered, partly by the destruction of all those members of the group which do not become directly adapted. In this latter way equilibrium is maintained indirectly; and natural selection, or survival of the fittest, may be accurately characterized as "indirect equilibration." Turning now to the internal processes, we see that direct equilibration which consists in continually arranging all the units of the organism in accordance with their physiological polarities, exemplified alike in heredity and in correlation of growth. On the other hand the dwindling and final evanescence of organs which are disused, is due to the fact that the nutritive material is all needed by the other organs which are in constant use; and it may accordingly be regarded as an indirect method of preserving the internal equilibrium of the organism. The process of organic evolution may therefore be summarized as follows:

| | | | |
|---|---|---|---|
| Equilibration | External | Direct . . | *Adaptation.* |
| | | Indirect . | *Natural Selection.* |
| | Internal | Direct . . | *Heredity.* |
| | | | *Correlation of Growth.* |
| | | Indirect . | *Use and Disuse.* |

Here we have a classification of agencies coextensive with our present knowledge of the subject, and sufficiently comprehensive to include such factors in the problem as may hereafter be discovered. Under one of these four sub-divisions every special process concerned in forwarding organic evolution must be included. For since it is admitted on all sides that specific change is due to the necessity for maintaining equilibrium between the organism and the environment, it follows that every process which results in the modification of species must be a process of adjustment or equilibration, either external or internal, direct or indirect. In the scientific treatment of the problem, there is room for much beside natural selection, but there is no room for *occultæ vires*, or pantheistic intelligences, or for "tendencies," save such as may be expressed as the unneutralized surplus of forces acting in a particular direction.

But we have now done something more than merely to classify the causes of organic evolution. In the act of classifying these, we have arrived at the law or formula which expresses the chief characteristic of organic evolution. We have reached the all-important truth that the progress of life on the globe has been the continuous equilibration of the organism with its environment. We need now only go a step farther in order to obtain a formula which will not only express the distinguishing characteristic of Life itself, but will also serve as an immediate basis for our inquiries into the phenomena of mind and of society.

## CHAPTER XIII.

### LIFE AS ADJUSTMENT.

ONE of the cardinal propositions of Mr. Spencer's system of philosophy is the definition of Life, first published in 1855, in his "Principles of Psychology," but now transferred to the first volume of his "Principles of Biology." According to Mr. Spencer, the continuous maintenance of an equilibrium between the organism and its environment is the process in which life essentially consists. Life—including also intelligence as the highest known manifestation of life—is the continuous establishment of relations within the organism, in correspondence with relations existing or arising in the environment.[1] Out of the host of illustrations by which

[1] The full definition runs thus:—"Life is the definite combination of heterogeneous changes, both simultaneous and successive, in correspondence with external coexistences and sequences." This is incomparably the most profound and complete definition of Life that has ever been framed; and the chapter in which it is set forth and illustrated would alone entitle Mr. Spencer to a place among the greatest thinkers that have ever lived. The objection has indeed been raised, in metaphysical quarters, that this is a definition, not of Life, but of the circumstances or accidents in which Life is manifested. Concerning this objection, we may content ourselves with the following remarks by Mr. Lewes. Both Life and Mind, says Mr. Lewes, are *processes.* 'Neither is a substance; neither is a force. To speak of Vitality as a substance would shock all our ideas; but many speak of it as a force. They might with equal propriety hold Mortality to be a force. What, then, is meant by Vitality, or vital forces? If the abstraction be resolved into its concretes, it will be seen that a certain process, or group of processes, is condensed into a simple expression, and the final result of this process is trans-

this formula is justified, it will be sufficient for our present purpose to select but one or two. "The stinging and contractile powers of a polyp's tentacle correspond to the sensitiveness and strength of the creatures serving it for prey. Unless that external change which brings one of these creatures in contact with the tentacle were quickly followed by those internal changes which result in the coiling and drawing up of the tentacle, the polyp would die of inanition. The fundamental processes of integration and disintegration within it would get out of correspondence with the agencies and processes without it; and the life would cease." So in higher animals, "every act of locomotion implies the expenditure of certain internal mechanical forces, adapted in amounts and directions to balance or out-balance certain external ones. The recognition of an object is impossible without a harmony between the changes constituting perception, and particular properties coexisting in the environment. Escape from enemies supposes motions within the organism, related in kind and rapidity to motions without it. Destruction of prey requires a particular combination of subjective actions, fitted in degree and succession to overcome a group of objective ones. And so with those countless automatic processes exemplified in works on animal instinct." And similarly, as will appear still more clearly when we come to treat especially of the evolution of intelligence, "the empirical generalization that guides the farmer in his rotation of crops, serves to bring his actions into concord with certain of the actions going on in plants and soil; and the rational deductions of the educated navigator who calculates his position at sea, constitute a series of mental acts by

posed from a resultant into an initial condition, the name given to the whole group of phenomena becomes the personification of the phenomena, and the *product* is supposed to have been the *producer*. In lieu of regarding vital actions as the dynamical results of their statical conditions, the actions are personified, and the personification comes to be regarded as indicating something independent of and antecedent to the concrete facts it expresses."—*Problems of Life and Mind*, vol. i. p. 110.

which his proceedings are conformed to surrounding circumstances."

We practically recognize the truth of this definition of life when we attempt to ascertain whether an animal is dead or alive by poking it with a stick. If it responds by motions of its own, we judge it to be alive; if it merely moves as the stick pushes it, we judge it to be dead. So we decide whether a tree is alive or dead by observing whether the increased supply of solar radiance in spring causes those internal motions which result in the putting forth of leaves. In these cases we recognize the truth "that the alteration wrought by some environing agency on an inanimate object does not tend to induce in it a secondary alteration, that anticipates some secondary alteration in the environment. But in every living body there is a tendency towards secondary alterations of this nature; and it is in their production that the correspondence consists."

This formula for vital phenomena is further illustrated and justified by the fact that the degree of life is low or high, according as the correspondence between internal and external relations is simple or complex, limited or extensive, partial or complete, imperfect or perfect. The lowest forms of life respond only to the simpler and more homogeneous changes which affect their total environment. The relations established within a plant answer only to the presence or absence of a certain quantity of light and heat, and to the chemical and hygrometric relations existing in the enveloping atmosphere and subjacent soil. In a polyp, besides general relations similar to these, certain more special relations are established in correspondence with the external existence of mechanical irritants; as when its tentacles contract on being touched. The increase of extension acquired by the correspondences as we ascend the animal scale, may be seen by contrasting the polyp, which can simply distinguish between soluble and insoluble matters, or between opacity and translucence in its environment, with the keen-scented bloodhound, and the far-sighted vulture. And the increase of complexity may be appreciated by comparing the motions respectively gone through by the polyp on the one hand, and by the dog and vulture on the other, while securing and disposing of their prey. In the next chapter it will be shown that the advance from lower to higher forms of life consists in the orderly establishment of relations within the organism, answering to external relations of coexistence and sequence, that are continually more special, more remote in space and in time, and more heterogeneous; until at last we reach civilized man, whose intelligence responds to every variety of external stimulus, whose ordinary needs are supplied by implements of amazing complexity, and whose mental sequences may be determined by circumstances as remote as the Milky Way and as ancient as the birth of the Solar System.

When viewed under this aspect the phenomena of life and of intelligence are so similar that it is difficult to keep them separate in our series of illustrations. As we proceed to treat of psychology, we shall much better appreciate the importance of the truth which I am now expounding. Restricting ourselves here, as far as possible, to physiological illustrations, let us note that in any organism life continues just so long as relations in the environment are balanced by internal relations, and no longer. The difference in result between a jump from a horse-car and a jump from an express train running at full speed, depends simply on the difference in the ability of the contracting muscles to neutralize a small or a large quantity of arrested momentum. The motor energy with which the head is carried forward until it strikes the ground, is exactly the surplus of external force to which the organism has failed to oppose an internal force. If the resulting concussion of the brain is not so great as to induce instant death, but only causes inflammation, with temporary loss of consciousness, then the continuance of life will depend upon the ability of the molecular forces within the organism to bring about a redistribution of matter and motion which shall balance the sudden redistribution caused by the blow. Dynamical pathology regards all diseases as disturbances of the internal equilibrium of the organism, and recovery is the restoration of the equilibrium. The avoidance of danger is the coordination of certain actions in anticipation of more or less complex relations about to arise without. If disease and danger be successfully avoided, the death which ensues in old age is due to the diminished plasticity of the organism which renders it incapable of responding to external changes. As we saw when treating of the primary aspects of Evolution and Dissolution, the evolution of the body, even to the close of life, is characterized by the integration of its constituent matter, shown in the increasing proportion of solids to fluids which makes the bones brittle, the muscles stiff, and the nerves sluggish. Death from old age ensues just when the consequent molecular immobility has reached the point at which incident forces can no longer be balanced by internal rearrangements.

A paragraph will suffice for the exposition of this formula of life in connection with the general law of evolution. That the evolution of life upon the earth, beginning with innumerable jelly-like patches of protoplasm, like the monera discovered by Prof. Haeckel, and ending with more than two million species of plants and animals such as naturalists classify, has been a change from homogeneity to heterogeneity, will be denied by no one. Nor is it needful to repeat, save for form's sake, what was sufficiently illustrated in an earlier chapter,—that the higher forms are also those in which the various orders of integration are most completely exemplified. We need only to note that the continuous adjustment of the organism to its environment, in which process we have seen that life consists, must necessitate both the differentiation of the organism and the integration or definite combination of the changes which constitute its activity. For as the life becomes higher the environment itself increases in heterogeneity as well as in extent. The environment of a fresh-water alga is, as Mr. Spencer remarks, limited to the ditch or pool in which the alga lives. The acaleph borne along on a wave of the sea has a much more homogeneous environment than the caterpillar which crawls over leaves; and the actions by which the caterpillar must "meet the varying effects of gravitation," are far more heterogeneous than the actions of the acaleph. In the case of the higher animals, not only is their environment extremely heterogeneous as consisting to a great extent of adjacent organisms which stand to them in the relations of enemies, competitors, or prey; but it also presents highly coordinated actions on the part of these organisms, which must be met by highly coordinated actions on the part of the former. Thus with the increase of the organism in heterogeneity, definiteness, and coherence, its environment increases in heterogeneity and presents more definite and coherent relations to which the organism must adjust itself. And in this way the heterogeneous, definite, and coherent activity of the organism is again enhanced. The corollary from this group of truths is one which will nearly concern us when we come to treat of the Evolution of Society: it is this,—the greater the amount of progress already made, the more rapidly must progress go on.

## CHAPTER XIV.

### LIFE AND MIND.

Before we proceed to treat of psychical life as the continuous establishment of subjective relations that are in correspondence with environing objective relations, we must dispose of certain questions which have been raised by Comte and his disciples concerning the right of psychology to be regarded as an independent science. Part of Comte's plan for the renovation of philosophy was the rescuing of psychology from the exclusive control of metaphysicians. The manner in which he proposed to accomplish the rescue is only too briefly described: he simply denied *in toto* the claims of psychology to be regarded as an independent science. According to Comte there can be no science, worthy of the name, founded upon the observation and comparison of states of consciousness; and psychology must therefore be studied as a part of biology, by the aid solely of the methods used in biology. That is, the study of mind must be reduced to the study of nervous phenomena simply. It is easy to say that the inevitable outcome of this is the unqualified assertion of materialism. But as Comte himself never drew such an inference, and always protested energetically against materialism, as based upon illegitimate inferences from the study of nervous phenomena, it would not be fair in us to draw the inference for him and then upbraid him with it. This kind of misrepresentation is dear to theologians, and we may contentedly leave them an entire monopoly of it. But worse remains behind. Having condemned psychological analysis as useless, Comte offers us in exchange the ludicrous substitute—Phrenology!

Of all the scientific blunders which Comte ever made, this was beyond question the one which has done most to injure his credit with competent scientific critics. Yet in fairness we must remember that Comte's ignorance of psychology was his weakest point, and that forty years ago, when the anatomy and physiology of the nervous system were in their infancy the conception of dividing the grey surface of the cerebrum into thirty or more provinces, each the seat of a complex group of mental aptitudes, did not seem so absurd as it does now. In those days even Broussais, a first-class physiologist, adopted some of the leading doctrines of phrenology. Moreover the fundamental conception of Gall—which included the anatomical comparison of all animal brains, in connection with the study of the mental characteristics of animals—was a noble conception; though in working it out he showed himself lamentably ignorant of the plainest rules of induction. The purposes of our inquiry do not render it necessary for me to discuss the merits of a hypothesis which has long since ceased to be of any interest, save as an episode in the early history of physiological psychology. Those who wish to see the question treated critically may be referred to the works of Müller, Valentin, Wagner, Vulpian, Gratiolet, Longet, and especially of Lélut; to the appendix to Hamilton's "Lectures on Metaphysics"; to the chapter on Gall in Mr. Lewes's "History of Philosophy"; and to Mr. Bain's treatise on "The Study of Character."

It is not Comte's acceptance of phrenology, but his denial of psychology, which here concerns us. The former is merely a personal question, bearing upon Comte's scientific competence; the latter is a question of general interest. We may note at the outset that many contemporary positivists differ from Comte on this point. It is generally agreed that a science may be founded, even if it has not already been founded, upon the observation and comparison of states of consciousness; though there is some disagreement as to the position of that science with reference to the other sciences. Mr. Lewes, for instance, misled by his general adherence to the Comtean classification of the sciences, regards psychology as a subdivision of biology, on the ground that the phenomena of consciousness are merely a special division of the phenomena of life. This is, in one sense, true; so true, indeed, as to be fatal to the conclusion which it is meant to support. For it may be said, with equal truth, that the phenomena of life are but a subdivision of the phenomena presented by the surface of our contracting and cooling planet; so that it might equally well be argued that biology is only a subdivision of geology. And again it may be said that geologic phenomena are only a subdivision of the general phenomena presented by the condensation of a nebula; so that geology is only a branch of astronomy. Yet it could hardly be said that psychology is a mere branch of astronomy; so that here we seem to have reached a *reductio ad absurdum.*

But by travelling back over the course, we shall get out of the difficulty, and not only see why psychology has as good a right as any other branch of inquiry to be ranked as an independent science, but also see why it must needs be partly founded upon an observation and comparison of states of consciousness. Let us then, having reached the primeval nebula, begin our journey backwards.

Our position is explained by the consideration that all the synthetic concrete sciences are but adjacent tracts of one general science,—Cosmology. "Practically, however, they are distinguishable as successively more specialized parts of the total science—parts further specialized by the introduction of additional factors. The astronomy of the solar system is a specialized part of that general astronomy which includes our whole sidereal system; and becomes specialized by taking into account the revolutions and rotations of planets and satellites. Geology is a specialized part of this special astronomy; and becomes specialized by joining with the effects of the earth's molar motions, the effects of continuous decrease in its internal molecular motion, and the effects of the molecular motion radiated from the sun. Biology is a specialized part of geology, dealing with peculiar aggregates of peculiar chemical compounds formed of the earth's superficial elements—aggregates which, while exposed to these same general forces molar and molecular, also exert certain general actions and reactions on one another. And psychology is a specialized part of biology, limited in its application to a higher division of these peculiar aggregates, and occupying itself exclusively with those special actions and reactions which they display, from instant to instant, in their converse with the special objects, animate and inanimate, amid which they move."[1]

This last point is one which requires further illustration. Concisely expressed, it amounts to this—that psychology is distinguished by dealing in a particular way with the relations between the organism and its environment. A few illustrations will render this perfectly intelligible; will show us that mere nervous physiology is not, and never can be, psychology.

Nervous physiology treats of relations subsisting within the organism. It explains how waves of molecular motion, set up in a nerve-centre and transmitted along a nerve-axis, cause contraction in the fibres of a muscle, or secretion in a gland, or molecular rearrangement in the substance of the tissues, or sets up a new molecular undulation in some other

[1] Spencer, *Principles of Psychology*, vol. i. pp. 137, 138.

nerve-centre. It seeks to formulate the conditions under which nervous stimulation and nervous discharge take place. Or it shows how certain feelings are invariably sequent upon certain rearrangements of the molecules composing the nerve-substance. Even if it recognizes, as it does continually recognize, some force external to the organism, which causes the molecular rearrangement and the resultant feeling, it nevertheless does not concern itself with the relation between the external cause and the internal effect, but only with the internal effect.

Now, as Mr. Spencer has forcibly pointed out, "so long as we state facts of which all the terms lie within the organism, our facts are anatomical or physiological, and in no degree psychological. Even though the relation with which we are dealing is that between a nervous change and a feeling, it is still not a psychological relation so long as the feeling is regarded merely as connected with the nervous change, and not as connected with some existence lying outside the organism. . . . For that which distinguishes psychology from the sciences on which it rests, is, that each of its propositions takes account both of the connected internal phenomena and of the connected external phenomena to which they refer. In a physiological proposition an inner relation is the essential subject of thought; but in a psychological proposition an outer relation is joined with it as a coessential subject of thought. A relation in the environment rises into coordinate importance with a relation in the organism. The thing contemplated is now a totally different thing. It is not the connection between the internal phenomena, nor is it the connection between the external phenomena; but it is *the connection between these two connections.* A psychological proposition is necessarily compounded of two propositions, of which one concerns the subject and the other concerns the object; and cannot be expressed without the four terms which these two propositions imply. The distinction may be best explained by symbols. Suppose that A and B are two related manifestations in the environment—say, the colour and taste of a fruit; then, so long as we contemplate their relation by itself, or as associated with other external phenomena, we are occupied with a portion of physical science. Now suppose that X and Y are the sensations produced in the organism by this peculiar light which the fruit reflects, and by the chemical action of its juice on the palate; then, so long as we study the action of the light on the retina and optic centres, and consider how the juice sets up in other centres a nervous change known as sweetness, we are occupied with facts belonging to the science of physiology. But we pass into the domain of psychology the moment we inquire how there comes to exist within the organism a relation between X and Y that in some way or other corresponds to the relation between A and B. Psychology is exclusively concerned with this connection between A B and X Y: it has to investigate its nature, its origin, and its meaning."[1]

It is true, as the last chapter showed us, that biology also presupposes a reference to phenomena outside the organism, the very definition of Life being "the continuous adjustment of internal relations to external relations"; so that Mind here appears to be but the highest form of Life. We see here the difficulty of sharply demarcating adjacent provinces of nature. Nevertheless there is a broad distinction, though not a sharp one. Exclude from biological problems all those adjustments which constitute mental reaction upon the environment, and the only external factors remaining are those general conditions of temperature, moisture, food and the like, which are taken for granted once for all. While in each special problem of psychology, the relation between internal and external relations is the main subject of inquiry; on the other hand in special problems of biology, the relation between the internal processes and these general external

[1] Spencer, *Principles of Psychology*, vol. i. p. 132.

factors is not the chief, but a subordinate, subject of inquiry. Digestion, for instance, implies food; and "food implies neighbouring plants or animals; but this implication scarcely enters into our study of digestion, unless we ask the quite special question—how the digestive organs become fitted to the materials they have to act upon." But a moment's introspection will make it clear to everyone, "that he cannot frame any psychological conception without looking at internal coexistences and sequences in their adjustments to external coexistences and sequences. If he studies the simplest act of perception, as that of localizing a touch in some part of his skin, the indispensable terms of his inquiry are:—on the one hand a thing (1) and a position (2), both of which he regards as objective; and on the other hand a sensation (3), and a state of consciousness constituting his apprehension of position (4), both of which he regards as subjective. Or, if he takes for his problem one of his complex sentiments, as that of justice, he cannot represent to himself this sentiment, or give any meaning to its name, without calling to mind actions and relations supposed to exist in the environment: neither this nor any other emotion can be aroused in consciousness even vaguely, without positing something beyond consciousness to which it refers."[1]

Let us observe, in passing, that these considerations are quite incompatible with Materialism. The doctrine of the materialists rests partly on the assumption that the study of the laws of nervous action can give us a complete account of mental phenomena. But we have seen that to understand the simplest act of perception, we must take into the account not only the subjective and the objective factors, but the relation between the two. It is this relation which constitutes the perception. But this relation exists only in consciousness, and we cannot explain it save by direct observation of consciousness. Push our researches in biology as far as

[1] Spencer, *Principles of Psychology*, vol. i. p. 133.

we may, the most we can ever ascertain is that certain nerve-changes succeed certain other nerve-changes or certain external stimuli in a certain definite order. But all this of itself can render no account of the simplest phenomenon of consciousness. As Mr. Spencer well says, "such words as *ideas, feelings, memories, volitions,* have acquired their several meanings through self-analysis, and the distinctions we make between sensations and emotions, or between automatic acts and voluntary acts, can be established only by comparisons among, and classifications of, our mental states. The thoughts and feelings which constitute a consciousness, and are absolutely inaccessible to any but the possessor of that consciousness, form an existence that has no place among the existences with which the rest of the sciences deal. Though accumulated observations and experiments have led us by a very indirect series of inferences to the belief that mind and nervous action are the subjective and objective faces of the same thing, we remain utterly incapable of seeing, and even of imagining, how the two are related. Mind still continues to us a something without any kinship to other things."

Thus we conclude that psychology—though, from the objective point of view, it may be regarded as a branch of biology in the same abstract sense in which biology may be regarded as a branch of geology, and geology as a branch of astronomy—has nevertheless an equal claim with any of these to be ranked as a distinct science. From the subjective point of view it has a superior claim to any of the others. Since here the phenomena studied are directly given in the consciousness of the investigator, there arises a distinction more fundamental than those by which the various departments of objective science are marked off from each other. And, indeed, without some of the data furnished by this unique subjective science, it is impossible to obtain the premises of philosophy; as will at once be admitted, on recollecting the topics which occupied us in the first part of this work. Psychology is therefore distinct alike from biology and from other sciences, in its problems and in its theorems. The problem of biology is to formulate the laws of nutrition and reproduction, muscular contraction and nervous irritation, heredity and adaptation. The problem of psychology is to formulate the laws of Association,—the order in which certain relations among environing phenomena give rise to certain corresponding relations among our states of consciousness. And while the theorems of objective science in general are based upon the observation of objective phenomena, whether external or internal to the organism; the theorems of psychology are based not only upon the observation of objective phenomena, but also upon the observation of subjective states.

In view of these results, we see how hopelessly Comte went astray. Rejecting all introspection as metaphysical and delusive, he would have had us confine our inquiries to the succession of those nervous phenomena which are the invariable concomitants of feelings, ignoring the fact that without introspective observation we can never even ascertain that there *is* any invariable concomitance between the feelings and the nervous phenomena. He would have us solve a problem in which two factors are concerned, by investigating only one factor.

In giving his reasons for thus rejecting all observation of consciousness, Comte reveals his inability (upon which I have already frequently remarked) to distinguish between psychology and metaphysics. He insists that psychologic inquiry, as hitherto conducted, has not resulted in discovery. If this were true, it would not help his case. Metaphysical psychologists have failed in discovery, not because they have directly examined states of consciousness, but because they have constructed unverifiable hypotheses about the nature of Mind in itself. Where they have abstained from ontological inquiries, and have contented themselves with scientific methods, psychologists have made discoveries. To say nothing of such recent inquirers as Bain, Wundt, Fechner, and Taine, it may be fairly claimed that, among older speculators, Hobbes, Locke, Leibnitz, Berkeley, Hume, Kant, and Hartley, have by psychologic analysis made real and permanent contributions to our knowledge of mental operations. And at the very date when Comte was preparing his great treatise for publication, there appeared a remarkable book which, by establishing some of the fundamental laws of Association, went far toward placing psychology upon a scientific basis. It is not to the crude and superficial Gall, as Comte would have us believe, that we must give the respect due to the founder of scientific psychology: that respect is due, in far greater degree, to James Mill, the illustrious author of the "Analysis of the Human Mind."

Nevertheless, while psychology is a science clearly distinct from biology, dealing with phenomena which may be classed as super-organic, and using introspective observation as one of its main implements of inquiry, it is no more than any other an absolutely independent science. Since the phenomena of Mind are never manifested to us save in connection with the phenomena of Life, and since the same general formula expresses the fundamental characteristics of the two groups of phenomena, it follows that no complete science of psychology can be constituted without the aid of biology. The conclusions reached by the analysis of subjective states must be shown to be in harmony with the conclusions reached by the synthesis of objective phenomena, before the scientific interpretation of Mind can be regarded as entirely satisfactory. The force of this statement becomes at once apparent, when we recollect that introspective observation can inform us only concerning the mental processes which go on in adult civilized men. In order to understand the genesis of these mental processes, we need the assistance of objective psychology and of nervous physiology; we need to compare the mental processes observed in adult civilized men, with the mental processes observed or inferred in civilized children, in adult barbarians, and in the lower animals, down to those humble organisms in which the phenomena of intelligence first become differentiated from the phenomena of organic life. The immense advance which has been made in mental science during the past forty years, has been mainly due to the practical recognition of this fact. Treatises on psychology are no longer solely based upon an analysis of what happens when "I see the inkstand," although analyses of this sort are still, as is here maintained, indispensable. The nervous system, in its ascending complications from the amphioxus to man, is now taken into the account. The normal variations in psychical manifestation, in the various human races, from childhood to old age, are taken into the account. The abnormal variations caused by stimulants and narcotics, as well as those exhibited in epilepsy, insanity, and other forms of nervous disease, are taken into the account. And careful investigations into the ways in which different organisms respond to external stimuli, show us that the lower forms of psychical activity are no longer neglected. While the analysis of complex mental operations has been pushed to an extent which until lately would have been deemed impracticable, on the other hand the sub-science of psychogeny, dealing with the origin of the various manifestations of mental activity, has arisen to coordinate importance with subjective psychology. It has become generally recognized that—ineffaceable as is the distinction between the phenomena of consciousness and all other phenomena—nevertheless the one as well as the other can be scientifically explained, only when present manifestations are studied in their connection with past manifestations. In this domain, as in all others, the Law of Evolution holds sway.

Let us now, in accordance with these general considerations, begin by contemplating the phenomena of Mind as gradually differentiated from the phenomena of Life; reserving for another chapter the interpretation of sundry psychological truths in terms of the law of evolution. And first let us reconsider the definition of life which was briefly illustrated in the preceding chapter. We saw that life essentially consists in the continuous adjustment of relations within the organism to relations in the environment. And we saw that the degree of life is low or high, according as the correspondence between internal and external relations is limited or extensive, partial or complete, simple or complex. We saw that the lowest forms of life respond to the changes going on about them only in a simple, imperfect, and general way. A tree, for instance, meeting by changes within itself none but physical and chemical changes which occur with general uniformity in the environment, exhibits life in a very simple and unobtrusive form. We habitually regard it as less alive than a polyp, because the polyp, by displaying nascent sensitiveness and contractility, responds to a greater variety of more special external stimuli. Yet the polyp, possessing no specialized organs of sense, can oppose but one sort of action to many diverse kinds of impression. Phenomena so different as those of light and heat, sound and mechanical impact, can affect it in but one or two ways,—by causing it to move, or by slightly altering its chemical condition. The modes of response to outer relations are few and homogeneous. Passing abruptly to civilized man, at the other end of the animal scale, we find a different state of things. To each kind of external stimulus there are many possible modes of response. Not only, for example, does the human organism sharply distinguish between variations which affect the eye and those which affect the ear; not only do eye and ear, which are themselves organs of amazing complexity, discern an endless number of differing tones and hues, as well as a great variety of intensities and qualities; but each particular manifestation of sound or of light is capable of arousing in the organism very different psychical combinations, entailing different muscular actions, according to circumstances. Tennyson's traveller, who, walking at nightfall in a strange land, hears the moaning of a distant sea,

> "And knows not if it be thunder, or a sound
> Of rocks thrown down, or one deep cry
> Of great wild beasts,"

will adopt a course of action more or less in conformity with environing relations, according to the degree of his sagacity and the extent of his experience. Streaks of light and strata of cloud in the horizon will lead the practised mariner and the unskilled passenger to different conclusions. A cartoon of Raphael or a symphony of Beethoven will excite different emotions in an artist and in a person of feeble impressibility. And from the swinging of a cathedral lamp the young Galileo drew inferences which had escaped the attention or baffled the penetration of thousands of less acute beholders. Thus, with civilized man, the modes of response to outer relations are almost infinitely numerous and heterogeneous.

But now, in this briefly indicated contrast between the lowest and highest extremes of life, regarded as a correspondence between the organism and the environment, we have passed abruptly from vital relations which are purely physical to vital relations which are almost purely psychical. The relations contemplated have been, in each of the instances, relations internally set up in adjustment to external relations. But while the relations set up within the tree are simply physico-chemical; and while the relations set up within the polyp, though involving nascent sensitiveness, are nevertheless, in the absence of specialized nerve-matter, unattended by consciousness, and therefore cannot strictly be classed as psychical; on the other hand, the relations set up within civilized man are almost purely psychical, involving only such physico-chemical elements as are necessitated by the fact that conscious activity does not go on unattended by molecular changes in nerve-tissue. It appears, therefore, that while in the vegetal world, and in the lower regions of the animal world, the life is purely or almost purely physico-chemical, it becomes more and more predominantly psychical as we ascend in the animal world, until at the summit it is mainly psychical. The continuous adjustment of inner to outer relations, which both constitutes life and maintains it from moment to moment, is a process which, at first purely physiological, becomes ever more distinctly psychological.

From the facts of comparative anatomy we may elicit a parallel truth. In standard works on human anatomy it is customary to distinguish between the *vegetative* organs, (comprising the nutritive and reproductive systems,) which are developed from the endoderm of the embryo, and the *animal* organs, (comprising the nervo-muscular system,) which are developed from the ectoderm. Not unfrequently these are otherwise and more appropriately distinguished as the *nutritive* and *relational* systems; the special office of the former being the integration of nutritive material, in behoof either of the organism or of its derivative offspring, while the special office of the latter is the maintenance of relations between the organism and the environment. The demarcation is thoroughly distinct, but it is not absolute; since the relations each moment set up even in the nutritive system must correspond with certain general relations of air, temperature, and assimilable material in the environment. Now we have to note that in the vegetal world such general correspondences are all that are established; there is no system of organs differentiated for the purpose of maintaining an equilibrium of relations with the environment. In such simply organized animals as the polyp there is no differentiation of relational tissues or organs; but the entire surface of the animal, besides maintaining such general correspondences as characterize vegetal life, exhibits in a slight degree the irritability and contractility which in higher creatures are specialized in those tissues which form the relational organs. In the molluscoida, the property of irritability being localized in a few nerve-threads uniting in ganglionic masses, and the property of contractility being specialized in a parallel manner, there is rendered possible that more special mode of response to environing agencies, known as reflex action. In the lower vertebrata, the integration of numerous adjacent ganglia into a medulla, having connections with various parts of the organism, renders possible a much more perfectly coordinated series of responses to external stimuli. And at the same time the development of a pair of pedunculated ganglia from the upper portion of the medulla, is attended by the ability to compound the impressions which the medulla receives; so that it becomes possible for the correspondences to extend in space and time. As we ascend through the vertebrate sub-kingdom, the growth of these pedunculated ganglia—the cerebrum and cerebellum—becomes more and more the predominant characteristic of the nervous system; and at the same time the power of adjusting inner relations to remote, special, and complex relations increases. Finally when we come to man, in whom the correspondences have reached a marvellous degree of heterogeneity, extent, and definiteness, we find not only that the relational system of organs is the dominant fact in his organization, but also that the system of pedunculated cephalic ganglia is the dominant fact in the relational system of organs. Not only is the nutritive life quite subordinated to the specially relational life, but the lower modes of the relational life, such as reflex action and instinct, are quite subordinated to those higher modes, such as thought and emotion, which are made possible by the great extent to which the cerebrum and cerebellum carry the compounding of impressions received in the medulla. In order to realize with vividness how completely human life has come to mean the higher psychical life, let us try to imagine what life would be without the cerebrum and cerebellum Yet from the biological point of view these systems of ganglia though nearly, are not quite, absolutely essential to human life; since the less complex acts and impressions are still coordinated after they have been destroyed by disease, and since infants, born without any brain save the medulla and basal ganglia, have been known to live for a short time. Such a deprivation of the higher relational activities naturally seems to us almost equivalent to deprivation of life.

We may now more thoroughly appreciate the force of the distinction between the provinces of biology and of psychology, which was stated in the earlier part of this chapter. We see that while life, physical and psychical, is the continuous adjustment of inner to outer relations, nevertheless in the lowest forms of life, unaccompanied by mind, the outer relations to which adjustment is made are exceedingly general, and the correspondence is simple, direct and homogeneous. But as we pass to forms somewhat higher, we find, along with this simple correspondence maintained by the whole organism, a number of more complex, indirect, and special correspondences, for the establishment and maintenance of which there is differentiated a particular relational structure. As the correspondence increases in complexity, in indirectness, and in speciality, the maintenance of it is confined more and more to this specialized nervo-muscular structure; and the enormously heterogeneous series of adjustments which eventually goes on becomes distinguished from the relatively homogeneous series of adjustments which has all along been going on, as psychical life in contrast with physical life. Thus by a regular process of evolution it happens that, while at the outset the psychical life is but a slight extension of the correspondence which constitutes the physical life, at the end the correspondence which constitutes the psychical life is all in all, and the processes of physical life come to be regarded as entirely subordinate to the maintenance of this higher correspondence.

Let us now briefly trace the various extensions and complications of the correspondence as it becomes more heterogeneous, definite, and coherent. Scanty justice can here be done to the subject, since it is necessary for me to compress into half-a-dozen pages the substance of a series of illustrations, which in Mr. Spencer's exceedingly condensed exposition fill a hundred pages. Nevertheless a few striking facts may be noted down, which will serve to assist in the comprehension of the process. Let us first note that in the simplest forms of life the correspondence extends "only to external relations which have one or both terms in contact with the organism. The processes going on in the yeast-plant cease unless its cell-wall is bathed by the saccharine and other matters on whose affinities they depend. . . . And so too among the lowest animals, the substances to be assimilated must come in collision with the organism before any correspondence between inner and outer changes is shown." The correspondence is similarly limited in time. The tree, which puts forth its leaves from year to year, does so only in response to luminous and thermal changes which occur contemporaneously. The polyp's tentacles contract only in response to immediately present stimuli. "Alike in all these forms of life, there is an absence of that correspondence between internal relations and *distant* external relations"—in space and time—which we see exhibited in higher forms.

Now the extension of the correspondence in space is effected by the gradual differentiation of organs of sense. One of the most notable achievements of modern biology is the discovery—due among others, to Huschke, Remak, Milne-Edwards, and Huxley—that all the sense-organs are but successive modifications of tactile structures, or rather, of those simple dermal structures which in the higher organisms are specialized as tactile. The most perfect organs of touch are the *vibrissæ* or whiskers of the cat, which act as long levers in communicating impulses to the nerve-fibres that terminate in clusters about the dermal sacs in which they are inserted. Yet these whiskers are merely specialized forms of just such hairs as those which cover the bodies of most mammals, and which are found evanescent upon the human skin, embedded in minute sacs or re-entrant folds. Now it is a demonstrated fact that the eye and ear are morphologically identical with *vibrissæ*. The bulb of the eye and the auditory chamber are nothing but extremely-metamorphosed hair-sacs, and the same is true of the olfactory chamber. The crystalline lens is a differentiated hair, the aqueous and vitreous humours are liquefied dermal tissue, and the otolites of the ear are "concretions from the contents of an epidermic sac." In view of these astounding disclosures of embryology, we may readily assent to Mr. Spencer's statement that modern science justifies the guess of Demokritos, "that all the senses are modifications of touch." From a single sense, more or less diffused over the surface of the body, and capable of establishing correspondences only with agencies in direct contact with the body, there have arisen, by slow differentiations, such localized senses as sight and hearing, which serve to enlarge the environment and establish correspondences with agencies more and more remote. Let us briefly consider the sense of sight, omitting hearing, as well as smell and taste, since our space is too limited to deal with them properly.

In such lowly organized creatures as the hydra the ability to distinguish between light and darkness, or between sunshine and shadow, is possessed in a slight degree by the entire surface of the body. But vision can hardly be said to exist, even in its most rudimentary aspect, until this sensibility is "concentrated in a particular spot. The rudimentary eye consisting, as in a planaria, of some pigment grains, may be considered as simply a part of the surface more irritable by light than the rest. Some idea of the impression it is fitted to receive may be formed by turning our closed eyes towards the light, and passing the hand backwards and forwards before them." But while this localization of sensibility enables the creature to adapt itself to the movements of neighbouring opaque bodies, the extension of the correspondence is nevertheless very slight. To produce noticeable obscuration the opaque object must approach very near; and hence "we may infer that nascent vision extends to those objects alone which are just about to touch the organism, . . . . so that it amounts at first to little more than anticipatory touch."[1] As we pass to higher forms, we find the eye gradually increasing in translucence, acquiring convexity of surface, liquefying internally into refracting humours, while the nerve-vesicles within multiply and arrange themselves as retinal rods; the result being seen in the gradually increasing power of the organism to adapt its actions to actions occurring at a distance. The process and the result of development are essentially the same in the case of hearing and smell, though there are great differences in the degrees to which these senses are developed in the highest animals.

Further extension of the correspondence is effected, in the higher vertebrates, by the increase in size and complexity of the cerebrum and cerebellum. These pedunculated groups of ganglia, which issue from the medulla, and whose function it is to compound in higher and higher aggregates the already-compound impressions received by the medulla, are capable of adjusting inner relations to outer relations beyond the reach of the organs of sense. "Chased animals that make their way across the country to places of refuge out of view, are obviously led by combinations of past and present impressions which enable them to transcend the sphere of the

[1] Spencer, *Principles of Psychology*, vol. i. pp. 314, 315.

senses." And in man, by the aid of science, the correspondence is extended not only over the entire surface of the earth, but through all visible space; witness the facts that telegraphic reports enable purchasers in New York to adapt their actions to prices in London, and that the inferences of astronomers are modified in accordance with chemical changes going on in remote nebulæ.

Along with the extension of the correspondence in space there goes on an extension in time, resulting in an enormous increase of the psychical life. Under their more simple forms the two kinds of extension go on together. The rudimentary eye, which enables the organism to anticipate the contact of an approaching opaque body, may serve to illustrate the primitive connection between adjustments to external coexistences and adjustments to external sequences. And it is obvious, without concrete illustration, that in general the more remote are the outer relations to which inner relations are adjusted, the longer will be the interval by which the adjustment may be made to anticipate the group of outer relations which it is designed to balance. But it is only in the higher vertebrates, whose cephalic ganglia are sufficiently large and complex to enable them to form ideal representations of outer relations not immediately present, that there is witnessed a decided extension of the correspondence in time. Dogs and foxes exhibit a well-marked anticipation of future events, in hiding food to be eaten hereafter. But it is first in the human race that such foresight becomes highly conspicuous; and the difference between civilized and savage men in this respect is probably even more marked than the difference between savage men and the higher allied mammals. There are strong reasons for believing that the more complex correspondences in time are chiefly effected by the cerebrum, while the more complex correspondences in space are chiefly effected by the cerebellum. And if this be the case, we may understand why it is that in the course of human progress the increase of the cerebrum in size and complexity has been so much greater than the increase of the cerebellum. In no other respect is civilized man so widely distinguished from the savage, as in his habitual adjustment of his daily actions to contingencies likely to arise in a more or less distant future. But here we touch upon an important theorem of sociology, which I shall hereafter consider at greater length.

Next let us note that the extension of the correspondence in space and in time is accompanied by a progressive increase in the speciality of the correspondence. Manifestly the differentiation of sense-organs which renders possible the adjustment of inner relations to distant outer relations, also renders possible the adjustment of inner relations to outer relations that are more and more special. Increased width of retina enhances the power of estimating the size of neighbouring objects, since the differences in the visual areas which they occupy will become more clearly appreciable. The multiplication of retinal rods enhances the power of estimating shape, since differently shaped objects affect different numbers and different combinations of these rods. Thus while animals with rudimentary vision, in becoming aware of the presence of approaching objects, can recognize them only as objects, on the other hand an animal with developed vision, in recognizing objects near or distant, can also distinguish between innumerable differences in their sizes and shapes, and can make a proportionally great number of special adaptations in its conduct. It is similar with the ability to distinguish colours, and to estimate direction by the eye. And from the growing heterogeneity of the other senses, we might draw parallel illustrations, were there room for them. Finally the high development of the cephalic ganglia, rendering possible the compounding of ideal representations of objects and relations not present to sense, increases to an enormous degree the speciality of the adjustments. Such special adjustments are seen in the cases of "the lion that goes to the river-side at dusk to lie in wait for creatures coming to drink, and the house-dog standing outside the door in expectation that some one will presently open it." But the increase in speciality of adjustment is most conspicuously exemplified in the progress of the human race; as is seen by contrasting the savage who sharpens his arrows in expectation of the periodic flight of certain birds, with the astronomer who at a given day, hour, and minute, adjusts his telescope to watch a transit of Venus.

In the life of the highest animals, and especially in the life of the human race, characterized as it is by the predominant activity of the great cephalic ganglia, there is witnessed an increase in the generality of the correspondence, parallel with the increase in speciality. As this topic falls almost entirely within the province of sociology, the illustration of it must be reserved for a future chapter. Let it here suffice to recall the fact, already mentioned, (Part I. Chap. viii.,) that the progress of human knowledge has all along been equally characterized by analysis and by synthesis,—by the differentiation implied in the recognition of relations that are more and more special, as well as by the integration implied in the grouping of relations in classes that are more and more general.

Along with the increase of the correspondence in spatial and temporal remoteness, in speciality and in generality, there is a continuous increase in complexity. Indeed, in the various aspects of psychical progress already contemplated, this aspect has been continually illustrated. Obviously the development of sense-organs, while widening the environment and increasing the number of relations to which the organism may adjust itself, enhances also the complexity of the adjustments. Contrast the simple movements of the planaria when an opaque object passes before its rudimentary eye, with the complex movements of a cat when a mouse is heard scratching in the wainscot, and it becomes evident that the heterogeneity of the impressions received by an organism is paralleled by the heterogeneity of the adjustments by which it responds to them. The multiplication of the objects and relations of which any organism can take cognizance, involves of necessity a growing complexity in the actions by which it adapts itself to their presence. In civilized man, whose immensely developed cephalic ganglia bear witness to the predominance of psychical over physical life, this correlated advance in heterogeneity of correspondence is exemplified in the interdependent progress of science and art. Here again we are carried into the domain of sociology, and this thread must be left to be gathered up with the others when we come to treat of intellectual progress.

It remains to note that the extension of the correspondence in space and time, and its increase in definite heterogeneity, both heighten the degree of life and add to the ability to maintain life. On the one hand, the more numerous, the more complicated, and the more clearly defined, are the outer relations to which the organism adapts itself, and the longer the interval of time by which the adjustments may be made to forestall external contingencies, the greater will be the number of heterogeneous changes in which life consists. And on the other hand, the greater the number of heterogeneous changes by which the organism can respond to outer changes, the more easily and surely will life be prolonged. Whence, says Mr. Spencer, "we may clearly see how life and ability to maintain life, are two sides of the same fact—how life is a combination of processes, the result of whose workings is their own continuance." An interesting commentary on this proposition is furnished by Mr. Lankester's recently-published essay on "Comparative Longevity," in which it is shown that high *individuation*, or the power of responding heterogeneously to external changes, is the chief, though not the sole, factor concerned in producing length of life. The amount of normal longevity in any species depends upon the definite heterogeneity of the adaptation of its individual members to environing circumstances, and also upon the ratio of their nutrition to their expenditure. But the preponderant importance of the former factor is seen in the fact that, in spite of their immensely greater personal expenditure, the higher animals are, as a rule, very much longer lived than the lower ones. In the civilized human races also, as contrasted with the savage races, the life is not only higher in degree but longer in duration: the longevity of the lowest savages rarely exceeds forty-five years.

As we proceed to survey, in a single view, the various truths here separately elucidated, we find that the essential distinction, above insisted on, between the sciences of biology and psychology, is thoroughly justified by the very facts which illustrate the close connection between the two. The foregoing exposition conclusively proves that in dealing with the adjustments of inner to outer actions, biology "limits itself to the few in which the outer actions are those of agents in actual contact with the organism—food, aerated medium, and things which produce certain effects by touch (as insects which fertilize flowers); thus leaving to psychology all other adjustments of inner to outer actions." "The moment we rose to a type of creature which adjusts certain organic relations to relations of which both terms are not presented to its surface, we passed into adjustments of the psychological order. As soon as there exists a rudimentary eye capable of receiving an impression from a moving object about to strike the organism, and so rendering it possible for the organism to make some adapted movement, there is shown the dawn of actions which we distinguish as intelligent. As soon as the organism, feebly sensitive to a jar or vibration propagated through its medium contracts itself so as to be in less danger from the adjacent source of disturbance, we perceive a nascent form of the life classed as psychical. That is to say, whenever the correspondence exhibits some extension in space or in time, some increase of speciality or complexity, we find we have crossed the boundary between physical life and psychical life."[1]

[1] Spencer, *Principles of Psychology*, vol. i. p. 392.

## CHAPTER XV.

### THE COMPOSITION OF MIND.

In pursuing the analysis of a complex series of phenomena, with the object of ascertaining the simple ultimate elements of which the complex series is made up, we shall sometimes most satisfactorily accomplish our purpose if we begin with the most complicated cases which the series presents. After explaining these by resolving them into their less complex components, our analysis "must proceed similarly with these components; and so, by successive decompositions, must descend to the simpler and more general, reaching at last the simplest and most general." Let us proceed, after this fashion, to inquire into the Composition of Mind. Beginning with the most highly-involved operations of conscious intelligence, and neglecting, for the time being, the consideration of those emotional states by which all operations of intelligence are to a greater or less degree accompanied, let us pursue our analysis until we have arrived at those ultimate units of feeling in the manifold compounding of which all conscious operations, whether intellectual or emotional, consist.

Beginning, then, with a somewhat complicated operation of intelligence, let us consider the process by which an astronomer, knowing the dimensions of the earth, is enabled to calculate therefrom the distance of the moon. He must, in the first place, assimilate in thought the case of the moon to like cases in which the distances of inaccessible objects upon the earth are indirectly measured. When a land-surveyor wishes to ascertain the distance of a church-tower situated on the farther side of a river, he has recourse to an indirect method of measurement. Upon his own side of the river he first measures the distance between two points sufficiently removed from each other, and this distance he calls a base-line. From each end of the base-line he now takes a sight at the inaccessible tower, and, with the proper instruments, measures the difference between its direction and the direction of the base-line. In this way he obtains an ideal triangle, of which the tower is the apex; and, knowing the length of the base-line, and the value of the two angles at the ends of the base-line he calculates by trigonometry the length of the two sides which express the distance of the tower from the ends of the base-line. Now, the astronomer, imitating this process, assumes as a base-line the known distance between two remote points on the earth's surface, as for example London and Cape Town; and then from each of these points he proceeds to take the bearings of the moon. The process, indeed, is here complicated by the fact that, owing to the long distance, the inequalities of the earth's surface, and its curvature, the observer at Cape Town cannot see the position of London, and *vice versâ*. It is necessary, therefore, again to resort to an indirect method, and, having measured the meridional bearings of the moon from the north-pole at London and from the south-pole at Cape Town, to compare these bearings with the knowledge that the bearing of the one pole from the other is 180 degrees or two right angles. A further correction must be made for the fact that London and Cape Town are not on the same meridian. But disregarding these steps in the process, as unnecessarily complicating our case, we have to note that, when the astronomer has thus indirectly measured the angles which ideal lines drawn to the moon must make at the two ends of his long base-line from London to Cape Town, he is at once enabled, like the land-surveyor, to calculate by trigonometry the lengths of these ideal lines, and thus to ascertain the moon's distance. What, now, is the essential characteristic of the process which the astronomer goes through? Or, in other words, what is the fundamental psychical process by the manifold compounding of which is built up this highly-complex series of inferences?

From beginning to end, the fundamental process is the cognition of the equality of sundry relations. The thought which underlies and determines the whole calculation is the cognition that the relations between the sides and angles of a great triangle, having for its apex the moon, and for its base the chord of the arc of the meridian of London measured to a point in the southern hemisphere upon the same parallel with Cape Town, are equal to the relations between the sides and angles of a similar small triangle, having an inaccessible tower for its apex and a measured line of five or six rods for its base; and that these relations, in turn, are equal to the relations between the sides and angles of a still smaller and similar triangle which may be drawn on a sheet of paper, and of which the sides and angles may, if necessary, be directly measured. Now, this cognition implies the previous establishment, in the calculator's mind, of sundry cognitions of the equalities and inequalities of certain relations between the sides and angles of triangles. To show briefly how such cognitions have been established, let us cite the simplest case —that in which the two angles at the base of an isosceles triangle are recognized as equal to each other. Euclid establishes this point by supposing two similar and equal isosceles triangles, of which the one is turned over and placed upon the other, so that the apex and one side of the one will coincide with the apex and opposite side of the other. Then the other sides and the bases must respectively coincide otherwise the two triangles would not be similar and equal, and the conditions of the case would be violated. All the sides being thus equal, each to each, the two triangles must everywhere coincide, and consequently the two basal angles must be equal, both in the triangle which has been turned over and in the one which has kept its original position. Now, each step of this demonstration is a cognition of the equality of a pair of relations of length or of direction; and in each case this cognition is established, not by any anterior demonstration, but by direct inspection. Or, in other words, when it is said that two lines of equal length, starting from the same point, and running in the same direction, must coincide at their farther extremities, the truth of the statement is at once recognized *simply because the states of consciousness which we call the ideas of the two lines are totally indistinguishable from each other.* This immediate perception of the equality—or, in some cases, of the inequality—between two or more relations of position or magnitude is the goal toward which every geometrical demonstration tends. And, still more, it is the mental act implied in every step of every such demonstration. All the devices familiar to the reader of Euclid—the bisecting of lines and angles, the drawing of parallels and the circumscribing of circles for argumentative purposes—are simply devices for bringing a given pair of space-relations directly into consciousness, so that their equality or inequality may be recognized by direct inspection.

Manifestly the case is the same in that algebraic reasoning which our astronomer will often find it desirable to employ in the course of his computation of the moon's distance. The axiom that "relations which are equal to the same relation are equal to each other" is an axiom which twice involves the immediate recognition of the equality of two given relations. And, if any proof were needed that the whole science of algebra is based upon this axiom, it may be found in one of the most common algebraic artifices "When a simplification may be thereby achieved, it is usual to throw any two forms of an equation into a proportion—a procedure in which the equality of the relations is specifically asserted." To cite Mr. Spencer's simple illustration: if we take any equation, $2\ xy=y^2$, and, dividing it by $y$, obtain a second equation, $2\ x=y$, the legitimacy of our proceeding is at once rendered apparent when the two equations are thrown together in a proportion, in which it is asserted that the ratio of $2\ xy$ to $y^2$ is equal to the ratio of $2\ x$ to $y$. Or, if any doubt still remain as to the correctness of this, we resort to the familiar device of multiplying extremes and means, and obtain the identical proposition $2\ xy^2=2\ xy^2$, in which the identity of the two terms is immediately cognized, because the states of consciousness which they evoke are indistinguishable from one another.

Thus the complicated quantitative reasoning by which an astronomer determines the distance of a heavenly body consists in the long-continued compounding of immediate cognitions of the equality or inequality of two or more given relations or groups of relations of position and magnitude.

Before proceeding to unfold all that is implied by this conclusion, let us consider another concrete example of a somewhat different kind. When a certain horned animal, of slender figure, with cloven hoofs, and a hairy integument, is presented to the inspection of a naturalist, he at once recognizes it as a giraffe; and, if required further to describe it, he observes that, as having four stomachs and chewing the cud, it belongs to the sub-order of ruminants; as having its toes firmly united in a solid hoof, it belongs to the order of ungulata; as having mammary glands and suckling its young, it belongs to the class of mammals; and, as having an internal bony skeleton, it belongs to the sub-kingdom of vertebrates. What, now, is the mental act which is repeated at each stage of this description? It is "a cognition of the fact that the relation between particular attributes in this animal is like the relation between homologous attributes in certain other animals." To confine ourselves to the first clause of the description—"the attributes implied by the term *ruminant* can be known only as previously observed or described; and the predication of these, as possessed by the animal under remark, is the predication of attributes *like* certain before-known attributes. Once more, there is no assignable reason why, in this particular case, a relation of coexistence should be thought, between 'such attributes as the possession of four stomachs and the possession of horns and cloven hoofs,' unless as being *like* certain relations of coexistence previously known; and, whether the thinking of this relation can be otherwise accounted for or not, it is clear that the predication cannot otherwise have any probability, much less certainty."[1] The case is the same with the remaining clauses of the description. In each instance the mental operation performed by the naturalist is the recognition of the likeness between certain groups of relations observed in this giraffe and certain other groups of relations previously classified as pertaining to ruminants, ungulata, mammals, and vertebrates. Obviously, therefore, the reasoning by which the places of animals in the zoological scale are determined, consists in the compounding of cognitions of likeness or unlikeness between certain given groups of relations.

So far, then, the mental operation performed by the naturalist seems to be not unlike that performed by the astronomer. And indeed, in spite of the superficial difference which seems so widely to separate the classification of animals from the measurement of celestial spaces, it will appear, on a moment's reflection, that the only real difference between the mental processes involved in the former case, and those involved in the latter, is the extent to which *likeness* is predicated of the relations concerned. Deeply con

[1] Spencer, *Principles of Psychology*, vol. ii. p. 69.

sidered, the act of the astronomer is the same as that of the naturalist, save that, while the former classifies together sundry groups of relations as *equal* to one another, or indistinguishable from one another, the latter classifies together sundry groups of relations as *like* one another, or but slightly distinguishable from one another. Now, in this statement we see that what is meant by *equality* is merely *exact likeness;* but something more is needed for the accurate description of the difference between the two cases. The objects which the astronomer contemplates are simple triangles, presenting simple relations of position and magnitude; while the objects contemplated by the naturalist are complex organisms, presenting immensely compounded relations of structure and function. Now, in speaking of simple things or simple relations, such as lengths and breadths, weights, times, and velocities, we habitually predicate *equality* or *inequality* of them. "Wherever the terms of the comparison, being both elementary, have only one aspect under which they can be regarded, and can be specifically posited as either distinguishable or indistinguishable, we call them either *unequal* or *equal.* But when we pass to complex things, exhibiting at once the attributes, size, form, colour, weight, texture, hardness—things which, if equal in some particulars, are rarely equal in all, and therefore rarely indistinguishable —then we use the term *like* to express, partly the approximate equality of the several attributes separately considered, and partly the grouping of them in a parallel manner in time and space. Similarly with the relations involved in reasoning. If simple, they are recognized as *equal* or *unequal;* if complex, as *like* or *unlike.*"

The essential difference, then, between the quantitative reasoning employed in the most advanced sciences, and the qualitative reasoning employed in those which are less advanced, may be thus stated: in the first case the relations contemplated are so simple that they may be directly juxtaposed in consciousness, and recognized as *equal* or *unequal;* but in the second case the relations contemplated consist of so many simple relations heterogeneously combined, that they can only through a very indirect process be juxtaposed in consciousness, and hence are only approximately recognized as *like* or *unlike.* That this is the only essential difference between quantitative reasoning and qualitative reasoning is shown by the fact that all qualitative reasoning is vaguely quantitative, while all quantitative reasoning begins by being qualitative. For example—to cite Mr. Spencer's admirable illustration—when a brewer describes a vat of fermenting wort as containing carbonic acid, he makes a qualitative statement; yet some rude notion of quantity is involved in it. "He thinks of the carbonic acid as more, certainly, than a cubic foot; less, certainly, than the total capacity of the vat: the quantity is thought of as in some ratio to the quantity of wort." On the other hand, "a man who has walked a mile in fifteen minutes, and, observing that he has a quarter of a mile still to go, infers the time it will take to reach his destination, does not primarily infer *three minutes and three quarters:* he primarily infers *a short time*—a time indefinitely conceived as certainly less than ten minutes, and certainly more than one." Doubtless he may in an instant proceed to calculate the exact length of the time; yet, as it will not be denied that even before calculating he has a vague notion of the interval, it must be admitted that his inference, though ultimately quantitative, is, at the outset, only qualitative. Between the two kinds of reasoning, therefore, the only difference is the degree of definiteness to which they are respectively developed.

Bearing in mind these mutually harmonious conclusions—which alike imply the assertion that, between the highest and the lowest kinds of reasoning employed by civilized man, the difference consists solely in the complexity of the relations contemplated, and in the greater or less definiteness with which these relations are cognized as equal or unequal, like or unlike—let us now advance a step farther. Already, in the course of the foregoing analysis, the essential similarity between reasoning and classification has been vividly brought before us. We have now to scrutinize this similarity somewhat more closely.

To cite an example with which we are already familiar: when our astronomer, some thirty years ago, observed that certain irregularities in the motions of Uranus still remained unaccounted for, after calculating the combined effects of all the interior planets in producing such irregularities, it occurred to him that the unexplained irregularities could only be due to the gravitative force of some undiscovered planet outside of Uranus; and the discovery of Neptune was the result of this most brilliant hypothesis. Now, the mental act involved in this deduction was essentially a *classification of cases.* The case of the unexplained perturbations was mentally ranked along with the several cases of explained perturbations presented by the solar system, as being similarly due to gravitative force; and to the number of known cases in which planets deflect each other from the regular paths in which they would otherwise move, a new hypothetical case was added. Comparing, now, this mental operation with that of the naturalist who, by virtue of certain observed likenesses of structure and function, ranks together lions, and elephants, and seals, in the class of mammals, we may conclude roughly that the one process consists in the formation of a group of *like cases,* while the other consists in the formation of a group of *like things.* And since by the expression "like cases" we mean merely "like sets of relations among two or more given groups of things," it follows that we may characterize Reasoning as the *classification of relations,* while Classification, ordinarily so called, is the *classification of things.* When, for example, on perceiving two similar triangles set side by side, we proceed to make some inference from the known value of a side in the one to the desired value of the corresponding side in the other, the act is an act of reasoning. But when, on taking up two similar sea-shells, we recognize them in their totality as belonging to an oyster or some other familiar mollusk, the act is an act of classification, commonly so called. In other words, if the perception of similarity is followed by the thought of one or more of the like relations which make up similarity, we have an act of reasoning; but if it is followed by the thought of other objects presenting like relations of similarity to the one now perceived, we have an act of classification.

But, closely related as these two mental operations are now seen to be, we have not yet disclosed the full extent to which they are related. Not only is classification involved in every act of reasoning or inference, but reasoning or inference is involved in every act of classification. Not only does reasoning consist in the grouping of relations as like or unlike, but the classification of things can go on only through the grouping of relations as like or unlike. To illustrate this, let us take a further downward step, and consider a mental operation apparently much simpler than those hitherto treated. Let us consider what is implied by the perception of an object.

It is admitted on all sides that the perception of an object necessarily implies the *recognition* of the object as this or that, as like certain objects, and as unlike certain other objects. Every act of perception, therefore, involves classification. We cannot even name a chair without implying the existence of a group of objects which the chair resembles; and the essential element in the perception of a chair is not the reception of a group of visual or tactual impressions, but the interpretation of these impressions as like other antecedent impressions which, taken together, constitute the consciousness of the presence of a chair. And this is as much an act of classification, as the act by virtue of which the naturalist would rank a newly-found horned and cloven-hoofed mammal among the ruminants; the only difference being that in ordinary perception the act has been performed so frequently as to have become automatic at an early period of life, while in scientific classification the act involves more or less conscious thinking, and comparison of relations.

Here, in this last clause, there is hinted what we are seeking for. Not only in scientific classification, but in ordinary perception also, there must go on a comparison of relations, and a grouping of them as like or unlike. In perceiving an apple, for example, "the bulk is perceived to be like the bulk of apples in general; the form like their forms; the colour like their colours; the surface like their surfaces; and so on." For if the bulk were like that of a water-melon, or if the shape were cubical, or if the colour were inky black, or if the surface were covered with thorns, the object would not be perceived to be an apple. The act of perception, therefore, consists in the recognition of sundry attributes as like sundry attributes previously known, and as having relations to one another like the relations between the before-known attributes. This will appear still more clearly, when we recollect what takes place in visual perception. It is well known that the eye, unassisted by the muscular and tactual senses, can take no cognizance of distance, shape, or solidity—the only impressions which the retina receives are impressions of colour, and indirectly of superficial extension. It is because of this that infants reach out for the moon, and that blind men, on first receiving sight, are unable to distinguish between a round orange and a cubical block, without feeling the surfaces of the two. Only after repeated and careful comparison of visual impressions with muscular and tactual impressions is the patient enabled to discover, by the eye alone, that all the objects in the room or in the landscape are not in contact with his body; and it is only after a similar elaborate comparison that the young child achieves the feat of looking at an object in a given direction, or of recognizing by vision its father or mother. Accordingly, when looking about the room, all that you really *see* is a congeries of coloured spots. Your knowledge of the presence of divers objects—chairs, windows, mirror, mantel-piece—is not given in the act of vision, but is the result of an exceedingly complex, though apparently instantaneous, process of reasoning. Your seemingly immediate knowledge that a certain group of coloured spots means a chair is due to the fact, that from early infancy this group of coloured spots, or some other like group, has been associated with sundry impressions of touch and resistance, and with sensations yielded by the little muscles which turn the eye hither and thither. The frequency with which the association has been repeated has rendered the process of inference automatic, just as, to a less-marked extent, the process of reading, at first accompanied by a conscious classification of every letter, has become automatic, so that we are not aware of cognizing the letters at all. Nevertheless, although too rapid to rise into consciousness, the process is still one of inference, implying, like any other process of inference, the grouping of certain relations as like or unlike certain other relations. Certain correlated groups of colours are automatically classified with other correlated groups of colours previously received upon the retina, and also with certain correlated groups of muscular and tactual impressions, previously received simultaneously with the groups of colours in question. Thus our visual perception of objects consists of a group of sensations *plus* a complicated series of inferences which does not differ fundamentally from a course of scientific demonstration. And the same truth may be, with equal justice, though less vividly, illustrated in the case of any other sense than sight. A much simpler case than that of visual perception is that of a spoon, containing some unknown liquid, thrust into the mouth by another person in the dark. Here the only clue to the character of the liquid is its taste ; and when, by its peculiar mild pungency, the liquid is recognized as bromide of potassium, the psychical process consists of a gustatory sensation *plus* an act of classification by which the sensation is grouped with other like sensations previously received. The example is a good one, as showing us also the obverse case. If bromide of potassium has not been previously tasted, the result is simply gustatory sensation unattended by perception; or rather, it is gustatory sensation generically classified as mildly pungent, but not specifically referred to any known liquid, and therefore only partially interpreted. There is perception, but it is incomplete.

It is not pretended that these psychological truths are established by the crude and fragmentary exposition here given. The numerous observations and experiments upon which they are based would be very interesting to recount; but our space does not admit of detailed proof, nor is it needed; since these truths are the common property of psychologists, and will be questioned by no competent student of the phenomena of mind. Referring, for minute and elaborate proof, to Mr. Spencer's "Principles of Psychology," let us be content with setting down the implication which is common to all these conclusions; namely, that between the various psychical processes thus far contemplated, which include alike the measurement of celestial distances by the astronomer, and the direct perception of objects by the unlearned child, or indeed by the ape or dog, there is generic identity. The fundamental characteristic which is common to them all is the reception of certain groups of sensations, accompanied by the classification of these groups of sensations, and of the relations between them, according to their various likenesses and unlikenesses. The difference between the highest and the lowest of the processes thus brought together consists solely in the heterogeneity and definiteness of the groups which are classified, and in the extent to which the classifications are compounded.

To such a statement, however, there is one essential qualification to be added. It is not strictly correct to say that the classification involved alike in the most complex act of reasoning and in the simplest act of perception is a classification of groups of *sensations* and of the relations between them. For, when an object is perceived, along with the sensations actually present, there are remembered or internally-revived sensations which enter into the classification, and these internally-revived sensations are what we call ideas or images. For example, "when passing the finger over a rough surface, the perception contains very much more than the coordinated sensations immediately experienced. Along with these there go the remembered visual impressions produced by such a surface, which cannot be kept out of the mind, and in the suggestion of which the perception largely consists; and there are automatic inferences respecting the texture and density of the substance." So when we see an orange lying on the table, the only sensation actually present and entering into the case is the sensation of a patch of reddish-yellow colour surrounded by other unlike patches of colour. The other elements in the classification of which the perception consists are ideas or internally-revived sensations of position, shape, bulk, texture, juiciness, and so on. And now we discover another point of difference in degree between perception and reasoning. While in perception some of the elements classified must be sensations actually present, in reasoning *all* the elements classified may be ideas or internally-revived sensations. The sides and angles of the isosceles triangles which the astronomer compares in estimating the moon's distance are ideal sides and angles; and the naturalist, in writing about the classification of ruminants, deals solely with internally-revived impressions of horns, hoofs, and multiple stomachs, which were previously present to sense. Thus the classification involved in reasoning differs from that involved in perception, not only in heterogeneity and definiteness, but also in *indirectness.* Nevertheless the difference is not fundamental, but is only a difference in degree ; as is proved by the fact that alike in reasoning and in perception there is implied the previous reception of the actually present sensations of which the ideas or revived sensations are the copies. Our statement, therefore, will become strictly correct if we say that the fundamental characteristic common to the most refined reasoning, and the crudest perception, is the presence of certain *states of consciousness*, accompanied by the classification of these states and of the relations between them according to their various likenesses and unlikenesses ; the differences between the processes being differences in heterogeneity, definiteness, indirectness, and extent of integration or compounding.

Let us next observe that, as between the highest and lowest kinds of reasoning there is a great difference in the extent to which the comparison of relations is carried, so between the highest and lowest kinds of perception there is a similar difference.

There is a striking contrast in degree of directness "between the perception that some surface touched by the finger is hard, and the perception that a building at which we are looking is a cathedral. The one piece of knowledge is almost immediate. The other is mediate in a double, a triple, a quadruple, and even in a still higher degree. It is mediate inasmuch as the solidity of that which causes the visual impression is inferential ; mediate inasmuch as its position, its size, its shape, are inferential; mediate inasmuch as its material, its hollowness, are inferential; mediate inasmuch as its ecclesiastical purpose is an inference from these inferences ; and mediate inasmuch as the identification of it as a particular cathedral is a still more remote inference resulting from the union of these inferences with those many others through which the locality is recognized."[1] From this example it appears that while, at the highest extreme, perception emerges into reasoning, on the other hand at its lowest extreme, as where a body is perceived to be rough or hard, it borders very closely upon simple sensation. Proceeding, then, a step farther in our descending analysis, we have to examine the character of the difference between perception and sensation.

Sensation, no less than perception, has a variety of grades. At the one extreme it rises to a point where it is barely distinguishable from perception; at the other extreme it lapses into an unconscious or sub-conscious psychical state. While writing these lines the sum-total of my consciousness may contain elements contributed by dull sounds of persons walking overhead, by the rumbling of wagons in the street, by faint odours wafted from the kitchen, by soothing pulses of sensation from the pipe held in my mouth, and by the occasional striking of the cuckoo-clock, as well as by the pressure exerted by the chair in which I am sitting, and the table upon which my arm is resting, and the pen which is grasped in my fingers. But, while I am absorbed in thought, none of these elements rise into the foreground of consciousness: though they are present as psychical states, as is shown by the fact that the going out of the pipe or the failure of the clock to strike is noticed, yet I become *conscious* of them, in the ordinary sense of the word, "only when they pass a certain degree of intensity," as when a child overhead falls on the floor, or when the shriek and rumble of a passing railway-train are added to the confused mass of out-door noises; "and only then can I be said to experience" these feelings "as sensations." But when a psychical state rises into the foreground of consciousness and becomes known as a sensation, as when my finger happens to touch the heated pipe.

[1] Spencer, *Principles of Psychology*, vol. ii. p. 245.

bowl, then "I not only contemplate the affection as an affection of myself—as a state through which my consciousness is passing or has passed—but I also contemplate it as existing in a certain part of my body—as standing in certain relations of position. I perceive *where* it is." The close relationship between sensation and perception is illustrated by this example: nevertheless psychology here distinguishes between two portions of the mental act. Though in the practical experience there is no separation between the two, yet analysis enables us to distinguish between the consciousness of the painful feeling and the consciousness of the presence of the heated object which causes the feeling; and the former of these we call sensation, while the latter we call perception.

We shall now be greatly assisted by observing a psychological fact of which Sir William Hamilton caught a glimpse, though, as usual, his analysis was not sufficiently thorough, and his statement of the case was inaccurate. We need not pause to criticize the theorem that while "perception proper and sensation proper exist only as they coexist, in the degree or intensity of their existence they are always found in an inverse ratio to each other;" for its inaccuracy has been fully demonstrated by Mr. Mill and also by Mr. Spencer, who shows the true statement to be, "not that sensation and perception vary inversely, but that they exclude each other with degrees of stringency which vary inversely." To illustrate this, we will suppose that you are getting water from a hot-water faucet, and that, as the water begins by running cold, you clasp your hand about the faucet so as to turn it off when the water has become sufficiently warm. While the water is cool or tepid, sensation is at the minimum, and not only is there no exclusion of perception, but consciousness is occupied with the outer phenomena, the faucet and the running water, more than with the inner phenomenon, the feeling of temperature. The pointed end of the upright part of the faucet, and the protuberance where the horizontal piece is fitted upon it, awaken tactual sensations which co-exist with the sensation of temperature, and the automatic comparison of these sensations which constitutes the perception of the faucet goes on unhindered. To concentrate consciousness upon the feeling of temperature requires a voluntary act of attention, induced by the desire to know how warm the water is getting. As the water becomes very much warmer, so as to be slightly uncomfortable, the perception of the faucet does not become gradually less vivid, but it tends to disappear entirely, and consciousness tends to occupy itself exclusively with the feeling of temperature. Only through a distinct voluntary effort can the perception be made to come into the foreground of consciousness. If, now, there comes a sudden spurt of very hot water, the tactual perception of the faucet is for the moment entirely excluded, and the perceptive act implied in the estimation of the degree of temperature is also expelled from consciousness, which is occupied entirely with the sensation of pain, inducing a violent withdrawal of the hand. Here sensation, reaching a maximum, has quite driven out the group of tactual perceptions, and even visual perceptions are to that extent held in abeyance, that for the moment they cease to occupy the attention. If, now, a piece of soap is taken from its dish, the newly-aroused group of sensations—of weight, hardness, smoothness, and the rest—exist in minimum intensity, and consciousness is occupied, not with them, but with the presence of the piece of soap: perception tends to exclude sensation.

"What, now," inquires Mr. Spencer, "is the real nature of this mutual exclusion? Is it not an instance of the general fact that consciousness cannot be in two equally distinct states at the same time; and that in proportion as the predominance of one state becomes more marked, the suppression of other states becomes more decided? I cannot know that I have a sensation without, for the moment, having my attention specially occupied with that sensation. I cannot know the external thing causing it, without, for the moment, having my attention specially occupied with that external thing. As either cognition rises, the other ceases." By the "external thing," Mr. Spencer does not here mean the *Ding an sich,* but the group of phenomena which are referred to an existence outside of the organism. But we have already seen that, when consciousness is so occupied with such a group of phenomena that the result is the perception of an object, the psychical act involved is an automatic classification of sundry states of consciousness and of the relations between them, according to their various likenesses and unlikenesses. Thus we arrive at the distinction between sensation and perception. Impossible as it is to disentangle the two in practical experience, analysis yet distinguishes the former as an apparently elementary state of consciousness, while the latter is "a discerning of the relations between states of consciousness." According, therefore, as attention is directed chiefly to a conscious feeling or to the relations between a number of feelings, is now sensation and then perception predominant.

It remains to be observed that sensations, or—as we may otherwise call them—feelings, are either peripherally or centrally initiated. In other words, a feeling may either originate at the surface of the organism—as is the case with sensations of sight, hearing, smell, taste, and touch, and in the main with muscular and thermal sensations; or it may originate in the interior of the organism—as is the case with the sensations of hunger and repletion, and with certain muscular sensations, such as cramp; or, again, it may start from some group of nerve-centres, as is the case with those vague feelings which accompany more or less complex acts of perception and reasoning, and which, when they acquire a certain degree of prominence, we call emotions. By the inclusion of these states of consciousness, the term "feeling" covers a somewhat wider range of meaning than the term "sensation." Nevertheless the current use of the word "feeling" to designate indifferently a sensation or an emotion bears unconscious witness to the fact that the two kinds of psychical state differ only in their modes of genesis and of composition. The contrast between a peripheral sensation, as of colour or touch, and an emotion, is chiefly a contrast in degree of definiteness and of localization. But this contrast holds also between peripheral sensations and such vague internal sensations as hunger, which, being known as cravings, are assimilated to the lowest orders of emotion. From this difference in definiteness arises the fact that the peripheral sensations admit of being definitely grouped according to their relations of likeness and unlikeness, and thus afford the material for perception and reasoning, while emotional states admit no such definite grouping, but arrange themselves variously in clusters, the particular character of the cluster being determined by certain contemporaneous perceptions or ideal reproductions of past perceptions. For these reasons the ultimate psychological nature of emotion can be reached only through a synthetical interpretation which starts by recognizing the fact that, along with that classifying of conscious states which occurs in perception and reasoning, there goes on a recognition of certain states as pleasurable or desirable to retain in consciousness, and a recognition of certain other states as painful or desirable to expel from consciousness. Thus in practical experience emotions are, in however slight a degree, inseparably associated with perceptions and inferences, as the vague, internally-initiated feelings accompanying the definite peripheral feelings in the classifying of which the perceptions and inferences consist.

Looking back, now, over the region already traversed, we find that we have passed in review a large number of mental operations which differ immensely in complexity, some of them being performed only by the most highly-educated adult civilized men, while others are performed habitually by children, barbarians, and numerous animals inferior to man. Yet, amid all this diversity, our analysis has detected a fundamental unity. In spite of their vast differences in complexity, we have seen that all these mental operations are ultimately made up of the same psychical process. The grouping of the relations among feelings is the elementary act which is repeated alike in each simple and direct act of perception, and in each complicated and indirect act of ratiocination. At the present stage of our analysis, therefore, the ultimate elements of mind would seem to be *feelings* and the *relations between feelings.* It remains to add that relations themselves must be secondary feelings due to the bringing together of primary feelings. We can know a relation only as some modification of consciousness resulting from some combination of the feelings directly aroused in us by inner or outer agencies; and such modification of consciousness must be itself a kind of feeling. For further illustration let us briefly mention the different relations in the order of their decreasing complexity, that we may note the fundamental relation involved in them all. The most complex relations are those of *similarity* and *dissimilarity,* as exemplified when we recognize the kinship between a thorough-bred race-horse and a Shetland pony, or the complicated divergences between a city and a village. Simpler relations are those of *cointension* and *non-cointension,* as when we perceive that two sounds are equal in degree of loudness, or that in grasping wood and in grasping marble the feelings of temperature are different in degree; of *coextension* and *non-coextension,* as when two lines or two areas are seen to be equal or unequal; of *coexistence* and *non-coexistence,* as when the yellow-reddish light reflected by an orange is regarded as accompanied by sweetness and juiciness, but not by viscidity; of *connature* and *non-connature,* as when greater warmth is mentally assimilated to less warmth, but distinguished from blueness or roughness. Now, underlying all these relations, and all mental processes whatever, is the relation of *likeness* and *unlikeness* between primary states of consciousness. Given the power of recognizing two feelings or conscious states as like each other, and two other feelings or conscious states as unlike each other, and we have the primordial process in the manifold compounding of which all operations of intelligence consist. Let us now take into the account the universally-admitted fact that consciousness is rendered possible only by ceaseless change of state—that a uniform state of consciousness is in no respect different from complete unconsciousness. If our minds were to become spellbound, like the palace of the Sleeping Beauty, all our thoughts and feelings remaining fixed *in statu quo*, our conscious existence would be practically at an end. For consciousness to exist at all, it is necessary that a given state should be followed by a different state. But this is not all that is required. A succession of feelings, of which no two were alike, would not give rise to consciousness, since the recognition of any feeling implies its classification with some antecedent like feeling. Consciousness, therefore, "is not simply a succession of changes, but an *orderly* succession of changes—a succession of changes *combined and arranged* in special ways." Thus we reach the law of the Composition of Mind. Since intelligence cannot arise or continue unless consciousness is continually passing from one state into a different state, it follows that there must be a continuous *differentiation* of states; and again, since intelligence cannot arise or continue unless particular states of consciousness are continually known as like certain previous states, it follows that there must be a continuous *integration* of states. Alike in the most rudimentary perception and in the most developed reasoning, the essential process is the separation of the unlike and the bringing together of the like. So that, "under its most general aspect, all mental action whatever is definable as *the continuous differentiation and integration of* *states of consciousness,*" and the kind of mental action is regarded as high or low, according to the greater or less extent to which the differentiation and integration are carried. The phenomena of conscious intelligence are thus seen to conform to the universal law of evolution; and we may further note that this conclusion is entirely in harmony with the definition of psychical life as the continuous adjustment of inner to outer relations. For clearly, when an intelligence is developing in the midst of a complex environment, the greater the number of subjective relations which are adjusted to objective relations, the greater will be the extent to which the differentiation and integration of conscious states will be carried.

Here we may seem to have arrived at a satisfactory conclusion of our analysis. But the lowest depths of the problem yet remain to be sounded, as will be seen when we consider a superficial objection not unfrequently urged against the foregoing views. Alike in all the mental operations which have formed the subject-matter of our analysis, we have seen that the relations of likeness and unlikeness entering into the case are classified with certain other relations of likeness and unlikeness previously cognized. The thought which determines the astronomer in calculating the moon's distance, implies previous experience of triangles and of numerical relations. In the classification of a giraffe there is implied previous acquaintance with the complex relations of structure and function connoted by the terms *ruminant, ungulate, monodelphian, mammal, vertebrate,* and *animal.* The perception of an apple implies numerous antecedent experiences of colour, size, configuration, smoothness, odour, and taste. And in like manner, though we have provisionally defined a sensation as an "elementary state of consciousness," yet we have also seen that, in order to become truly conscious of a sensation, we must know it, or, in other words, must classify it with some like sensation previously felt.

In short, we have seen that there can be no *cognition*, of whatever order, which is not a *recognition*, necessarily implying some previous combination of psychical states. How, then, it is asked, can there be any first cognition? How can intelligence ever begin at all, if the first and simplest intelligent act implies a reference to experiences which, in accordance with the theory, must have preceded any intelligent act?

Formidable as this objection may seem, and unanswerable as it would have been, if urged half a century ago, it has to-day no force whatever; and those who now deliberately urge it succeed only in betraying their entire lack of acquaintance with the progress which psychology has made since the times of Reid and Stewart. As long as psychological questions were settled simply by introspection—by observing what goes on in the consciousness of adult civilized man—the objection here cited must have seemed conclusive. But familiarity with the conception of evolution has now led us to regard things in general, not as coming at once into fulness of being, but as gradually beginning to be; and in the case of the phenomena of intelligence, this view of the question is amply justified by experiments in objective psychology presently to be mentioned. The conception of an absolutely first cognition, not determined by previous psychical states, rests upon a fallacy similar to that upon which rested the preformation theory in biology. Just as it was formerly held that the embryo started as a fully-developed organism, differing from an adult organism only in size, so the objection which we are now considering involves the hypothesis that the earliest cognitions of an infant are like those of an adult in point of definiteness, the only difference being in the quantity of them. The latter hypothesis is as contrary as the former to the Doctrine of Evolution, and it is quite as decidedly negatived by the observation of facts. For, let us observe what is implied by the acquiring of a definite cognition by an infant. If the foregoing analysis be taken as correct, it is obvious that when any object, as an orange, is first presented to the mind of an infant, it cannot be perceived or identified as an orange. Before this intellectual feat can be achieved, there must go on for some time that complicated grouping of visual, tactual, and gustatory sensations above described. In accordance with the established theory of vision, we must admit that, when the orange is held before the child's eye, the only sensation aroused is that of a reddish-yellow colour, which cannot even be perceived to be round until after it has been associated with sundry tactual sensations. But this is not all. Not even the sensation of a reddish-yellow colour can acquire definite shape in consciousness, until sensations of blue, or red, or green, or white colour, have been aroused, with which it can be contrasted, and until a subsequent like sensation of reddish-yellow colour has been aroused to which it can be assimilated. Observe, now, the position into which we are brought. We are obliged to hold that the first sensation of orange-colour cannot, strictly speaking, exist as a sensation at all; while, nevertheless, a subsequent sensation of orange-colour (not, in any actual case, the second, but the twentieth or hundredth) occurring after intervening sensations of blue or green, can acquire definite shape as a sensation by being compared with this first sensation which is not strictly a sensation. Obviously, then, though the first presentation of orange-colour cannot awaken a visual sensation which can be known as such, it must produce some psychical state which is real, though not known. For if no psychical state were produced by the first presentation, then the second, or twentieth, or hundredth presentation could no more awaken a definite state of consciousness than the first. We are thus led to the assertion that states of consciousness may be produced by the differential grouping or compounding of psychical states which are beneath consciousness.

Now, this conclusion, which admirably explains the beginnings of conscious intelligence in the young child, is completely confirmed by experiments lately made with reference to the continuous genesis of sensations in the adult. Not only does the infant frame its earliest conscious sensations by the compounding of unconscious or sub-conscious psychical changes, but in every sensation of sound, colour, odour, taste, or touch, which the adult receives, there is a precisely similar formation of a conscious state by the compounding of unconscious or sub-conscious psychical states. In the case of sound, the evidence for this statement amounts to complete demonstration; the evidence is hardly less strong in the case of sight; and, in the case of the other senses, all the evidence thus far obtained points toward the same conclusion. Let us first examine the composition of a sensation of sound, as admirably elucidated by M. Taine in his recent treatise on "Intelligence."

In musical sounds three characteristics are to be distinguished—loudness, pitch, and quality or *timbre.* The first of these, the loudness, depends upon the amplitude of the atmospheric waves by which the sensation of sound is caused. A series of sound-producing waves, like any other series of waves, has its elevations and depressions, and the height of the elevation above the depression is called the *amplitude* of the wave. The loudness of the sound varies as the square of the wave's amplitude. From this it follows that every elementary sound has a period of minimum intensity, answering to the wave's minimum amplitude when it is just beginning to rise; secondly, a period of maximum intensity anwering to the wave's maximum amplitude when it has risen to its greatest height; and, thirdly, a period of minimum intensity, answering to the wave's minimum amplitude when it has sunk nearly to the level again; while between these minima and the maximum there are many varying degrees of loudness. In other words, every elementary sound is at first faint, then gradually becomes loud, then grows fainter, till it disappears. Now, note what happens when elementary sounds are made to succeed each other. If the succession be irregular, there is a mere chaos of noises—a case with which we need not here deal. But if the succession be regular, and steadily increase in rapidity, there follows a remarkable series of results. As long as the waves or pulses answering to the elementary sounds succeed each other slowly, the sounds are distinguishable from each other as raps or puffs, according to the instrument employed, and each has its maximum and its two minima of intensity. But, when the waves begin to strike the ear at the rate of about sixteen in a second, the consciousness of separate raps or puffs becomes evanescent, and there arises the consciousness of a continuous tone of very low pitch. That the consciousness of the separate sounds has not quite ceased, and that the continuousness of the tone which they compose is not complete, are shown by the fact that the maxima and minima are still perceived. In the deepest bass-notes of an organ, for example, the pulsations are clearly distinguishable —a fact which proves that we are conscious of the effects answering respectively to the protuberances and to the hollows of the waves. Now, the pitch of a tone depends upon the rapidity with which the waves succeed each other, and, therefore, upon their length, or the distance between two successive hollows, because as the waves come faster they grow shorter. The shorter the waves, the higher the pitch. Hence, as the pitch rises, the protuberance of any wave approaches nearer and nearer to the protuberances of the waves immediately behind it and in front of it, and the maximum intensities of sound which answer to the protuberances become crowded together in consciousness. The result is that, after a while, the maxima and minima are no longer distinguishable by the ear, so that by no effort of attention can we discern the elementary pulses of which the tone is composed. The tone asserts itself to be completely homogeneous. All that mere introspection could discover in consciousness would be an apparently simple sensation of musical tone. Yet into the composition of this sensation there enter a thousand or several thousand psychical states answering to the presence of as many elementary sounds with their maxima and minima of intensity. And if any one of these elementary sub-conscious psychical states were absent, the character of the conscious sensation would be different from what it is.

But this is not all. Every musical tone has a *timbre* or quality of its own, according as it proceeds from a piano, a violin, a flute, or any other instrument. Now, Helmholtz has proved that the quality of any tone is due solely to the number and combinations of certain higher and fainter tones which accompany it. Along with the fundamental note there are heard sundry harmonic notes, due to vibrations from two to ten times more rapid than those which constitute the fundamental note. When any note is sounded on the piano, the first six harmonics are sounded with it; when the same note is sounded on the violin, by means of the bow, the first six harmonics are sounded so feebly as to be overpowered by the seventh, eighth, ninth, and tenth; and this is the only cause of the difference in quality of tone between the piano and the violin. Now, by an effort of attention these harmonic over-tones may be recognized as distinct sensations when two or three notes are slowly struck. But in ordinarily rapid playing they are not distinctly recognized. Their only effect is to impart to the tones that peculiar quality which enables the ear to recognize the instrument from which they emanate. Thus our apparently simple sensations of musical sound are enormously complex. When F-*in-alt* is sounded on the violin, there are produced, in the course of a single second, several thousand psychical states which together make up the sensation of pitch, fifty-five times as many psychical states which together make up the sensation of quality, and an immense number of other psychical states which together make up the sensation of intensity. These psychical states are not, in any strict sense of the term, states of consciousness; for, if they were to rise individually into consciousness, the result would be an immense multitude of sensations, and not a single homogeneous sensation. There is no alternative, therefore, but to conclude that in this case a seemingly simple state of consciousness is in reality compounded of an immense multitude of sub-conscious psychical changes.

Returning, now, to what we have called the elementary sound, by the manifold compounding of which all cognizable tones, qualities, and intensities are built up, we shall the more readily yield to the evidence which shows that even this primitive unit of sound is not elementary. For, as M. Taine observes, each so-called elementary sound, in passing from its minimum to its maximum, passes through an infinite series of degrees of intensity, and, unless there were some psychical modification corresponding to each increment of intensity, there would be no state of consciousness answering to the total rise from the minimum to the maximum. Again, while, for simplicity's sake, we have assumed that each of the raps or puffs which occur too slowly to be heard as a single tone of lowest pitch is heard by itself as an elementary sensation, this is not strictly true. For the so-called simple sensation must be either a sensation of musical tone or a sensation of noise. In the former case its composite character has been already shown. In the latter case, in the sensation of noise, rap, or puff, the truly primitive elements are sub-conscious psychical states answering to successive waves of unequal lengths. Any one of these waves by itself will not produce a genuine state of consciousness; it is only by compounding the sub-conscious psychical affections which they severally produce, that we obtain the so-called elementary sensation of noise or rap.

In every way, therefore, the conclusion is forced upon us that every one of our apparently simple auditory sensations is made up of a vast multitude of psychical affections, of which the really simple ones would never rise into consciousness save by being joined with others. Our simplest cognizable sensation of sound is in reality a compound of the fourth or fifth, or even of some higher, order.

In the case of visual sensations, the same conclusion is reached by a precisely similar argument, sensations of colour differing from those of sound only as answering to wave-lengths immeasurably shorter and more rapid in succession. It is unnecessary to insist upon the manifold analogies between sound and light, which are each day brought more vividly before the attention of the physical inquirer, as, for example, in the wonderful but plausible hypothesis lately propounded, that all the lines in the spectrum are simply the harmonic overtones of a fundamental colour, which, being a couple of octaves below red, is itself invisible. Restricting our statement to ascertained points of resemblance, it may be said that the argument from the phenomena of musical pitch applies step by step to the phenomena of colour as we rise in the scale from red to violet; the only difference being that, as the slowest vibrations which the eye receives occur at the rate of about 458,000,000,000,000 in a second, we cannot experimentally distinguish, as in the case of the lowest sounds, the seemingly elementary sensation which answers to each couple of vibrations. Nevertheless, from experiments with the electric spark it has been shown that a sensation of light which endures for one second is composed of at least a million successive sensations, each one of which, if separately excited, would rise into consciousness and be recognized as a flash of light. Now, as this flash of electric light is cognized as white, it follows that the cognizable sensation which lasts for one-millionth of a second is really made up of at least three sub-conscious psychical states, which, if they were severally to rise into consciousness, would be severally cognized as red, green, and violet flashes—these being the primitive elements of which the consciousness of white light is composed. This fact alone shows that the method by which a sensation is formed out of sub-conscious psychical changes is essentially the same in the eye and in the ear.

No such elaborate investigations have been made with reference to the other peripheral sensations. Yet, in the cases of smell and taste, the argument is not essentially different from what it is in the cases of hearing and vision. The physical antecedent, either of smell or taste, is a chemical reaction between particles of the odorous or sapid substance, and the ends of the olfactory or gustatory nerve-fibrils. Now, a chemical reaction implies an enormous number of undulatory movements by which myriads of molecules are seeking to reach a position of equilibrium. Accordingly, the end of the nerve-fibrils in the olfactory chamber or in the tongue must be rapidly smitten by little molecular waves, just as the auditory filaments are smitten by atmospheric waves; and thus there is indicated a course of argument similar to that employed in the case of sound. It may be fairly argued that if each wave does not produce some sub-conscious psychical effect, the sum of the waves will not produce a state of consciousness known as smell or taste; so that here too the seemingly primitive sensation is really derivative and compound.

M. Taine's argument with reference to the tactile sensations is singularly beautiful, but no room is left for more than the briefest allusion to a few of its salient points. All tactile sensations are either dermal or muscular; that is, they are due either to disturbances of nerve-fibrils embedded in the skin, or to disturbances of nerve-fibrils embedded in the extremities of the muscles lying under the skin. In the first case, the sensation is either of contact or of temperature; in the second case, there is a sensation of resistance or pressure; and in both cases, when the sensation proper to the nerve is prolonged or intensified beyond a certain degree, it is at first accompanied and finally supplanted by a sensation of pain. Now, Weber's experiments have shown that these differences in sensation are not due to the excitation of distinct nerves, but to the differently-combined excitation of the filaments of the same nerves. The difference between the sensation of contact and the sensation of temperature depends upon the order in which the filaments of a particular nerve are set in vibration. And thus, as Fick observes, we may understand why it is difficult to distinguish between a prick from a needle and a minute burn from a spark of fire; for the nearer we approach to a truly elementary sensation, the more evanescent becomes the distinction between the compound sensation of temperature and that of mechanical contact. On the contrary, when a larger area of skin is suddenly rubbed or burnt, so that enough nerves are brought into play to compound the elements of the sensations, then there is no difficulty in distinguishing the feeling of temperature from that of mechanical contact. From these and many other kindred facts, to which scanty justice is done by this cursory allusion, M. Taine very plausibly concludes that our ordinary tactile sensations are made up of little component psychical affections differing only in number, order, and duration; while, according as these elementary psychical states are differently compounded, they form conscious sensations which, as presented to consciousness, seem to be severally simple and distinct in kind.

Throughout this remarkable analysis questions are suggested which can be completely answered only when physics and chemistry, as well as physiology and psychology, are much more advanced than at present. Yet there are three important principles which we may regard as established in the case of sound, and as clearly indicated in the case of the other sensations. The *first* is, that sensations which are apparently simple and elementary, and which cannot be analyzed by mere observation of consciousness, are nevertheless compounded of many successive and simultaneous sensations, which are themselves compounded of still lower psychical affections. The *second* is, that two sensations, which differ only in the mode in which their elements are compounded, may appear in consciousness as generically different and irreducible to each other. The *third* is, that two or more psychical affections which, taken separately, are as non-existent to consciousness, may, nevertheless, when taken together, coalesce into a sensation which is present to consciousness. And when these three conclusions are presented in a single statement, they become equivalent to the conclusion above obtained from examining the beginnings of conscious intelligence in an infant; namely, that states of consciousness may be produced by the differential grouping or compounding of psychical states which are beneath consciousness.

This result is in entire harmony with what might be inferred *à priori* from the known characteristics of nerve-action. Whether in the grey substance of ganglia, or in the white substance of nerve-fibres, the physical action which accompanies psychical changes is an undulatory displacement of molecules resulting in myriads of little waves or pulses of movement. From this fact we might have suspected that, as a cognizable state of consciousness is attended by the transmission of a number of little waves from one nerve-cell to another, so the ultimate psychical elements of each conscious state must correspond to the passage of these little waves taken one by one. And this inference, which by itself would be only a plausible guess, is raised to the rank of a scientific hypothesis by its harmony with the results of the analysis above sketched.

Thus we are led to infer, as the ultimate unit of which

Mind is composed, a simple *psychical shock*, answering to that simple *physical pulsation* which is the ultimate unit of nervous action. By the manifold and diverse compounding of myriads of such primitive psychical shocks, according to the slight structural differences of different nerves, are formed innumerable elementary sensations, which appear to be generically different; just as aquafortis and laughing-gas, which seem generically different, yet differ really only in the proportions of nitrogen and oxygen which compose them. By a similar differential compounding of these elementary sensations, we get complex sensations of blueness and redness, warmth, pressure, sweetness, roughness, and of various kinds of *timbre* and degrees of pitch. Carrying still farther the same process of differentiation and integration, we rise step by step to perceptions of greater and greater complexity, to conscious classifications, and to reasoning in its various forms, from the crude inferences of the child, barbarian, or boor, to the subtle and indirect combinations of the artist and the scientific discoverer. Thus, amid all their endless diversities, we discern, though dimly, a fundamental *unity of composition* throughout all orders of psychical activity, from the highest to the lowest.

Near the close of his first edition of the "Origin of Species," Mr. Darwin predicted that the establishment of his theory would eventually place the science of psychology upon a new basis—that of the acquirement of each mental faculty by slow gradations.[1] We seem now to have fairly started upon the path which leads to this desired goal. For, while, among the mental operations above analyzed, some are peculiar to the highest human intelligence, there are others which are shared by the highest and the lowest human

[1] Mr. Darwin has since recognized that this new basis is already well laid by Mr. Spencer. See *Origin of Species*, 6th edit., p. 428. Indeed the "Principles of Psychology," upon which the present chapter is almost entirely founded, was first published in 1855, four years before the "Origin of Species."

intelligence. Others—as the simplest inferences, several complex perceptions, and all the most simple ones—are shared by all human intelligence with the intelligence of apes, dogs, horses, and indeed of the majority of mammals, many birds, and possibly some lower animals. Others, again—as the simplest perceptive acts implied in recognizing a sensation—must be shared with all those animals whose nervous system is sufficiently complex to allow of their having any consciousness whatever. While others, finally—as the simplest sub-conscious groupings of primitive psychical shocks—must be shared by humanity with all those forms of animal existence which possess any nervous structure whatever. For instance, that reflex action which occurs when the foot of a sleeping person, casually moved into a cold part of the bed, is quickly withdrawn without arousing any state of consciousness, involves the activity of a fragment of the human nervous system which corresponds in general structure to the entire nervous system of a medusa or jelly-fish. In such lowly creatures, then, we must suppose that the psychical actions which go on are similar to our own sub-conscious psychical actions. And, clearly, if we could trace the slow increments by which the nervous system has grown in heterogeneity, definiteness, and coherence, during the countless ages which have witnessed the progress from the primeval marine vertebrate to the civilized modern man, we should also be able to trace the myriad stages of the composition of mind, from the reflex contractions of a rudimentary fin, up to the generalizations of an Aristotle or a Newton.

# CHAPTER XVI.

## THE EVOLUTION OF MIND.

That the amcunt of intelligence manifested by any vertebrate animal depends to a certain extent upon the amount of nerve-tissue integrated in its cephalic ganglia, and especially in the cerebrum, is a truth familiar to everyone, though often crudely stated and incorrectly interpreted. In the lowest vertebrate, the amphioxus, there is no brain at all. In fishes, the cerebrum and cerebellum are much smaller than the optic lobes; the cerebrum being in many large fishes about the size of a pea, though in the shark it reaches the size of a plum. Continuing to grow by the addition of concentric layers at the surface, the cerebrum becomes somewhat larger in birds and in the lower mammals. It gradually covers up the optic lobes, and extends backwards as we pass to higher mammalian forms, until in the anthropoid apes and in man it covers the whole upper surface of the cerebellum. In these highest animals it begins also to extend forwards. In the chimpanzee and gorilla the anterior portion of the cerebrum is larger than in inferior mammals; but in these animals, as in the lowest races of men, the frontal extension is but slight, and the forehead is both low and narrow. In civilized man, the anterior portion of the cerebrum is greatly extended both vertically and laterally. As already observed, the most prominent physiological feature of human progress has been the growth of the cerebrum. The cranial capacity of an averag European exceeds that of the Australians and Bushmen by nearly forty cubic inches; and the expansion is chiefly in the upper and anterior portions.

But this parallelism between increased intelligence and increased size of the cerebrum is complicated by a further parallelism between the amount of intelligence and the irregular creasing and furrowing of the cerebral surface. In the higher mammals both the cerebrum and the cerebellum are convoluted. But the convolutions do not correspond with any "bumps," real or imaginary, on the external surface of the skull; they are not symmetrical on opposite sides, like the fancied "organs" of the phrenologists; nor indeed, so far as the general brain-surface is concerned, do they constitute elevations and depressions at all. The surface of the brain does not resemble a group of hills and valleys, but rather a perfectly smooth table-land cut here and there by very steep and narrow chasms. A perfectly smooth lump of butter, irregularly furrowed by a sharp knife held perpendicularly, would present a surface like that of the human brain. Now the amount of intelligence depends in some way on the number and irregularity of these furrows. In the lowest monodelphian mammals, as the rodents and the lowest monkeys, there are no furrows, or only a few very shallow ones. In the carnivora and ungulata, there are numerous furrows, some of them tolerably deep, but all of them symmetrically arranged. As we proceed to the higher apes, we find the furrows increasing in number and depth, though not yet losing their symmetry of arrangement. Idiots, young children, and adult savages have these creases few and regular; and in the lower races their arrangement is similar in different individuals. But in civilized man the creases are very numerous, deep and irregular; and they are not alike in any two individuals.[1]

[1] Phrenologists have done good service by familiarizing the unlearned public with the fact that the quantity of mental capacity is related to the

The convolutions into which the human brain is divided by these furrows, consist for the most part of "eight distinct and concentric layers, formed chiefly of closely-packed fibres, and of crowds of cells of very different shapes, the layers differing in the relative proportion of cells and fibres, and in the manner of their arrangement."[1] Each cell sends forth processes with which the tissue of certain fibres becomes continuous. The office of the fibres is to establish communication between the cells. Between millions of these cells there run millions of fibres, establishing communications in all directions. And the elaborate researches of Schroeder van der Kolk have gone far to prove that the shapes of the cells and the intricacy of their communications vary with the amount of intelligence. In various forms of mental disease, both cells and fibres undergo pathological changes, such as atrophy, hardening, softening, or some other form of degeneration. That is to say, not only are the activities of the cells impeded, but the channels of communication are variously obliterated or blocked up.

quantity of brain. But the character of this relationship is seriously misinterpreted both by phrenologists and by the rest of the unlearned public. It is impossible to say that a man with an unusually large head must be a man of unusual mental capacity, because the quantity of mental capacity depends on many other factors besides quantity of brain. It not only depends upon the sinuous creasing of the brain-surface here described, which can in nowise be detected by an examination of the outside of the head, but it also depends largely, as Mr. Lewes well reminds us, upon the very important element of vascular irrigation. "Many individual variations in mental character depend on the variations in the calibre of the cerebral and carotid trunks—and many variations in the intellectual, emotive, and active tendencies depend on the *relative* importance of the cerebral and carotid trunks. The *energy* of the brain depends mainly on the *calibre* of its arteries; the special *directions* of that energy depend on the ***territorial distribution.***"—*Problems of Life and Mind*, vol. i. p. 151. Again, the quantity of available mental energy which can be evolved in a given period of time, depends, to a very great extent, upon the efficiency with which the blood is supplied with oxygen and freed from carbonic acid; so that mental capacity not only depends upon capacity of brain, but also upon capacity of lungs and liver. In short, a thorough examination shows that while Mind is most directly correlated with Brain, it is indirectly but closely correlated with the entire organism. So that the attempt to estimate individual differences in mental capacity by referring to brain-size alone, is an utter absurdity.

[1] Maudsley, *Physiology and Pathology of Mind*, p. 55.

Between these fibres and cells there are differences of molecular structure implying differences in molecular activity. While the matter composing a cell is built up in enormously complex aggregates of molecules, wholly unshielded from external disturbance, the nerve-matter of a fibre is protected throughout its entire length by a membranous sheath. And while it is probable that the action going on in a cell consists in the continual fall of unstably arranged molecules into a state of more stable equilibrium, from which a fresh rush of blood is continually raising them to their former unstable state; it is probable that the action going on in a fibre consists in the successive isomeric transformations and retransformations of the systems of molecules which make up the fibre. These conclusions are quite probable, though not proven. But it is entirely proved that a cell is a place where nervous energy is liberated, while a fibre is a path along which nervous energy is transmitted.

Bearing all this in mind, it appears that the cerebrum and cerebellum are places where countless centres are constantly liberating nervous energy, and where this liberated energy is continually flowing along definite channels and from one centre to another. But to make the statement complete, we should add that much of the liberated energy is drafted off along centrifugal fibres into the corpora striata, whence it flows into the medulla and spinal centres, and is thus diffused over the body. Omitting the further consideration of these circumstances, let us inquire into the meaning of this unceasing interchange of molecular motion between the innumerable cells crowded together in the cerebrum and cerebellum. In other words, what are the functions of these supreme ganglia?

That their functions are not in any degree the direct coordination of sensations and movements, would appear from the fact that these direct coordinations are already made in the spinal cord and in the medulla. All the muscular adjustments made in the trunk and limbs are effected either directly by the spinal centres, or indirectly by the sympathetic ganglia in cooperation with the spinal centres. The medulla coordinates all these muscular adjustments with the muscular adjustments of the face, and with the impressions received from the specialized organs of sense. It is therefore highly improbable that the supreme ganglia can be in any way directly concerned with these coordinations. And the improbability is increased by the fact that the cerebrum and cerebellum are as destitute of sensation as the free ends of the finger-nails. Scratch one of the spinal centres, and the result is tetanus. Scratch the medulla, and the whole body is thrown into terrible convulsions. But the cerebrum and cerebellum may be scratched and sliced without pain or convulsion. They take heed only of those impressions which are communicated to them indirectly. Countless multitudes of nerve-fibres coming up from the medulla, are gathered together in the corpora striata; whence other fibres, continuing from them, radiate to the innumerable cells of which the supreme ganglia are composed.

We must conclude, therefore, that the functions of the cerebrum and cerebellum are comprised in the further compounding of sensory impressions already compounded in the medulla. And as such compounding involves the reproduction of impressions received in lower centres, and also involves the coordination of past with present impressions, we may say that the supreme ganglia are the seats of the higher psychical life,—of memory, reason, emotion, and volition. Dr. Maudsley has thus appropriately termed them the *ideational* centres. But between the functions of the two, thus closely related, there is nevertheless a difference. Although the precise determination of the way in which ideational functions are shared between the two centres, has long remained a puzzling problem, there is good reason for believing that Mr. Spencer has solved the difficulty by assigning to the cerebellum the office of doubly-compound coordination in space, and to the cerebrum the office of doubly-compound coordination in time. The facts of comparative anatomy, and of comparative psychology, so far as known, are in harmony with this opinion. We saw in the chapter on Life and Mind that the extension of the correspondence in time at first goes on parallel with the extension of the correspondence in space; the increased area over which the organism can act being the measure of its increased capacity for adapting its actions to longer and longer sequences in the environment. But we saw also that in the human race the extension of the correspondence in time has gone on far more rapidly than the extension in space; the most striking characteristic of intellectual progress being the ability of civilized man to adapt his inferences and actions to remote contingencies. Side by side with these facts, comparative anatomy shows us that the cerebrum and cerebellum at first keep pace with each other in growth; but, as we reach those higher mammals which exhibit some degree of foresight, we find the cerebrum outgrowing the cerebellum and overlapping it; while in man the growth of the cerebrum has been so great as to render comparatively insignificant all other changes in the nervous system. With the enormous cerebrum of civilized man we may further contrast the preponderant cerebellum in those carnivorous birds whose psychical life consists chiefly in the coordination of those extremely complex and remote space-relations involved in the swooping upon prey from great distances. The human cerebellum is absolutely larger than that of such birds; but its smallness relatively to the cerebrum is a fact parallel with the simplicity of the space-relations which man coordinates, as compared with the time-relations. Among the latter are comprised all our ideas of cause, motion, progress,—in a word, all manifestations of force which involve the relation of sequence. But these ideas make up by far the largest and most heterogeneous portion of our psychical life.

I am inclined to regard these considerations as very powerful ones,—and there are several others which lead to the same conclusion. To present the case properly would require a whole chapter; but it is not essential for our present purpose that the question should be decided. Whether Mr. Spencer's view of the respective functions of the cerebrum and cerebellum be correct or not, it equally remains true that the class of functions shared by the two are ideational functions. They compound in double, triple, quadruple, or in far higher multiples, the sensory elements already simply compounded by the medulla. And it is in this compound grouping of impressions, past and present, according to their various degrees of likeness and unlikeness, that thought and emotion, the highest phases of psychical life, consist.

A moment ago we asked, what is the meaning of the ceaseless interchange of molecular motion which goes on among the innumerable cells of the brain? We now see what is the meaning of it, for there can be but one meaning. The continual redistribution of nervous energy among the cells, is the objective side of the process of which the subjective side is the recompounding of impressions. If we may for a moment unduly simplify the matter, it may be said that for every renewed grouping of impressions, for every revived association of ideas, there is a nervous discharge between two or more cells, along formerly-used sets of transit-fibres; and for every fresh grouping of impressions, for every new connection of ideas, there is a discharge along new transit-lines. In reality the matter cannot be so simple as this, since, as we shall presently see, the maintenance of consciousness implies a state of tension between many simultaneous discharges. But however great the complexity, the principle remains the same.

If it be objected to this view that it obliges us to assume a vast amount of differentiation and integration in the brain, during the lifetime of single individuals, it may be replied that the assumption is fully sustained, both by sound deduction and by observation. Not only does the brain increase in size and heterogeneity during the first twenty-five years of life, but ordinarily it increases in heterogeneity, and often in size, for many years later; and in some cases it increases in heterogeneity until the end of life. The brain of a young child is in homogeneity like the brain of an ape; the furrows are shallow, symmetrical, and few in number. With advancing years they increase in number, depth, and irregularity; and the increase is most marked in those persons who do the most brain-work. In the brains of five very eminent men examined by Wagner, the heterogeneity of surface is described as quite astonishing. Such facts prove that the operations of thought work strongly-marked structural changes in individual brains, in the course of a few years. And as these strongly-marked changes are but the summing-up of countless little changes in the arrangements of cells and fibres, the inference is inevitable that such little changes must be going on all the time. This is the testimony of observation, and deduction might have taught us to expect as much; since the molecules of nerve-tissue are chemically by far the most unstable molecules known to science, ever ready to undergo metamorphosis and arrange themselves in new groups. Waste and repair go on more rapidly in the brain than in any other part of the body; the cerebrum, weighing between three and four pounds, receives at each pulsation one-fifth of all the blood sent from the heart, and if the supply is stopped for an instant, consciousness ceases. Where nutritive change is so excessively rapid, such structural changes as are involved in the continual setting-up of new transit-lines, must be readily effected. And quite in harmony with this course of inference is the fact that, when cerebral nutrition is notably retarded, as by the anæmia and feeble circulation of disease or old age, new associations of ideas become difficult or even impossible.

To sum up this whole preliminary argument:—the cerebrum and cerebellum are organs whose function is ideation or the generation of ideal feelings and thoughts. They are organs made up of a tissue in which chemical changes occur with unparalleled rapidity. We cannot see these changes go on, but we can equally well infer their general character when we have examined the chemical properties and molecular structure of the tissue in which they occur. Microscopic and chemical examination of this tissue shows that these chemical changes must consist in a perpetual transfer of energy from one cell to another along transit-lines composed of nerve-threads. Bear in mind that the cell does not average more than one ten-thousandth of an inch in diameter, and that the quantity of matter contained in a transit-line is almost infinitely small. Now since the cerebrum and cerebellum are, subjectively speaking, places where ideation is continually going on; and since they are, objectively speaking, places where nerve-cells are continually sending undulations back and forth along transit-lines; the inference seems forced upon us, that the transfer of an undulation from one cell to another is the objective accompaniment of each subjective unit of feeling of which thoughts and emotions are made up. And if this be so, it becomes a mere truism to say that the formation of a new association involves the establishment of a new transit-line, or set of transit-lines, while the revival of an old association involves merely the recurrence of motion along old transit-lines. That this is merely a hypothesis, I readily grant. Nevertheless it is a verifiable hypothesis; it is in harmony with all that we know of nerve-action; and it may be held provisionally until some better one is propounded. When we proceed to see how many phenomena it explains, we shall be, I think, quite ready to admit that, if it does not contain the whole truth, it must at least contain a foreshadowing of the truth.

For we have now to note that, by a deduction from an established law of molecular motion, this hypothetical law of nervous action can be shown to explain that law of association which subjective analysis proclaims as the fundamental law of intelligence. In the chapter on Life and Mind, we saw that the chief business of psychology is to answer the question how there comes to be established in the mind a relation between two subjective states X and Y, answering to a relation between two phenomena A and B in the environment. How is it that there is a subjective relation between the idea of sweetness and the group of ideas comprised in the visual perception of a peach, answering in some way to the objective relation between the coexistent properties of the peach, so that the presentation of the one to the cephalic ganglia is inevitably accompanied by the representation of the other? This question lies at the bottom of psychology, and we have now to see how it is to be answered. The answer will lead us through a portion of the domain of molecular physics, and will incidentally give us a hint concerning the genesis of nervous systems.

In the chapter on Matter, Motion, and Force, it was shown that all motion takes place along the line of least resistance, whether the motion be the movement of a mass of matter through a resisting medium, or the passage of a series of undulations through the molecules of an aggregate. Let us reconsider this truth in one of its concrete applications.

When a wave of molecular motion traverses a mass of matter for the first time, the line of least resistance will of course be determined by the intimate structure of the mass. But now mark what happens. Immediately after the passage of the wave, the intimate structure of the mass, in the vicinity of the line along which the wave has travelled, is different from what it was a moment ago. The passage of the wave has pushed a linear series of molecules out of position, and a short time must elapse before these molecules can return to their positions. Therefore if the first wave is instantly followed by a second, starting from the same point, the line already traversed will be the line of least resistance, even more decidedly than before. The second wave will encounter less resistance than the first wave, because it will find its work of altering the positions of the molecules already partly done for it. Thus, according to the molecular mobility of the matter in question, the transit of succeeding waves, along the line once established, will rapidly become less and less hindered. And the process must go on either until the inertia of the molecules along the transit-line opposes a minimum of resistance to the passage of the wave, or even until the energy given out by the molecules in changing position adds to the momentum of the wave. In either case there is established a permanent line of least resistance, along which all subsequent waves that start from the same point must travel. The most familiar illustration of this process is afforded by the facts of magnetization, which show "that the establishment of undulations along certain lines determines their continuance along those lines."[1] The case of liquid matter flowing through solid matter—as when currents of rain-water, percolating through loose soil, gradually break away obstructing particles and excavate small channels which ultimately widen and deepen into river-beds—is a case in which similar dynamic principles are involved. In all these cases, "if we confine our attention to that part of the motion which escaping transformation continues its course,

[1] An illustration of this principle is perhaps to be found in the mellowing of old violins. According to Prof. Tyndall, "the very act of playing has a beneficial influence; apparently constraining the molecules of the wood, which in the first instance were refractory, to conform at last to the requirements of the vibrating strings." *On Sound*, p. 90. As Dr. Maudsley would say, "musical residua" remain in the molecular structure of the wood.

then it is a corollary from the persistence of force that as much of this remaining motion as is taken up in changing the positions of the units, must leave these by so much less able to obstruct subsequent motion in the same direction."[1]

Now in the case of organic bodies, the enormously complex molecular changes involved in nutrition are such as to aid in the setting-up of the most perfect transit-lines. In an inorganic mass the molecules have comparatively little mobility, and they do not leave their connections from moment to moment, to be instantly replaced by new molecules. But the complex clusters of molecules which make up living tissue possess immense mobility, and they are continually falling to pieces and getting built up again. Consequently the repeated passage of waves either of fluid matter or of molecular motion along a definite line of least resistance, not only changes the positions of the molecular clusters, but also modifies the nutritive changes by which the temporary equilibrium of the clusters is restored. Instead of a set of relatively homogeneous molecules, which are simply pushed aside and then tend to oscillate back again, the advancing wave encounters a heterogeneous edifice of molecules, which tumbles to pieces and is instantly rebuilt. But in the rebuilding the force exerted by the advancing wave has to be expended; and the result is that in the rebuilt cluster there is a surplus tension exerted in the very direction in which the waves are travelling. The transit-lines thus become far more permeable than any which can be established in inorganic bodies. The energy given out by the decomposing cluster of molecules adds to the momentum of the wave; so that the line of least resistance becomes to a certain extent a

[1] Spencer, *First Principles*, p. 248. Thus, though Mr. Mill is justified in saying (*Inaugural Discourse*, p. 62) that "physiology is the first science in which we [distinctly] recognize the influence of habit—the tendency of something to happen again merely because it has happened before"—yet, as we here see, the phenomena of habit are foreshadowed in the inorganic world. An admirable instance of that continuity among phenomena which is everywhere implied by the theory of evolution.

line of traction. A good illustration is afforded by the gradual evolution of the circulatory system as we ascend in the animal scale. In the lowest animals which possess any nutritive fluid perceptibly distinct from the protoplasmic jelly of which their bodies are composed, this fluid percolates here and there at seeming random, its course being determined by local pressures, just as in the case of rain-water trickling through the ground. Now as we ascend to higher animals, we find that the nutritive fluid has wrought for itself certain channels, to which it confines itself, and which gradually become more and more definite in direction, and more and more clearly demarcated from the adjacent portions of tissue. Until, when we reach animals of a high type of structure, we find the blood coursing through permanent channels, the walls of which contract and expand in such a way as to assist the blood in its progress. A similar explanation is to be given of the genesis of the contractile fibres of muscle, as due to the continuance of molecular undulations along certain lines.

When we come to the nervous system, we find most completely realized all the conditions requisite for the rapid establishment of permanent transit-lines. The clusters of molecules of which nerve-tissue is composed, are more heterogeneously compounded than any other known systems of molecules; and the alternate pulling to pieces and putting together of these clusters, which we call nutrition, goes on here with unparalleled rapidity. Of all known substances, nerve is the most changeable, the most impressible, the most readily adaptable to changing combinations of incident forces,—in short, the most easily differentiable and integrable. Hence we find that those long transit-lines, known as afferent and efferent nerves, are not only so constituted that a wave of disturbance set up at one end is immensely increased before it reaches the other end, but are also protected by enveloping clusters of molecules in such a way that none of the transmitted motion is allowed to escape laterally. Ease of transit is here witnessed at its maximum.

Making use of these theorems of transcendental physics, and applying to the problem his vast and accurate knowledge of biological details, Mr. Spencer has propounded a theory of the genesis of nervous systems of all orders of complexity, which, whether entirely or only partially true, must be regarded as one of his most brilliant achievements. In the lately-published "Physical Synthesis," which concludes the first volume of his "Principles of Psychology," Mr. Spencer shows that the irritability which characterizes the entire surface of the lowest animals, and which probably consists in the isomeric transformation of colloidal clusters of molecules distributed over the surface, must gradually become concentrated in certain definite transit-lines, just as the circulation of a nutritive fluid becomes confined to certain channels: while the collision of waves which takes place wherever two or more of these transit-fibres inosculate, must result in such chemical changes, and in the gradual formation of such a structure, as characterize nerve-centres. But the exposition, when carried into details, is altogether too abstruse to be profitably presented here, nor is it necessary for our present purpose. The explanation of the laws of association only requires that, starting with some kind of nervous system as already established, we should examine the character of the nutritive changes set up within it by environing agencies.

The foregoing argument shows us that the most prominent characteristic of such changes is the formation of transit-lines between neighbouring cells; and we have seen that the more frequently a wave of molecular disturbance passes along any such transit-line, the more easily will it pass, and the more difficult will it be to divert it into any other transit-line. Hence in any complex aggregate of cells and fibres, like the human brain, we may expect to find a countless number of transit-lines, of all degrees of permeability. Those which have been oftenest traversed will be the most permeable, and those which are traversed only at rare intervals will be but slightly permeable; while the passage of a nervous discharge in a new direction will involve the differentiation of a new line of transit.

Now subjective psychology furnishes us with an exact parallel to this state of things. The profound analysis of conscious changes carried on by the English school of psychology since the time of Hobbes, and accepted by the Kantian school in all save a few very important instances —which we shall presently see to be similarly explicable— has ended in the conclusion that states of consciousness cohere with a strength dependent upon the frequency with which they have been repeated in experience. In other words, "the persistence of the connection between states of consciousness is proportionate to the persistence of the connection between the agencies to which they answer. This fundamental law of association is illustrated by such familiar truths as the following:—"that phenomena wholly unrelated in our experience, we have no tendency to think of together; that where a certain phenomenon has occurred in many relations, we usually imagine it as recurring in the relation in which it has most frequently occurred; that when we have witnessed many recurrences of a certain relation we come to have a strong belief in that relation; that if a relation has been daily experienced throughout life with scarcely an exception, it becomes difficult for us to conceive it as otherwise—to break the connection between the states of consciousness representing it; and that where a relation has been perpetually repeated in our experience with absolute uniformity, we are entirely disabled from conceiving the negation of it."[1]

[1] Spencer, *Principles of Psychology*, vol. i. p. 421

The correspondence between the subjective and the objective sides of the phenomena is thus complete, and the increasing complication of cell and fibre in the brain, from infancy to old age, is seen to have a psychological meaning. If the acquisition of a new idea is attended by the passage of a wave of molecular motion along a new path; and if recollection is a state of consciousness attending the transmission of a later wave along the same path; we have an adequate physical interpretation of the fact that the repetition of an idea is favourable to the recollection of it. And we have also the physical interpretation of habit and prejudice. Molecular motions that have been repeatedly transmitted between particular groups of nerve-cells, end by establishing more or less intricate webs of transit-lines which cannot be obliterated. No effort can prevent their occasional recurrence along these lines, or establish a new plexus of transit-lines, involving the derangement of the old ones. Late in life, when the ratio of repair to waste is greatly diminished, when the nutrition of the cerebral tissue is impaired, when the pulling to pieces and putting together of molecular clusters in which nutrition consists goes on slowly, then the formation of new sets of transit-lines becomes especially difficult; and hence, as we say, the shaking off of old habits and prejudices, and the acquiring of new and strange ideas, is next to impossible. It is proverbially hard to teach an old dog new tricks. We may here also see why it is impossible to learn or to carry on complicated thinking when in a state of anæmia: the nutritive changes go on too slowly. Changes in memory further illustrate the theory. In youth, when the excess of repair over waste is at the maximum, but few discharges through any transit-fibre are needful in order to work a permanent nutritive change, setting up a line of communication which shall last through life: hence learning is easy and rapid, and memory is powerful. In old age, when waste is slightly in excess of repair, and both are at the minimum, a great many discharges are necessary for the achievement of any permanent nutritive change: hence learning is slow and difficult, and memory is feeble. And hence—what is most significant of all—the old man does not remember recent events, while he remembers very well what happened in his youth, when his rate of nutrition was rapid. These and countless similar facts show us that a state of consciousness and a nutritive change in the cephalic ganglia are correlated like the subjective and objective faces of the same thing. And thus are explained the many facts which in the seventh chapter were brought forward in illustration of the transformations of vital energy,—such as the facts that consciousness ceases the instant the carbonic acid in the blood has attained a certain ratio to the oxygen; that much thinking entails a great excretion of alkaline phosphates; and that prolonged mental exertion is followed by a bodily fatigue and a keen appetite not essentially different from the fatigue and hunger which follow muscular exercise.

Regarding it now as provisionally established that an association of ideas is dependent upon the formation of a transit-line between two nerve-cells, and that the more often the fibrous path is traversed the more indissoluble will be the association, let us proceed briefly to apply this doctrine to the explanation of sundry psychical phenomena. Now as we begin to examine the simplest psychical phenomena—those of reflex action and instinct—we are met by the seeming difficulty that indissolubly connected psychical states occur where the corresponding objective relation has *never* been repeated within the experience of the individual. Instinctive adjustments of inner to outer relations are apparently made without any help from experience. Moths and butterflies take to wing immediately on emerging from the envelope of the chrysalis; "a fly-catcher, immediately after its exit from the egg, has been known to peck at and capture an insect"; and "a young pointer will point at a covey the first time he is taken afield." But in such cases as these, where the cohesion of psychical states has not been determined by the experience of the individual, it has nevertheless been determined by the experience of the race. That the repetition of ancestral experiences must end in the automatic cohesion of psychical states, is both demonstrable *à priori* and illustrated by many facts. Birds living in islands uninhabited by men will not fly away when approached by travellers, having none of that instinctive fear which "continued experience of human enmity has wrought" in other birds. Yet in a few generations, these birds will acquire the same instinctive fear. In many cases the offspring of a dog that has been taught to beg will beg instinctively; and various peculiarities of demeanour, carefully impressed by education upon sporting dogs, are manifested without education by their descendants. Indeed it is familiar to breeders that the dispositions and instincts of domestic animals can be to a certain extent modified by training and selection, no less than their physical constitutions.[1]

The physical explanation of the automatic cohesion of psychical states implied in hereditary instinct, is not difficult at this stage of our inquiry. When the experience of many past generations has uniformly contributed to establish a certain arrangement of transit-lines in the chief ganglia of the animal, there must be a hereditary tendency for such

[1] "How strongly these domestic instincts, habits, and dispositions are inherited, and how curiously they become mingled, is well shown when different breeds of dogs are crossed. Thus it is known that a cross with a bull-dog has affected for many generations the courage and obstinacy of greyhounds; and a cross with a greyhound has given to a whole family of shepherd-dogs a tendency to hunt hares. These domestic instincts, when thus tested by crossing, resemble natural instincts, which in a like manner become curiously blended together, and for a long period exhibit traces of the instincts of either parent: for example Le Roy describes a dog, whose great-grandfather was a wolf, and this dog showed a trace of its wild parentage only in one way, by not coming in a straight line to his master, when called."—Darwin, *Origin of Species*, 6th edit., p. 210.

transit-lines to develop by the mere process of nutrition. And where the psychical life is very simple, and but little varied from generation to generation, a nervous system embodying certain organized aptitudes will be transmitted as surely as the muscular or vascular system is transmitted Nervous discharges will run along pre-established transit-lines as inevitably as in human beings the nervous discharges which regulate the respiratory and alimentary movements run in permanent channels. The character of the process is best exemplified in *reflex action,* the simplest form of psychical life. In reflex action, which is unaccompanied by consciousness, a single inner relation is adjusted to a single outer relation. For the simpler kinds of reflex action nothing is needed but what is called a *nervous arc,*—that is, an afferent nerve, a ganglion, and an efferent nerve. When a person sound asleep draws away a limb that is touched, the impression is simply carried along an afferent nerve to one of the spinal ganglia, and thence reflected along an efferent nerve to the muscle which moves the limb. The assistance of the brain is not needed. In many animals the limbs thus respond to stimuli after the head has been cut off or the brain sliced away. This kind of psychical life, which is but one degree removed from purely physical life, is all that is manifested by those lowly-organized animals whose nervous systems consist of simple arcs. So thoroughly physical is this group of phenomena that it may seem almost inappropriate to call it psychical: nevertheless it forms the transition from the one kind of life to the other. It is the lowly beginning from which higher forms of psychical activity arise.

Now in reflex action, as it is exemplified alike in the rhythmical movements of our heart, lungs, stomach, and other viscera, and in the contraction of a polyp's tentacle when food comes against it, we see a series of nervous discharges which are automatically directed along certain definite transit-lines. The lines of least resistance have become permanently organized in the animal structure, and they are transmitted, with the accompanying capacities of action, from generation to generation. Here we see "indissolubly connected psychical states existing where there are perpetually repeated experiences of the external relations to which they answer."

The phenomena of *instinct* are more distinctly psychical than those of reflex action. "While simple reflex action is common to the internal visceral processes and to the processes of external adjustment, instinct is not. There are no instincts displayed by the kidneys, the lungs, the liver: they occur only among the actions of that nervo-muscular apparatus which is the agent of psychical life." Instinct, moreover, implies the coordination of a large number of stimuli with the answering movements, and herein is its chief difference from reflex action,—a difference in degree only. The newly-hatched fly-catcher, in seizing a fly, shows "an exact appreciation of distance, as well as a power of precisely regulating the muscular movements in accordance with it." The number of impressions and movements here coordinated is so considerable that it would take several pages to describe them thoroughly. Here certain systems of transit-lines, involved in the establishment of a correspondence in space, are wrought by nutrition in the animal's nervous system, so completely that when the outer relation occurs the discharge instantly takes place along the pre-established channels, and the adjustment is made. There is an intricate compounding of reflex actions, involving the assistance of the brain; for if the cerebellum be sliced, the fly-catching can no longer be performed. Intricate, however, as the combination is, it is a special and unvarying one which has been continually repeated during the whole lifetime of countless ancestral fly-catchers, so that there is nothing strange in the fact that it is completely organized at birth. The principle is the same as in the simpler phenomena of reflex action. Here, as before extending the experience theory to the entire race, we see "indissolubly connected psychical states existing where there are perpetually repeated experiences of the external relations to which they answer."

Though the higher kinds of instinct, in which the supreme ganglia cooperate, are probably accompanied by a vague consciousness, yet in the main the processes which we have just described must be regarded as automatic. Let us now notice what must occur when the correspondence between inner and outer relations has become quite complex and special. As Mr. Spencer has pointed out, "phenomena become less frequent in proportion as they become more complex; and hence the experiences of them can never be so numerous as are the experiences of simple phenomena. The relation between a passing obscuration and a living body, recurs oftener than the relation between a certain degree of obscuration and danger, or than the relation between a certain other degree of obscuration and food. Again, each of these relations is more general than the relation between a particular size and form of visual impression and an object of a particular class. And again, this relation is more general than that between a particular size, form, and colour of visual impression, and a certain species of that class."[1] From this it follows that a lowly-organized animal, in which there is established a correspondence only with the most general environing relations, and which therefore has experience only of such most general relations, has at the same time a uniform experience which maintains a complete cohesion among its simple psychical states. On the other hand, a highly-organized animal, in which there are established correspondences with many complex and special relations, will have a varied experience, and at the same time a varying cohesion among its complex psychical states. While the most general relations which it experiences will also be the most frequent,

[1] Spencer, *Principles of Psychology*, vol. i. p. 441.

and while sundry special relations (as in the seizing of its prey by the fly-catcher) will be extremely frequent, there are many other special relations of which the experience will be much less frequent. And accordingly, along with the perfectly coherent psychical states generated by the former, there will be a congeries of less coherent psychical states generated by the latter. Or, to restate the case in physiological language :—While in the lower organism there will be a number of transit-lines permanently established, and scarcely any tendency toward the formation of new ones; on the other hand, in the higher organism, there will be a number of permanent transit-lines and a number of such lines in process of formation, along with a continual tendency toward the establishment of new ones. The consequences of this are obvious. In becoming more and more complex, the correspondences become less and less instantaneous and decided. "They gradually lose their distinctly automatic character, and that which we call Instinct merges into something higher."

For as long as the psychical life consists solely in the passage of nervous undulations along permanent pre-established channels, there is no consciousness. Consciousness, as already shown, implies continual discrimination, or the continual recognition of likenesses and differences; and this process implies a rapid succession of changes in the supreme ganglia. Now this rapid succession of changes occurs when a vast number of relations are brought together in a single ganglion, or group of ganglia, as in the cerebrum, in order to be compared with each other. Besides this, consciousness implies a certain lapse of time during which impressions persist; and there is no such persistence in reflex action, or in the lower forms of instinct, where the molecular disturbance constituting a nervous impression is instantly drafted off along the pre-established channels. Such persistence occurs only when a number of impressions are brought together in a single ganglion, where an appreciable time must elapse before they are carried off each along its own set of transit-lines. For example, when you tickle or pinch the arm of a person asleep, the arm is at first withdrawn by simple reflex action: the ordinary channel, through the afferent nerve to the spinal centre and back again through the efferent nerve to the limb, suffices to carry off all the molecular disturbance,—and there is no consciousness of the irritation or of the resulting contraction. But if the pinching be frequently repeated, so that the disturbance is generated faster than it can be thus drafted off, the surplus is sent up through a centripetal fibre from the spinal ganglion to the brain; and some dreaming ensues, or perhaps a fretful sound is emitted. If the impression be kept up long enough, there is full consciousness of it, and the person awakes. Now the rise of consciousness implied in the dreaming and waking is due to the persistence in the cerebrum of a molecular disturbance which is not at once drafted off through the proper centrifugal fibres.

Obviously, therefore, when the number of impressions sent in to the brain from moment to moment exceeds the number of thoroughly permeable channels which have been formed there, so that there is a brief period of tension during which occur the nutritive changes implied in the transmission of the disturbance through the appropriate channels, then there arise the phenomena of conscious intelligence. For mark what must happen. In the *first* place, the persistence of the impressions enables them to be consciously felt, either pleasurably or painfully; so that there is the germ of Emotion. *Secondly*, the disturbance tends to propagate itself along various permeable transit-lines, so that there is a revived association of ideas, or what we call Memory. *Thirdly*, there is an integration of the present impressions with such past ones as they resemble, and a differentiation of them from such past ones as they do not resemble; and this comparison of present with past impressions, dependent on memory, implies classification, and is the germ of what we call Perception and Reasoning. *Fourthly*, there is, in the case of many kinds of impressions, a period of tension during which it becomes determined along what set of centrifugal fibres the surplus disturbance shall be drafted off, and here we have the primitive form of Volition. Thus the various phases of conscious psychical life—which we call emotion, memory, reason, and volition—arise as soon as there begins to elapse an appreciable time between the accumulation of molecular disturbance in a group of cephalic nerve-cells, and its discharge along the proper transit-fibres. And this state of things, which is not possible in simple nervous systems which only respond instinctively or by reflex action to a few general relations in the environment, becomes possible in those compound nervous systems which respond to a great number of infrequent and special relations. For the establishment of inner relations, answering to these infrequent and special outer relations, involves a lapse of time during which numerous diverse impressions are getting distributed through various transit-lines hitherto little used. When, as in the fully-developed human cerebrum, a vast number of infrequent and special relations are continually set up, there is a maximum of nutritive change, there is a maximum of time during which impressions simultaneously coming in may be compared and classified, and there is a maximum of consciousness.

This explanation of the way in which the various phases of conscious psychical life arise, is fully confirmed by the way in which they disappear when actions at first consciously performed become instinctive. The confirmation is so complete as to afford a very strong proof of the truth of the hypothesis. Many of the actions performed by civilized man are designated by psychologists as "secondarily automatic." That is, they are at first performed with the assistance of reason, volition, and conscious memory, and they are attended by feelings of pleasure or pain. But after a while they are performed without the aid of reason, volition, or conscious memory, and they are not attended by pleasurable or painful feelings. In becoming instinctive, they lapse partially or entirely from consciousness. The child in learning to walk and talk, must will each movement and rationally coordinate it with other movements in order to attain the desired end. But the man, in walking and talking, is unconscious of the separate movements, and volition serves only to set them going. In learning to read, the child must consciously remember each letter, combine it with others into a word, and associate the word with the thing signified; and this last process is repeated in later years when we learn foreign languages. But in reading our own language, or a foreign one which has been thoroughly learned, the association of words and things is automatic. In reading an English book, in which French quotations are inserted, one frequently passes from one language to the other and back again, without noticing the change, if the attention be concentrated on the subject-matter. In learning to play the piano, there is at first a vast amount of conscious association between the written notes, the key-board, and the muscular adjustments of the fingers, wrists, and arms; but an accomplished pianist will play a familiar piece while his attention is directed to other matters. The case is similar with writing, and indeed with all habitual actions which require nervo-muscular coordination. In many cases, moreover, the intervention of conscious attention only impairs the accuracy of adjustment. In billiard-playing and rifle-shooting, the aim is usually impaired if we stop to think about it; and on the piano it is almost impossible to play triple notes with one hand and double notes with the other if we attempt to measure out the time.

Purely intellectual acts also become to a certain extent automatic with practice, as was indeed implied in some of the foregoing illustrations. Not only the combination of words into a sentence, but the combination of sentences into a proposition, and the combination of propositions into a theory, is effected more and more rapidly, until the process hardly attracts attention. In a complicated exposition like the present, numerous scientific theorems, at first laboriously comprehended one by one, are wrapped up together and thrown into some subordinate clause of a sentence, the total being so obvious as not to withdraw the attention from the main current of thought while writing. In such facts we have a partial explanation of many of the phenomena of what is called unconscious or "sub-conscious" thinking. And thus, too, are to be explained those sudden flashes of insight, scientific or poetical, which in early times were attributed to inspiration or dictation from without. Obviously without a good deal of such automatic acting and thinking, we could achieve but little in art or science. We should never become good pianists if we had to keep paying attention to all the requisite muscular adjustments; and science would advance but slowly if at each step of an intricate inquiry in dynamics it were necessary to stop and reflect upon the elementary laws of matter and motion.

The physical interpretation of these secondary automatic processes is not difficult, according to the hypothesis here expounded. During the process of learning, there is an extensive formation of new transit-lines, and consequently an appreciable interval between the accumulation of molecular disturbance in the cerebral cells and its discharge. Impressions persist long enough to be compared together, and accordingly there is reason and there is volition. There is a maximum of consciousness, because there is a maximum duration of the nutritive changes, and hence weariness soon follows; cerebral nutrition entailing greater waste than occurs in any other part of the system. But with constant repetition the resistance to the passage of undulations along the new transit-lines disappears entirely. Nutrition has so modified them that, as above explained, they become lines of traction instead of lines of resistance. As we say, nothing can prevent the one group of ideas or movements from following the other. The discharges are made instantly, and along with a minimum duration of nutritive change there is a minimum of consciousness. The combinations become permanently organized in the brain-structure, and in becoming permanently organized they become instinctive or automatic.

We may now also begin to understand why it is that in man the organization of instincts, primary and secondary, is continued through the early years of life, while in the other animals the majority of the instincts are already organized at birth. The distinction is not an absolute one, as many of the higher vertebrates, both birds and mammals, and in a marked degree the anthropoid apes, cannot take care of themselves immediately after birth, though they soon become able to do so. The lower we descend the animal scale, the more completely organized is the psychical life of the newly-born organism. The reason is obviously to be found in the greater speciality and complexity, and the consequent relative infrequency, of the coordinations made by the highest animals, and especially by man. When, for example, we put forth the hand to grasp an object, the muscular adjustments are as instinctive as those of the fly-catcher pouncing on an insect; "volition being concerned merely in setting the process going." But with us, the impressions which we receive and the motions which we make are endlessly varied, and the complex combinations of them occur *severally* with less frequency than is the case with the simpler combinations formed by lower animals. They are accordingly not coordinated before birth, though they are easily coordinated during childhood.[1]

A great number of psychical phenomena are thus satisfactorily explained by the hypothesis. But one further service, and a most signal one, is rendered by it; and this we must briefly indicate, in accordance with previous promises, before leaving the subject. The view of cerebral action here adopted settles the long-vexed question between the Lockian and Kantian schools as to the sources of knowledge; and the verdict, while partly favourable to each of these schools, is not wholly favourable to either. Let us reconsider the portion of our hypothesis which bears upon this question.

It follows from the general principles involved in the foregoing exposition, that the peculiar intellectual activity of any parent, by modifying the nutrition of his cerebral tissue, must impress itself upon the unstimulated and half-developed brain of his infant offspring. Eliminating the effects wrought in it by countless environing circumstances, we may say that the infant brain just as surely tends to develop transit-lines similar to those in the parental brain, as the infant face tends to develop muscular peculiarities of expression like those characteristic of the parental face. And while the tendency is so slight as to count for little or nothing in the case of the more complex and infrequent associations of ideas, it must be a resistless tendency in the case of those nerve-connections which answer to associations involved in every act of experience,—as, for example, those concerned in building up our conceptions of space, time, force, and causation. A concise restatement of the case will now lead us at once to our conclusion. While ancestral experience impresses upon the brain a nutritive

[1] In the concluding chapter of this Part, I shall endeavour to show that this origination and prolongation of the period of infancy, which is the effect of increasing intelligence, is in turn the proximate cause of the genesis of social relations and of ethical feelings, and thus, indirectly, of the entire intellectual and moral supremacy of man.

tendency toward the formation of certain special nerve-connections, individual experience tends now to assist and now to check the inherited tendency. And so the number and direction of transit-lines in any brain is due to the cooperation of innumerable ancestral and individual experiences. Locke was therefore wrong in calling the infant's mind a blank sheet upon which experience is to write knowledge. The mind of the infant cannot be compared to a blank sheet, but rather to a sheet already written over here and there with invisible ink, which tends to show itself as the chemistry of experience supplies the requisite conditions. Or, dropping metaphor, the infant's mind is correlated with the functions of a complex mass of nerve-tissue which already has certain definite nutritive tendencies. On the other hand, the school of Leibnitz and Kant was wrong in assuming a kind of intuitional knowledge not ultimately due to experience. For the ideas formerly called innate or intuitional are the results of nutritive tendencies in the cerebral tissue, which have been strengthened by the uniform experience of countless generations, until they have become as resistless as the tendency of the dorsal line of the embryo to develope into a vertebral column. The strength of Locke's position lay in the assertion that all knowledge is ultimately derived from experience,—that is, from the intercourse between the organism and the environment. The strength of Kant's position lay in the recognition of the fact that the brain has definite tendencies, even at birth. The Doctrine of Evolution harmonizes these two seemingly-opposite views, by showing us that in learning we are merely acquiring latent capacities of reproducing ideas; and that beneath these capacities lie more or less powerful nutritive tendencies, which are transmissible from parent to child.

I believe that the last difficulties which may have hovered about the doctrine of the Test of Truth, expounded in the third chapter of our Prolegomena, are now swept away. It must be by this time quite clear that the inconceivability-test and the experience-test are merely the obverse faces of the same thing. An association of subject and predicate, which answers to an objective relation of which the experience has been absolutely uniform, must be absolutely indissoluble; and *vice versa.* The ultimate question at issue between Mr. Mill and Mr. Spencer thus becomes reduced to a question of terminology, save in one important particular, in which I have already shown that Mr. Mill is not only demonstrably wrong, but also inconsistent with himself. The foregoing exposition adds new weight to the argument by which it was formerly (Part I., Chap. iii.) proved that when Mr. Mill asserts that the negation of such an axiom as the indestructibility of matter, which is now inconceivable, was in past times conceivable, he virtually asserts that there was a time when men could frame inner relations of which the corresponding outer relations had never been presented in experience. And thus he not only runs counter to the general theory of Life as Adjustment which is here adopted, but he contravenes his own favourite doctrine of the experiential origin of all knowledge, which is in reality part and parcel of that general theory of life.

With these corollaries I must conclude this too brief account of the process of psychical evolution. In the present chapter and its two predecessors, while steadily refraining from the chimerical attempt to identify Mind with some form of Matter or Motion, it has nevertheless been shown that, owing to the mysterious but unquestionable correlation which exists between the phenomena of Mind and the phenomena of Matter and Motion, it is possible to describe the evolution of the former by the same formula which describes the evolution of the latter. By a continuous differential compounding of impressions, we pass, through infinitesimal stages, from the relatively homogeneous and simple set of correspondences known as reflex action, manifested alike by the highest and the lowest animals, to those exceedingly complex and heterogeneous sets of correspondences known as reason and volition, which are manifested only by the highest animals, and in their greatest complexity by man alone. Throughout this wonderful process we have seen how closely the evolution of psychical function is correlated with the evolution of nerve structure. But, great as has been our gain during the foregoing exposition, our theory of psychical evolution is as yet by no means complete. Concerning the relations of Mind to Life, and concerning the Composition and Evolution of Mind in general, we have obtained many valuable results. But nothing has as yet been said concerning the especial mode of genesis of those highest manifestations of thought and feeling which distinguish civilized man. This problem must be duly treated before our account of psychical evolution can be regarded as complete even in outline. Upon questions of this sort, however, we are not yet prepared to enter. Those highest manifestations of thought and feeling which distinguish civilized man from inferior mammals, and in a less-marked degree from uncivilized man, are the products of countless ages of social evolution; and before we can hope to understand their mode of genesis, we must see what are the teachings of history and psychology concerning the character of social evolution in general. Having shown how, starting from a relatively low degree of sociality, a relatively high degree is attained in conformity to the general theory of Life as Adjustment, we shall be better enabled to comprehend the genesis of that lowest degree of sociality, the attainment of which was the decisive step which first raised Man above the level of the Brutes. The four following chapters will therefore be concerned with Sociology; and the first will be devoted to clearing away a complicated misunderstanding, by the help of which metaphysicians have long sought, and still seek, to deter us from applying scientific methods of interpretation to the phenomena of human history.

## CHAPTER XVII.

### SOCIOLOGY AND FREE-WILL.

THAT the phenomena manifested by human beings, as grouped in societies, conform to fixed and ascertainable laws, is a proposition which has thus far been taken for granted, inasmuch as it is logically inseparable from the other sets of propositions which go to make up our Cosmic Philosophy. Not only, moreover, have we thus tacitly assumed that social phenomena conform to law and may be made the subject of science, but in the fourth chapter of this Synthesis it was expressly stated that the fundamental law to which they conform is the Law of Evolution, which has now been proved to hold sway among inorganic and organic phenomena, as well as among those super-organic phenomena which we distinguish as psychical. Under ordinary circumstances we might fairly go on and justify our tacit assumption and our explicit assertion, by showing, both deductively and inductively, that the evolution of society follows in general the same method as the evolution of organic life. In the following chapter I shall proceed to do this. I shall show, first, that social evolution consists in the integration of human families or tribal communities into larger and larger groups, which become ever more heterogeneous and more interdependent; and secondly, that what we call civilization consists in the ever increasing definiteness and complexity of the correspondence between the community and the environment. Thirdly, I shall carry on the inquiry to a point somewhat in advance of Mr. Spencer's exposition, as it now stands, and show how these truths must be supplemented in order to give us a law of social evolution which shall cover social phenomena simply, excluding the more general phenomena of organic life.

But while under ordinary circumstances it might be well enough to proceed directly to such an investigation, since there is no better way of proving that certain groups of phenomena conform to law than by pointing out the law to which they conform, nevertheless in the present case I think it desirable to preface the inquiry with a brief discussion of one or two logical and psychological truths—truths of method and of doctrine—which lie at the basis of sociology. In our survey of the simpler sciences, no such preface was called for. In beginning to treat of biological truths, we did not deem it necessary to prove that waste and repair proceed according to immutable laws, or to forestall possible cavils by declaring that, although we cannot predict our states of health from week to week, nevertheless organic phenomena are not the sport of chance. It is otherwise in sociology, which is a new science, encumbered with many popular misconceptions, and regarded with an evil eye by theologians,—persons who profess great devotion to the interests of advancing knowledge in general, while the particular advance in knowledge at any time going on somehow never happens to be the one which they think fit to regard with favour. Of each new trophy which Science has from time to time laboriously won, these opponents have hastened to declare, "Behold it is the last!" Though the phenomena presented by the heavenly bodies, by the surface of the earth, and by the life which covers the earth, have one after another, in spite of vehement theological protest, been made the subjects of science,[1] it is still stoutly

[1] "Als Pythagoras seinen berühmten Lehrsatz entdeckte, opferte er den Göttern eine Hekatombe, d. h. ein Opfer von hundert Stieren. Seitdem

maintained that the results of human volitions can never become amenable to scientific treatment. Here, it is cried, on the threshold of sociology we must take our final stand, and insist, in the interests of religion and morality, that although all other events may occur in regular sequence, nevertheless in human affairs there is no such sequence. The arguments by which it is sought to establish this desperate proposition, are based partly on those facts which are assumed to prove the freedom of the will, partly on the endless diversity and complexity of human affairs. Concerning this latter class of considerations, I may say here that they are at once irrelevant and inconclusive. Irrelevant, since even if it were to be granted—which it is not—that the extreme intricacy of social phenomena may prevent our discerning the order of their sequence, this would prove, not that there is no sequence, but that our vision is limited. Inconclusive, because from the nature of the case, other things being equal, complex phenomena cannot be generalized until the simpler phenomena which they involve have been mentally reduced to orderly succession. As we shall again have occasion to notice, the laws of social life could not be discovered until the sciences of biology and psychology had gone far toward formulating the laws of physical and psychical life in general. But the misconceptions which cluster about this subject are so numerous that they may best be eliminated by a somewhat detailed controversy. Let us examine the argument from complexity, as presented by Mr. Froude; and afterwards the argument from the assumed lawlessness of volition, as presented by Mr. Goldwin Smith.

Mr. Froude begins [1] by dogmatically denying that there is or can be such a thing as a science of history. There is something incongruous, he says, in the very connection of

brüllen alle Ochsen, so oft eine neue Wahrheit entdeckt wird."—Büchner, *Die Darwin'sche Theorie*, p. 288.

[1] *Short Studies on Great Subjects*, vol. i.

the two words. "It is as if we were to talk of the colour of sound, or the longitude of the rule-of-three." But he carries on the thought in a way that shows plainly his reluctance to grapple fairly with the problem. In his next sentence he says, "where it is so difficult to make out the truth on the commonest disputed facts in matters passing under our very eyes, how can we talk of a science in things long past, which come to us only through books?" Now to reason like this, is merely to shrink from the encounter. For the question is, not whether the science is difficult, but whether it is possible. Mr. Froude sets out to show that there can be no such science, and his first bit of proof is that, if there is such a science, it must be far more difficult than any other; a position which we may contentedly grant. Let us follow him a step farther. "It often seems to me as if history were like a child's box of letters, with which we can spell any word we please. We have only to pick out such letters as we want, arrange them as we like, and say nothing about those which do not suit our purpose." And what does all this amount to? Is this Mr. Froude's idea of historical investigation? Why, the same thing may be done in any science. We have only to pick out all the facts on one side, and blink all the facts on the other side to prove the veracity of every oracle, soothsayer, and clairvoyant that ever existed, the validity of every paltry omen, the credibility of every crazy notion of alchemy or judicial astrology. In this way we may prove that the homœopathist always saves his patient, while the allopathist always kills him; or *vice versa*. And it was in this way that the phrenologists erected their pseudo-science. By following this method, also, it becomes easy to prove that Henry VIII. was an exemplary husband. It is in this way that every incorrect or inadequate hypothesis in physical science or in history has arisen and gained temporary recognition. Supposing Tycho Brahe had said to his Copernican antagonists, "Astronomy is like a child's box of letters;

if we take out what we want and let the rest go, we can spell whatever we please; I spell out the Ptolemaic hypothesis. and will therefore abide by it;"—he would have been talking much after the manner of Mr. Froude. It is true, as Mr. Froude further says, that one philosopher believes in progress, a second in retrogression, and a third, like Vico, in ever-recurring cycles. But is this because the facts are undecipherable, or because the investigation is one-sided? Because Agassiz still believes organic species to be fixed, while almost all other naturalists believe them to be variable in character, are we to infer that there is no science of biology? In such unworthy plight does Mr. Froude retreat before the problem he has encountered. He starts to show us that a science of history is as ridiculous an impossibility as a scarlet B-flat or a westerly proportion; and he ends by mildly observing that history is a difficult subject, in which a series of partial examinations may bring forth contradictory conclusions!

The next bit of inference concerns us more intimately. "Will a time ever be when the lost secret of the foundation of Rome can be recovered by historic laws? If not, where is our science?" Just where it was before. The science of history has nothing to do with dates, except to take them, so far as they can be determined, from the hands of historical criticism. They are its data, not its conclusions. As Mr. Morley reminds us, we do not dispute the possibility of a science of meteorology, because such a science cannot tell us whether it was a dry or a wet day at Jericho two thousand years ago. Facts like these show us that sciences dealing with phenomena which are the products of many and complex factors, cannot hope to attain that minute precision which is attained by sciences dealing with phenomena which are the products of few and simple factors. They show that sociology cannot, like astronomy, be brought under the control of mathematical deduction. But it was not necessary for Mr. Froude to write an essay to prove this.

But, continues Mr. Froude, "can you imagine a science which would have *foretold* such movements as" Mohammedanism, or Christianity, or Buddhism? To the question as thus presented, we must answer, certainly not. Neither can any man foretell any such movement as the typhoid fever which six months hence is to strike him down. If the latter case does not prove that there are no physiologic laws, neither does the former prove that there are no laws of history. In both instances, the antecedents of the phenomenon are irresistibly working out their results; though, in both cases, they are so complicated that no human skill can accurately anticipate their course. But to a different presentment of Mr. Froude's question, we might return a different answer. There is a sense in which movements like Mohammedanism, or Buddhism, or Christianity, could not have been predicted, and there is a sense in which they could have been. What could not have been predicted was the peculiar character impressed upon these movements by the gigantic personalities of such men as Mohammed and Omar, Sakyamuni, Jesus and Paul. What could have been predicted was the general character and direction of the movements. For example, as I shall show in the following chapter, Christianity as a universal religion was not possible until Rome had united in a single commonwealth the progressive nations of the world. And when Rome had accomplished this task, it might well have been predicted that before long a religion would arise, which should substitute monotheism for polytheism, proclaiming the universal fatherhood of God, and the universal brotherhood of men. I admit that such a prediction could have been made only by a person familiar with scientific modes of thought not then in existence; but could such a person have been present to contemplate the phenomena, he might have foreseen such a revolution in its main features, as being an inevitable result of the interaction of Jewish, Hellenic and Roman ideas. I am inclined to think he might have foreseen that it would arise in Palestine, that its spread would be confined to the area covered by Roman civilization, and that its work would for a long time be most thorough in the most thoroughly Romanized regions.

We do not need, however, to insist upon this point. For in none of the concrete sciences is there anything like thorough and systematic prevision, save in astronomy; and even in astronomy, our foresight becomes precarious as soon as we pass beyond the solar system, and begin to inquire into the results of the mutual gravitation of the innumerable stellar bodies. We know that our sun is rushing, with immense velocity, toward the constellation Hercules; but we cannot yet trace his orbit, as Kepler traced the orbit of Mars. When we come to biology and psychology, the power of accurate prevision is very small; yet no one denies that the phenomena of life and intelligence conform to fixed and ascertainable laws. In sociology we must expect still less ability to predict. The truth is, as Comte acutely pointed out, that while in the simpler sciences our object is gained if we can foretell the course of phenomena so as to be able to regulate our actions by it, in the more complex sciences our object is gained when we have generalized the conditions under which phenomena occur so as to be able to make our volitions count for something in modifying them. We cannot modify astronomic phenomena, but we can predict them. We cannot predict, save to a limited extent, biologic phenomena; but, knowing more and more thoroughly the conditions under which they occur, we can more and more skilfully modify them so as to ensure health or overcome disease. And obviously even this limited ability to modify the phenomena implies a certain amount of prevision,—quite enough to justify us in asserting that the phenomena conform to law The case is similar in sociology. Though we may not be able definitely to predict a given political revolution, we may nevertheless understand the general movement of affairs and the effects which certain kinds of legislation are likely to produce, so as to hasten a desired result or avert social mischief. Upon this possibility are based all our methods of government and of education. And, as in biology, this ability to modify the phenomena proves that the phenomena occur in some fixed order of sequence. For if there were phenomena without any definite order of sequence, we could neither predict nor modify them; and where there is a definite order of sequence, there is, or may be, a science.

Now in denying that there is or can be a science of history, Mr. Froude, if he means anything, means that social affairs have no fixed order of sequence, but are the sport of chance. Either Law or Chance—these are the only alternatives, unless we were to have recourse, like the Mussulman, to Destiny, an illegitimate third idea, made up of the other two misconceived and mutilated in order to fit together. But for the modern thinker there is no middle course. It is either symmetry or confusion, law or chance, and between the two antagonist conceptions there can be no compromise. If the law of causation is universal, we must accept the theory of law. If it has ever, in any one instance, been violated, we may be excused for taking up with the theory of chance. Now we know that all the vast bodies in this sidereal universe move on for untold ages in their orbits, in strict conformity to law. In conformity to law, the solar system in all its complexity has grown out of a homogeneous nebula; and the crust of the cooling earth has condensed into a rigid surface fit for the maintenance of organic life. Out of plastic materials furnished by this surface and the air and moisture by which it is enveloped, organic life has arisen and been multiplied in countless differing forms, all in accordance with law. Of this aggregate of organic existence, man, the most complex and perfect type, lives and moves and has his being in strict conformity to law. His periods of activity and repose are limited by planetary rotations

His achievements, physical and mental, are determined by the rate of his nutrition, and by the molecular structure and relative weight of the nervous matter contained in him. His very thoughts must chase each other along definite paths and contiguous channels marked out by the laws of association. Throughout these various phenomena, already generalized for us by astronomers, geologists, biologists, and psychologists, we know that neither at any time nor in any place is law interfered with,—that yesterday, to-day, and for ever, the effect follows the cause with inevitable and inexorable certainty. And yet we are asked to believe that in one particular corner of the universe, upon the surface of one little planet, in a portion of the organism of one particular creature, there is one special phenomenon, called volition, in which the law of causation ceases to operate, and everything goes helter-skelter!

Such is the demand which Mr. Froude makes upon our powers of acquiescence, and such is the theory which Mr. Goldwin Smith, in the interests of theology, pronounces it unphilosophical, if not impious, for us to reject. Of the Science of History, Mr. Smith asserts that "it extinguishes all sympathy"; it "must put an end to self-exertion"; it "would dissolve the human family"; it makes man the most helpless of animals, no better in fact than "a beast or a blade of grass"; it degrades humanity to mere clay; it establishes "a strange contradiction between our outward observation and our inward consciousness; it makes us "render up our personality," and become "a mere link in a chain of causation, a mere grain in a mass of being"; it builds up, "with much exultation," an "adamantine barrier of law"—whatever that may be—between man and the source of all goodness; and, to crown all, it tells us that "conscience is an illusion," and prevents our having any "rule of right action."[1]

[1] *Lectures on the Study of History*, pp. 63, 67, 48, 82, 85, 87, 59. Far abler men than Mr. Smith or Mr. Froude have in like manner allowed their

Hard words are as powerless to overthrow as to establish a philosophical theory. In scientific inquiry the ability to weigh evidence goes for much, but facility in declamation goes for little. And to anyone who has been brought up amid scientific pursuits, there is but little that is instructive or edifying in the fervid rhetoric of a writer who, in attacking a disagreeable doctrine, prefers to stigmatize it as disagreeable, rather than to show that the evidence is against it. Nevertheless beneath the emotional assertions just quoted there lies a complicated theoretical misconception, the character of which it is worth our while to examine. The well-worn argument is that unless the human will were "free," there could be no responsibility, and therefore no morality; that if volitions are caused, even though it be by our own desires, we are all in a condition similar to that of the man who has made a promise under duress, to whom neither praise nor blame can justly be attached for the manner in which his promise is kept.

It is popularly supposed that there is something very forcible in this argument; and that, when coupled with the opposing arguments drawn from such sequences as are easily traceable among human affairs, the result is a puzzle which must for ever remain insoluble. The problem of free-will has been described by poets, and is customarily regarded, as the most difficult problem which can occupy human attention; and we frequently hear it said that it can never be

feelings to run away with them when treating of this question.—"Not the picture of a man; but the representation of an automaton that is what it cannot help being; a phantom dreaming what it cannot but dream; an engine performing what it must perform; an incarnate reverie; a weather-cock shifting helplessly in the winds of sensibility; a wretched association-machine, through which ideas pass linked together by laws over which the machine has no control; anything, in short, except that free and self-sustained centre of underived, and therefore responsible activity, which we call Man";—such, says Prof. Ferrier, is "the false representation of man which philosophy invariably and inevitably pictures forth whenever she makes common cause with the natural sciences."—*Lectures and Philosophical Remains*, vol. ii. p. 195. Verily the free-will question is a great opener of the flood-gates of rhetoric!

completely solved. But in reality all this perplexity is the result of the desperate muddle into which metaphysics has brought the subject. Strip the question of the peculiar metaphysical jargon in which it is usually propounded, restate it in precise scientific language, and it becomes a very easy question to answer. Would that science presented none more difficult! Confused and inaccurate verbiage is responsible for the chronic disputation upon this subject. Nowhere else is Berkeley's complaint so thoroughly applicable, that in dealing with metaphysics men first kick up a dust and then wonder why they cannot see through it. Those who have come to regard the question from a purely scientific point of view, also regard it as thoroughly settled; and the need for refuting such arguments as the one above cited, they class among the needs, too often thrust upon us, of refuting fallacies already thrice exploded. In illustration of this, let us notice the theory which the free-will argument implies concerning the nature of volition.

The theory implies that over and above particular acts of volition, there is a certain entity called "The Will," which is itself a sort of personage within the human personality. This entity, called "The Will," is supposed to have desires and intentions of its own, which the causationists are supposed to declare constantly liable to be frustrated by external agencies. In opposition to this imaginary heresy, it is asserted that this autocratic Will is "free," and sitting in judgment over "motives," may set aside the stronger in favour of a weaker, or may issue a decree in defiance of all motives alike. Some such crude conception as this is implicitly conveyed by every statement which, alluding to the Will as an entity, ascribes "freedom" to it. Only by means of such a conception can the phrase "freedom of the Will" be shielded from the imputation of nonsense. Only thus can the argument above cited be regarded as relevant to the subject in dispute. For if Will be not conceived as an entity acting under conditions, then no comparison can be made between caused volition and constrained behaviour. If instead of "The Will" we look at the act of willing—which is not an entity, but a dynamic process—then it becomes absurd to talk of this act as being either free or not free, and we must seek for some other word than "freedom" by which to designate its alleged want of causal connection with preceding psychical states.

Now the tendency to erect relations and processes into entities is a tendency which modern metaphysics has inherited from a mischievous mode of thought current in ancient times and rather loosely known as "Realism." Among metaphysicians, unused to the habits of thought which science nurtures, the tendency is an almost irresistible one. Civilization, for example, is obviously a *process*, but Dr. Whately continually speaks of it as if it were a *thing* which could be handed about from one nation to another, or hidden away for a time in some dark corner. And upon this amusing misconception he builds a wonderful theory, which, however, it is not worth while for any busy man to stop and refute. It is in a similar way, and owing to the same realistic tendency, that there has arisen the conception of such an entity as "The Will," the existence of which modern psychology does not recognize any more than it recognizes the *lapidity* of stones or the *ubication* of points in space. Modern psychology is concerned only with the *process of will*, or volition. As Dr. Maudsley observes, "it is not man's function in life to think and feel only: his inner life he must express or utter in action of some kind—in word or deed. Receiving impressions from nature, of which he is a part, he reacts upon nature intelligently, modifying it in a variety of ways. . . As the spinal cord reacts to its impressions in excito-motor action, and as the sensory centres react to their impressions in sensori-motor action, so, after the complex interworking and combination of ideas in the hemispherical ganglia, there is in like manner a reaction or desire of determination of energy outwards, in accordance with the fundamental property of organic structure to seek what is beneficial and to shun what is hurtful to it. It is this property of tissue that gives the impulse which, when guided by intelligence, we call volition; and it is the abstraction from the particular volitions which metaphysicians personify as the Will. . . . Physiologically we cannot choose but reject the Will: volition we know, and will we know, but the Will, apart from particular acts of volition or will, we cannot know. To interpose such a metaphysical entity between reflection and action thereupon, would bring us logically to the necessity of interposing a similar entity between the stimulus to the spinal cord and its reaction. Thus instead of unravelling the complex by help of the more simple, we should obscure the simple by speculations concerning the complex." As scientific inquirers, "we have to deal with volition as a function of the supreme centres, following reflection, varying in quantity and quality as its cause varies, strengthened by education and exercise, enfeebled by disease, decaying with decay of structure, and always needing for its outward expression the educated agency of the subordinate motor centres. We have to deal with will, not as a single undecomposable faculty unaffected by bodily conditions, but as a result of organic changes in the supreme centres, affected as certainly and seriously by disorder of them as our motor faculties are by disorder of their centres. Loss of power of will is one of the earliest and most characteristic symptoms of mental derangement; and whatever may have been thought in times past, we know well now that the loss is not the work of some unclean spirit that has laid its hands upon the Will, but the direct effect of physical disease."

Volition is, accordingly, that transformation of feeling into

[1] *Body and Mind*, pp. 22, 23.

action which is attended by a conscious comparison of impressions, and which involves nutritive changes in the cerebrum or cerebellum, or in both. As we saw in the preceding chapter, the sequence of actions upon impressions is either reflex or instinctive, and in either case automatic, so long as the nervous energy liberated by the impression is instantly discharged through a completely permeable channel or set of channels. But in those higher organisms in which an immensely varied experience has established innumerable complex systems of less permeable channels, there intervenes between the liberation of energy in the brain and its discharge upon the motor centres a period during which there is a tension between various nerve-currents, each seeking to discharge itself along the most permeable lines of transit. We saw also that this period of tension is a period of conscious deliberation, involving conscious reflection, and feelings of desire or aversion. And these views turned out to be justified by the fact that as soon as the frequent repetition of any given set of experiences has rendered all the transit-lines involved in the case completely permeable, so that there is no longer any appreciable period of tension, then the acts once conscious and voluntary become involuntary and automatic.

Now the state of consciousness called Desire is accompanied by a nascent excitement of the nerve-fibres distributed upon the muscular apparatus whose activity is requisite for the attainment of the desired object. There is a tendency to go through with the movements needful for realizing the desire; and this tendency, unless neutralized by an antagonist tendency, must end in action. In the language of dynamics, tension when not counteracted by opposing tension, must pass into *vis viva*. This passage of nervous tension into nervous *vis viva* constitutes *volition*, which may for practical purposes be regarded indifferently as the final stage of emotion or as the initial stage of action.

Passing from the case in which a single desire is operative let us briefly consider the special case of two conflicting desires, where the gratification of the one is incompatible with that of the other. In this case, two groups of motor-nerves are nascently-excited. Here there are two opposite tensions, and the resulting action will depend on their comparative strength. If they exactly neutralize each other, as in the hypothetical case of the ass between the two bundles of hay, no volition will ensue. But in a complex aggregate, like the human or animal organism, such a state of equilibrium cannot be of long continuance. Sooner or later,—either from the greater vividness with which one of the desired objects is mentally realized, or from any one of a thousand other disturbing circumstances down to those of a purely physical nature,—one desire will become stronger than the other. And instantly thereupon, the surplus nervous tension remaining after the weaker desire is neutralized, will pass into nervous *vis viva;* or, in other words, volition will take place.

The opposing tension need not, however, have desire for its concomitant. It may be furnished by the mere inertia of the nervo-muscular system; as when a man, wishing to do something which requires exertion, is too weary to do it. Weariness implies a diminution in the total amount of contractile force; a state in which a tension greater than ordinary is obviously required for the initiation of muscular motion. Conversely, the originating tension need not always be supplied by desire, but may be consequent upon vivacity, which is the presence of a superfluous amount of vital energy; as exemplified alike in the morning frolics of an infant, in the singing of birds, and in the gambols of a dog when released from his kennel.

Cases as simple as those here treated occur no doubt with comparative infrequency. Usually a great number of motives indefinitely complex and variable in their mutual combinations and oppositions, are simultaneously operative. But however numerous or complicated the forces at work, from whatever source the motives to action or inaction arise, whatever be the nature of the incentives to one kind of conduct or to some other kind, it is equally true that the result depends upon their comparative strength. Indeed, since forces can be measured only by their effects, to say that of two conflicting motives one is followed by volition, is to call that motive the stronger one. "Our only evidence of excess of force is the movement it produces"; and when the ancient engineer wished to ascertain the comparative power of a couple of catapults, he had no alternative but to see which would hurl its stone to the greater distance. To say explicitly that volition does not follow the strongest motive, is to say implicitly that motion does not always follow the line of least resistance; which is to deny the persistence of force.

Volition being accordingly regarded as the process whereby feeling initiates action, it becomes evident that the term "free" is no more applicable to it than the term "copper-coloured." As Mr. Bain observes; "The designation 'liberty of choice' has no real meaning, except as denying extraneous interference. If I am interfered with by another person compelling me to act in one way, then it may be said, intelligibly enough, that I have not liberty of choice. But, as between the different motives of my own mind, there is no meaning in the use of the word 'liberty.' Various motives,—present or prospective pleasures and pains,—concur in urging me to act. The result of the conflict shows that one group is stronger than another, and that is the whole case."[1] Or, as M. Littré has still more forcibly reminded us, the term "liberty," as applied to volition, *means* the power of obeying the strongest motive. When that power is interfered with,

[1] Bain, *The Emotions and the Will*, 1st edit. p. 550.

by paralysis or insanity, or the constraint exercised by other persons, then we may truly say that we are deprived of free-will and of responsibility. But so long as circumstances allow volition to follow the strongest motive, then we truly say that we are free and responsible for our actions. Thus the tables are completely turned, and much of the current disputation on this subject is reduced at once to unmeaning verbiage. The popular arguments in favour of "freedom" are seen to be as palpable cases of *ignoratio elenchi* as are those daily urged against the development hypothesis. By a scientific definition of Will, the assertion of freedom is set aside as irrelevant, leaving behind the assertion of non-causation. That this too is virtually disposed of by the same definition, scarcely needs pointing out. Yet, for the sake of still greater clearness, our present results may fitly be supplemented by a new class of considerations.

That volitions differ from all other phenomena by their capability of occurring without any cause, is the opinion of the free-will philosophers; and Mr. Smith, in criticizing the contrary opinion, remarks that "if comets formed their own future" (*i.e.*, were endowed with volition), "they would be rather embarrassing subjects of science." Without attempting to decipher the vagaries in which these cosmical bodies might in such case take it upon themselves to indulge,[1] it will be enough for my present purpose to point out some of the shoals on which the free-will doctrine must land its defenders. If volitions arise without cause, it necessarily follows that we cannot infer from them the character of the antecedent states of feeling. If, therefore, a murder has been committed, we have *à priori* no better reason for suspecting

[1] In point of fact a comet does "form its own future" in the same way that a man does. The state of a heavenly body at any given moment is a product, partly of the forces, molar and molecular, with which it was endowed at the preceding moment, and partly of the forces simultaneously exerted upon it by environing heavenly bodies. The case of human volition differs from this in nothing save the number and complexity, and consequent relative incalculableness, of the forces at work.

the worst enemy than the best friend of the murdered man. If we see a man jump from a fourth-story window, we must beware of too hastily inferring his insanity, since he may be merely exercising his free-will; the intense love of life implanted in the human breast being, as it seems, unconnected with attempts at suicide or at self-preservation. We can thus frame no theory of human actions whatever. The countless empirical maxims of every-day life, the embodiment as they are of the inherited and organized sagacity of many generations, become wholly incompetent to guide us; and nothing which any one may do, ought ever to occasion surprise. The mother may strangle her first-born child, the miser may cast his long-treasured gold into the sea, the sculptor may break in pieces his lately-finished statue, in the presence of no other feelings than those which before led them to cherish, to hoard, and to create.

To state these conclusions is to refute their premise. Probably no defender of the doctrine of free-will could be induced to accept them, even to save the theorem with which they are inseparably wrapped-up. Yet the dilemma cannot be avoided. Volitions are either caused, or they are not. If they are not caused, an inexorable logic brings us to the absurdities just mentioned. If they are caused, the free-will doctrine is annihilated. No help is afforded by the gratuitous hypothesis that there is a connection between the act and the motive, which yet is not a causal connection. Such connection, if it exist, must be a case either of conditional invariable sequence, or of unconditional invariable sequence. On the first supposition, we have a case like the succession of day and night, in which both terms of the sequence are conditioned upon a third fact; so that here we do not escape causation. The second supposition is but an assertion of causation in other words. While to take refuge in the postulate that this assumed connection is a case of variable sequence, is to affirm and deny connection in the same breath.

But it is said that consciousness declares the Will to be free; and therefore that any attempt to disprove its freedom by reasoning is suicidal, since all such reasoning must end by impugning the veracity of that consciousness on which its own data are ultimately based. An ingenious argument truly, the conclusion whereof would be more readily admitted, if its premise were true. Consciousness, which is so confidently appealed to as establishing by its infallible verdict the doctrine of free-will, in fact says nothing about the matter. That volitions are uncaused, is a proposition altogether too indirect for consciousness to sit in judgment upon, and it can neither be proved nor disproved by simple introspection. It would have been equally appropriate for the mediæval astronomer to appeal to consciousness as testifying to the revolution of the sun about the earth. As Mr. Bain observes, "it is a great stretch of asseveration to call the construction of an enormous theory an act of consciousness so simple that we cannot make a slip in performing it." [1] Consciousness tells us only that we will. By observation and experience—not by the simple and direct interrogation of consciousness—we know that, circumstances permitting, our volitions may be accomplished. With the exception, therefore, of those theological fatalists who assert that human actions are determined by an external constraining power, it is the universal opinion that men can voluntarily determine their own actions; and this is just what the much-abused testimony of consciousness amounts to. This is all that it means to anyone not mystified by metaphysics; the non-causation of volitions being a theorem so far from obvious to a great many men, that it requires considerable explanation to make them understand it. By the testimony of consciousness, as thus interpreted, the assertors of the lawlessness of volition are not helped in the least. The question at issue between them and their opponents is, not

[1] *The Emotions and the Will*, 1st edit. p. 563.

whether the actions of men are normally free, but whether their freedom is consistent with their being caused. The assertors of "Free-Will" maintain that causation is inconsistent with liberty.[1] The so-called necessarians assert that liberty and causation are quite consistent with each other. To which we must now add, that it is not causation, but the absence thereof, which is as incompatible with liberty as it is with law.

For the causationist, believing that volition invariably follows the stronger motive, endeavours to increase the relative strength of all those emotions whose outcome is virtuous and upright conduct, while he strives to weaken those feelings whose tendency is toward base and ignoble conduct. Knowing that by continual indulgence desire is reinforced, while by constant repression it is enfeebled, he applies this knowledge to the control of his will and the discipline of his character. But on the theory that volitions are causeless, all methods of self-discipline become of no avail. If they are powerless to influence action, it is of small practical importance whether noble and sympathetic or base and selfish motives are prevalent; and the moral distinction between them loses most of its significance. Why, asks Mr. Smith, "is a Philip II. more the subject of moral disapprobation than the plague?" Why, indeed, unless his atrocious crimes are to be interpreted as the necessary outgrowth of a character wherein good motives were impotent and bad motives all-powerful. Were volition self-determining, then similar acts

[1] "The law of bondage throughout the universe is the law of cause and effect. In the violation, then, of this law, true freedom must consist." Ferrier, *Lectures and Philosophical Remains*, vol. ii. p. 255. One might expect such a remark as this from Mr. Goldwin Smith, who speaks of being "bound by the chain of certain causation"; but from so acute a thinker as Prof. Ferrier, it is surprising. To adopt, in a somewhat altered sense, Kant's happy illustration,—the spectacle of a bird denouncing as an encumbrance the air by which alone it is enabled to fly, would be a fitting parallel to the spectacle of those philosophers who decry that regularity of sequence through which alone has "freedom" any meaning. As Lessing long ago said, with well-bestowed contempt, "Le beau privilège d'être soumis à une puissance aveugle qui ne suit aucune règle! *En serait-je moins le jouet du hasard parce que ce hasard résiderait en moi?*"

might have been committed by a Washington or a Borromeo. Obviously there would be little use in laboriously schooling our desires to virtue, if at any moment in spite thereof, some uncaused volition might bring forth from us a detestable deed. It is therefore not the doctrine of causation, but the so-called free-will doctrine, that, if true, would "put an end to self-exertion," and deprive us of every "rule of right action." Since self-control, and therefore liberty, is impossible unless volition is determined by desire; it is the latter doctrine—not the former—which is really inconsistent with the assertion of human freedom, which takes from us the dignity of responsibility, and makes man the sport of a grotesque and purposeless chance.

In truth, the immediate corollaries of the free-will doctrine are so shocking not only to philosophy but to common-sense, that were not accurate thinking a somewhat rare phenomenon, it would be inexplicable how any credit should ever have been given to such a dogma. This is but one of the many instances, in which by the force of words alone, men have been held subject to chronic delusion. The libertarian doctrine has obtained currency because it has talked loudly of human freedom, with which nevertheless a brief analysis proves it to be incompatible. Substitute for the unmeaning phrase "freedom of the Will," the accurate phrase "lawlessness of volition," and the theory already looks less plausible. In place of the vague and ambiguous word "necessity," write the clear and definitely-connotative word "causation," and the scientific theory at once loses its imaginary terrors. The titles with which the free-will doctrine decorates itself, and those with which it brands its opponent, are alike "question-begging epithets." They serve to prejudge the point at issue.

Not content with the overwhelming prestige which its name thus gives it, the free-will doctrine seeks to follow up its advantage by identifying its antagonist with Asiatic fatalism; a confusion of ideas like that under which Mr. Bounderby laboured, when unable to see the difference between giving workmen their just dues, and feeding them with turtle-soup out of a gold-lined spoon. To say that actions dependent on volition will take place whenever the essential conditions are present, and to say that they will take place even if the conditions are absent, are by free-will theorists held to be one and the same assertion![1] Fatalism is, however, much more closely akin to their own doctrine. Each ignores causation; each is incompatible with personal freedom; the only difference between them being that the one sets up Chance, while the other sets up Destiny, as the arbiter of human affairs. And while each doctrine is theoretically held by large bodies of men, each in practice is habitually contradicted by its upholders. The defenders of free-will, who in practice are obliged to admit a certain connection between acts and motives, and the Arab fatalists, among whom the saying is current that "when Allah wills an event, he prepares the causes beforehand," alike exemplify this. Though both agree in repudiating causation, both equally in their every-day maxims give evidence of an unconscious belief in its existence.

Having identified the causation theory with fatalism, it becomes all the easier for its opponents to accuse it of denying moral responsibility. Accordingly, when Mr. Buckle, following in the footsteps of Laplace, inferred from the regularity of the statistics of crime and suicide, marriages and dead-letters, that voluntary actions conform to law;[2] it was

[1] "It is owing to the very general misconception of the nature of Law that there arises the misconception of Necessity; the fact that events arrive irresistibly whenever their conditions are present, is confounded with the conception that the events must arrive whether the conditions be present or not, being fatally predetermined. Necessity simply says that whatever is is, and will vary with varying conditions. Fatalism says that something *must be;* and this something cannot be modified by any modification of the conditions." —Lewes, *Problems of Life and Mind*, vol. i. p. 309.

[2] Buckle, *Civilization in England*, vol. i. pp. 20—30; Laplace, *Essai sur les Probabilités*, p. 76.

proposed by one of his reviewers that state-governments should at once suspend judicial operations, and having ascertained from statistics the yearly number of murders, should forthwith hang a corresponding number of individuals, selected by lot from the community. To which suggestion the natural reply would have been, that if governments ever do adopt this singular course of administering justice, they will then be consistently acting on the belief that motives do not stand in a causal relation to volitions. If the volition can follow the weaker motive, the feelings which ordinarily deter from the commission of crime, need not be strengthened by the fear of punishment.[1]

Thus do all the favourite arguments in behalf of the free-will hypothesis recoil upon its defenders. To adopt from barbarian warfare, an ungraceful but expressive simile, they are like awkwardly-thrown boomerangs which wound the thrower. Attempting, as the free-will philosophers do, to destroy the science of history, they are compelled by an inexorable logic to pull down with it the cardinal principles of ethics, politics, and jurisprudence. Political economy, if rigidly dealt with on their theory, would fare little better; and psychology would become chaotic jargon. That psychical actions, and volitions among them, conform to law, is the indispensable axiom of every science or philosophy which treats of the mind and its products, whether indi-

[1] "The very reason for giving notice that we intend to punish certain acts, and for inflicting punishment if the acts be committed, is that we trust in the efficacy of the threat and the punishment as deterring motives. If the volition of agents be not influenced by motives, the whole machinery of law becomes unavailing, and punishment a purposeless infliction of pain. In fact it is on that very ground that the madman is exempted from punishment; his volition being presumed to be not capable of being acted upon by the deterring motive of legal sanction. The *free* agent, thus understood, is one who can neither feel himself accountable, nor be rendered accountable to or by others. It is only the *necessary* agent (the person whose volitions are determined by motives, and, in case of conflict, by the strongest desire or the strongest apprehension) that can be held really accountable, or can feel himself to be so."—Grote, *Review of Mill's Examination of Hamilton's Philosophy*, p. 97.

vidually or socially embodied. He who asserts the contrary, maintains "a form of the Manichæan doctrine of two principles . . . . in which one principle, that of order, presides over the physical phenomena of the universe, and the other, that of disorder, over its moral phenomena."[1] As I have already said, no middle ground can be taken. The denial of causation is the affirmation of chance, and "between the theory of Chance and the theory of Law, there can be no compromise, no reciprocity, no borrowing and lending." To write history on any method furnished by the free-will doctrine, would be utterly impossible. Mr. Smith tells us that "finding at Rome a law to encourage tyrannicide, we are certain that there had been tyrants at Rome, though there is nothing approaching to historical evidence of the tyranny of Tarquin." By drawing this inference he abandons his own principles, according to which the law in question might have originated without any cause except the self-determining will of some Roman legislator. And he is equally inconsistent in saying that "a nation may *have* to go through one stage of knowledge or civilization before it can reach another, but its going through either is still *free*." If by this it is meant that a nation's progress need not be due to constraint exercised over it by other nations, the statement is true, but it is one which no one has thought of disputing. But if it is meant that the latter of two successive stages of civilization is not caused by the former, the statement destroys itself. By admitting that "a nation may *have* to go through one stage of civilization before it can reach another," Mr. Smith gives up his case and concedes all which has ever been claimed by those who would construct a science of history. If there is a definite order of sequence among the stages of civilization, that order may sooner or later be formulated, and to formulate that order is to found sociology as a science. But if causation in history is denied,

[1] W. Adam, *Theories of History*, p. 65.

if each epoch is not determined by the preceding epoch, then the inference is inevitable that the French Revolution might have happened in the reign of Louis XI., or that the progress of Christianity might have been eastward instead of westward. Thus all conception of progress, as well as all conception of order, is at an end. Thus the vast domain of History, numbering among its component divisions the phenomena of Language, Art, Religion, and Government, the products of social activity as well as the phases of social progress, becomes an unruly chaos, a Tohu-va-Bohu, where event stumbles after event, and change jostles change, without sequence and without law.

I think, therefore, we are quite justified in saying that, when stripped of the metaphysical jargon in which it is usually propounded, the question of free-will becomes an easy one to answer. Having laid the dust which metaphysicians have kicked up, we find our vision no longer obscured. From whatever scientific stand-point we contemplate the doctrine of the lawlessness of volition, we find that its plausibleness depends solely on tricks of language. The first trick is the personification of Will as an entity distinct from all acts of volition; the second trick is the ascription to this entity of "freedom," a word which is meaningless as applied to the process whereby feeling initiates action; and the third trick is the assumption that desires or motives are entities outside of a person, so that if his acts of volition were influenced by them he would be robbed of his freedom. Anyone, however, who is not misled by these verbal quibbles, and who bears in mind that a person, psychologically considered, is nothing more than the sum of his conscious states, will perceive at once that when the desires or aversions determine the volitional acts, it is the person himself who determines them. We have accordingly seen that, since liberty of choice means nothing if it does not mean the power to exert volition in the direction indicated by the strongest group of motives;

and since all control over character is impossible unless desires and volitions occur in a determinate order of sequence; it is the doctrine of lawlessness and not the causationist doctrine which is incompatible with liberty and destructive of responsibility. The rhetoric which Mr. Goldwin Smith lavishes, on the strength of a set of misapplied phrases, might therefore be justly retorted upon him, on the strength of a psychologic analysis. And this, which is the conclusion of science, we have seen to be also the conclusion of common sense. Whatever may be our official theories, we all practically ignore and discredit the doctrine that volition is lawless. Whatever voice of tradition we may be in the habit of echoing, we do equally, from the earliest to the latest day of our self-conscious existence, act and calculate upon the supposition that volition, alike in ourselves and in others, follows invariably the strongest motive. And upon this ineradicable belief are based all our methods of government, of education, and of self-discipline. Finally, in turning our attention to history, we have found that the aggregate of thoughts, desires, and volitions in any epoch is so manifestly dependent upon the aggregate of thoughts, desires, and volitions in the preceding epoch, that even the assertors of the lawlessness of volition are forced to commit logical suicide by recognizing the sequence. Thus, whether we contemplate volitions themselves, or compare their effects, whether we resort to the testimony of psychology or to the testimony of history, we are equally compelled to admit that Law is coextensive with all orders of phenomena and with every species of change.

It is hardly creditable to the character of the present age for scientific enlightenment that such a statement should need to be made, or that twenty-six pages of critical argument should be required to illustrate it. To many this chapter will no doubt seem much like an elaborate attempt to prove the truth of the multiplication table. Nevertheless where such a blinding metaphysical dust has been raised, a few drops of the cold water of common-sense may be not only harmless but useful. Having thus done somewhat to clear the air, we may next proceed to point out the way in which social changes conform to the Law of Evolution.

## CHAPTER XVIII.

### THE EVOLUTION OF SOCIETY.

Any attempt to discover the laws to which social changes conform must run great risk of being frustrated by the mere immensity of the mass of details which the investigator strives to arrange in orderly sequence. Seemingly numberless as are the phenomena dealt with by the physical sciences, they bear no proportion, either in multitude or in variety, to the facts upon which the student of sociology must build his scientific theorems. Facts concerning man in his physical relations to soil, climate, food, and the configuration of the earth, blend with facts concerning the intellectual and moral relations of men to each other and to the aspects of nature by which they are surrounded, making up a problem of such manifold complexity that it may well have long been deemed incapable of satisfactory solution. The fit ground for wonder is, indeed, not that we are as yet unable to arrive at accurate prevision amid such a diversified throng of phenomena, but that, considering the meagreness of our knowledge in many other departments, we should have been able to detect any uniformity whatever in human affairs, and having detected it, to explain it upon trustworthy scientific principles.

There is but one way to conduct such an intricate investigation securely to its final issue · and that is, to make extensive use of elimination as it is employed in the simpler sciences. "If without any previous investigation of the properties of terrestrial matter, Newton had proceeded at once to study the dynamics of the universe, and after years spent with the telescope in ascertaining the distances, sizes, times of revolution, inclinations of axes, forms of orbits, perturbations, etc., of the celestial bodies, had set himself to tabulate this accumulated mass of observations, and to educe from them the fundamental laws of planetary and stellar equilibrium, he might have cogitated to all eternity without arriving at a result." This lucid illustration, which I have cited from the introduction to Mr. Spencer's "Social Statics," suggests the proper method of approaching the investigation of complex phenomena. Minor perturbing elements must for a time be left out of consideration, just as the inequalities of motion resulting from the mutual attractions of the planets were at first passed over in the search for the general formula of gravitation. The discussion of endless minute historical details must be reserved until the law of social changes has been deduced from the more constant phenomena, and is ready for inductive verification. A law wide enough to form a basis for sociology must needs be eminently abstract, and can be found only by contemplating the most general and prominent characteristics of social changes. The prime requisite of the formula of which we are in quest is that it should accurately designate such changes under their leading aspect.

Now by far the most obvious and constant characteristic common to a vast number of social changes is that they are changes from a worse to a better state of things,—that they constitute phases of Progress. It is not asserted that human history has in all times and places been the history of progress; it is not denied that at various times and in many places it has been the history of retrogression; but attention is called to the fact—made trite by long familiarity, yet none the less habitually misconceived—that progress has been on the whole the most constant and prominent feature of the history of a considerable and important portion of mankind.

Around this cardinal fact have clustered, as I just hinted, many serious misconceptions. The illustrious thinkers of the last century, who endeavoured to study human history from a scientific point of view, were unconsciously led into an error from which contemporary writers have not as yet entirely freed themselves. The followers of Turgot and Condorcet were prone to regard progress as something necessary and universal. They attempted to account for it, much as Lamarck tried to explain organic development, as the continuous and ubiquitous manifestation of an occult, inherent tendency toward perfection. Subsequent literature exhibits many traces of this metaphysical conception. Thus Dr. Whately, in his edition of Archbishop King's discourses, asserts that "civilization is the natural state of man, since he has evidently a natural tendency toward it." Upon which it has been aptly remarked that, "by a parity of reasoning, old age is the natural state of man, since he has evidently a natural tendency towards it." Indeed, as this comparison is intended to show, it is difficult to use such expressions as "natural state" and "natural tendency" without becoming involved in a confusion of ideas. And to ascribe progress to an inherent tendency, without taking into account the complex set of conditions amid which alone that tendency can be realized, is to give us an empty formula instead of a scientific explanation. Whether the individual will die young or reach old age, and whether the community will remain barbarous or become civilized, depends, to a great extent, upon environing circumstances; and no theory of progress can have any value which omits the consideration of this fact. Mr. William Adam labours under the confusion of ideas here signalized, when he finds fault with Sir G. C. Lewis for upholding the doctrine of progress while admitting that certain races have never advanced in civilization. For this, Mr. Adam accuses him of virtually dividing mankind into two differently-constituted races, of which the one possesses, while the other lacks, the inherent tendency toward perfection![1] He might as well maintain that because we admit that certain men are stunted, while others grow tall, we divide mankind into two differently-constituted races, of which the one possesses while the other lacks, the inherent tendency toward increase in size. Closely allied to this fallacy is that which associates lateness in time with completeness in development, and requires us to assume that nowhere at any time has there been a temporary retrogression. Thus Mr. Goldwin Smith appears to be confused by the impression that the temporary decline in the moral tone of English society after the Restoration of Charles II., is a fact inconsistent with the doctrine of a general progress. And Mr. Mansel still more preposterously declares that on the theory of progression we ought to regard the polytheism of imperial Rome as a higher form of religion than the earlier Hebrew worship of Jehovah. While another form of the same confusion is to be seen in the attempts which writers imbued with the conception of progress often make, to coax the annals of the past into affirming the uninterrupted advance of civilization.

These examples show how vaguely the doctrine of progress has hitherto been apprehended. The fallacy of supposing civilization to have proceeded serially, or uniformly, or in consequence of any universal tendency, is nearly akin to the fallacy of classifying the animal kingdom in a series of ascending groups,—a fruitful source of delusion, which it was Cuvier's great merit to have steadily avoided. The theological habit of viewing progressiveness as a divine gift to man,[2] and the

[1] W. Adam, *Theories of History*, p. 87.

[2] "It is impossible for mere savages to civilize themselves. . . . Consequently men must at some period have received the rudiments of civilization

metaphysical habit of regarding it as a necessary attribute of humanity, are equally unsound and equally fraught with error. Until more accurate conceptions are acquired, no secure advance can be made toward discerning the true order of social changes. Far from being necessary and universal, progress has been in an eminent degree contingent and partial. Its career has been frequently interrupted by periods of stagnation or declension, and wherever it has gone on, it has been forwarded, not by an inexplicable tendency or *nisus*, but by a concurrence of favourable conditions, external and internal. We must remember moreover, as Sir Henry Maine reminds us,[1] that the communities which have attained to a conspicuous degree of civilization constitute a numerical minority of mankind. Contemporaneous with the rapidly advancing nations of Europe exist the sluggish nations of Asia, and the almost stationary tribes of Africa and Polynesia.

"Better fifty years of Europe than a cycle of Cathay."

So irregular, indeed, has been the march of civilization, that most stages of progress may be made the subject of ocular investigation at the present day.

In the science of history, therefore, old "means not old in chronology, but in structure: that is most archaic which lies nearest to the beginning of human progress considered as a development, and that is most modern which is farthest removed from that beginning."[2]

Nevertheless, in spite of the fact that the career of progress has been neither universal nor unbroken, it remains entirely true that the law of progress, when discovered, will be found to be the law of history. The great fact to be explained is

from a superhuman instructor." (!) Whately's *Rhetoric*, p. 94. A statement not altogether compatible with the one just quoted from the same author in the text.

[1] *Ancient Law*, p. 24; cf. Lewis, *Methods of Observation in Politics*, vol. i p. 302.

[2] M'Lennan, *Primitive Marriage*, p. 9.

either the presence or the absence of progress. And when we have formulated the character of progress, and the conditions essential to it, we have the key to the history of the stationary as well as of the progressive nations. When we are able to show why the latter have advanced, the same general principle will enable us to show why the former have not advanced. Though in biogeny we habitually view the process of natural selection as the process whereby higher organisms are slowly originated, the principle loses none of its importance because sundry species from time to time suffer deterioration, or remain stationary, or become extinct. When we know how it is that some species advance, we know how it is that other species do not advance. So, in the science of language, which is equally with sociogeny a science of development—being, indeed, neither more nor less than a quite special province of sociogeny—we rightly consider the main problem solved when we have explained the process of phonetic integration, by which languages ascend from the primary, through the secondary, to the tertiary stage of structure. It matters not that Chinese remains to this day a primary language, and that the numerical majority of languages have not yet become tertiary by completely fusing together the component roots of their words. The process by which languages pass from a lower stage to a higher remains none the less the fundamental phenomenon to be investigated, and when we have generalized the conditions under which this process takes place, we can xplain its absence as well as its presence. Now the case is the same with progress in society, that it is with progress in language or in organic life. Whether manifested or not manifested in any particular community, progress is still the all-important phenomenon to be investigated. It is the one grand phenomenon, to explain the presence and the absence of which, is to explain the phenomena of history Just as the study of the languages which have advanced furnishes us the key for understanding those which have not advanced, so the study of the progressive communities furnishes us, as we shall see, the law of history; a law which, in its most general expression, covers the phenomena presented by the non-progressive communities likewise. Comte was therefore right in restricting the main current of his inquiry to the course of that civilization which began on the eastern shores of the Mediterranean, and has extended over Europe and a portion of America. The same plan will be pursued in the present chapter. Although incidental confirmation will be sought in the history of the stationary communities, our main problem will be to formulate the law of progress from a comparison of the phenomena presented by the progressive communities.

But before we can fairly enter upon our task, it will be desirable for us to note the Factors of Progress with which we shall chiefly have to deal.

The prime factors in social progress are the Community and its Environment. The environment of a community comprises all the circumstances, adjacent or remote, to which the community may be in any way obliged to conform its actions. It comprises not only the climate of the country, its soil, its flora and fauna, its perpendicular elevation, its relation to mountain-chains, the length of its coast-line, the character of its scenery, and its geographical position with reference to other countries; but it includes also the ideas, feelings, customs, and observances of past times, so far as they are preserved by literature, traditions, or monuments; as well as foreign contemporary manners and opinions, so far as they are known and regarded by the community in question. Thus defined, the environment may be very limited or very extensive. The environment of an Eskimo tribe consists of the physical circumstances of Labrador, of adjoining tribes, of a few traders or travellers, and of the sum-total of the traditions received from ancestral Eskimos. These make up the sum of the conditions affecting the social existence of the Eskimos. The environment of the United States, on the other hand, while it comprises the physical conditions of the North American continent, comprises also all contemporary nations with whom we have intercourse, and all the organized tradition—political and ethical, scientific and religious—which we possess in common with all the other communities whose civilization originated in the Roman Empire. The significance of this increase of size and diversity in the environment will be explained presently.

Bearing in mind this definition of a social environment—which I believe carries with it its own justification—let us briefly notice the error committed by those writers who would fain interpret all the most important social phenomena as due, solely or chiefly, to physical causes. This is an error frequently committed by physiologists who try their hand at the investigation of social affairs, and who attempt to treat sociology as if it were a mere branch of biology. But this is not the case. As we have seen psychology to be an offshoot from biology, specialized by the introduction of inquiries concerning the relations of the percipient mind to its environment; we must similarly regard sociology as an offshoot from psychology, specialized by the introduction of inquiries concerning the relations of many percipient and emotionally-incited minds to each other and to their common environment. As in biogeny all attempts to discover the law of organic development failed utterly so long as the relations of the organism to physical environing agencies were alone studied, and succeeded only when Mr. Darwin took into account the relations of organisms to each other; so still more inevitably in sociogeny must all our efforts fail so long as we consider merely the physiologic relations of a community to the country in which it dwells, and refuse to recognize the extent to which communities influence each other by means that are purely intellectual or moral. Doubtless the character of the physical environment is of importance, more especially, perhaps, in the earlier stages of civilization. No doubt civilization will first arise, other things equal, in a locality where food and shelter can be obtained with a medium amount of exertion; where nature is neither too niggard nor too lavish in the bestowal of her favours. No doubt there is a physical significance in the fact that civilization began, not in barren Siberia, or in luxuriant Brazil, but in countries like Egypt and Mesopotamia, which were neither so barren as to starve, nor so luxuriant as to spoil, the labourer. No doubt the Greeks owed much to the extent of their coast-line. No doubt—above all—the Mediterranean is justly sacred to the student of history as partly the civilizer of the peoples who upon its waves first courted adventure, and conducted commerce, and imparted to each other cosmopolitan sympathies which could never have been evoked but for some such intercourse. All this may be granted. But as civilization advances, the organized experience of past generations becomes to a greater and greater extent the all-important factor of progress. As Comte expresses it, in one of his profoundest aphorisms, the empire of the dead over the living increases from age to age. If we contemplate, from a lofty historical point of view, the relative importance of the factors in the environment of our United States, I believe we shall be forced to conclude that the victory of the Greeks at Marathon, the conquest of Gaul by Cæsar, the founding of Christianity, the defeat of Attila at Châlons and of the Arabs at Tours, the advent of the Normans in England, the ecclesiastic reforms of Hildebrand, the Crusades, the revolt of Luther, the overthrow of the Spanish Armada, and the achievements of scientific inquirers from Archimedes to Faraday, have influenced and are influencing our social condition to a far greater extent than the direction of the Rocky Mountains, or the position of the Great Lakes or the course of the Gulf Stream. Or if we inquire why the Spaniards are still so superstitious and bigoted, I believe we shall find little enlightenment in the fact that Spain is peculiarly subject to earthquakes, but much enlightenment in the fact that for eight centuries Spain was the arena of a life-and-death struggle between orthodox Christians and Moorish unbelievers.

The mention of Spain and earthquakes brings me to Mr. Buckle, a writer of marked ability, who, though he did not explicitly countenance the error I am here criticizing, was nevertheless sometimes betrayed into committing it, as may be seen from the following passage:—"The Arabs in their own country have, owing to the extreme aridity of their soil, always been a rude and uncultivated people; for in their case, as in all others, great ignorance is the fruit of great poverty. But in the seventh century they conquered Persia; in the eighth century they conquered the best part of Spain; in the ninth century they conquered the Punjab, and eventually nearly the whole of India. Scarcely were they established in their fresh settlements, when their character seemed to undergo a great change. They who in their original land were little else than roving savages, were now for the first time able to accumulate wealth, and, therefore, for the first time did they make some progress in the arts of civilization. In Arabia they had been a mere race of wandering shepherds; in their new abodes they became the founders of mighty empires,—they built cities, endowed schools, collected libraries; and the traces of their power are still to be seen at Cordova, at Bagdad, and at Delhi." [1] To exhibit the utter superficiality of this explanation, we have only to ask two questions. First, if the Arabs became civilized *only* because they exchanged their native deserts for Spain, Persia and India, why did not the same hold true of the Turks, when they exchanged their barren steppes for the rich empire of Constantinople? Though they have held for four centuries what is perhaps the finest geographical position on the

[1] *History of Civilization*, vol. i. p. 42.

earth's surface, the Turks have never directly aided the progress of civilization. Secondly, how was it that the Arabs ever came to leave their native deserts and to conquer the region between the Pyrenees and the Ganges? Was it because of a geologic convulsion? Was it because the soil, the climate, the food, or the general aspect of nature, had undergone any sudden change? One need not be a profound student of history to see the absurdity of such a suggestion. It was because their minds had been greatly wrought upon by new ideas; because their conceptions of life, its duties, its aims, its possibilities, had been revolutionized by the genius of Mohammed. The whole phenomenon requires a psychological, not a physical, explanation.

The environment in our problem must, therefore, not only include psychical as well as physical factors, but the former are immeasurably the more important factors, and as civilization advances their relative importance steadily increases. Bearing in mind these preliminary explanations, let us now address ourselves to the problem of social evolution, applying to the solution of it sundry biological principles established in previous chapters. We have first to observe that it is a corollary from the law of use and disuse, and the kindred biologic laws which sum up the processes of direct and indirect equilibration, that the fundamental characteristic of social progress is *the continuous weakening of selfishness and the continuous strengthening of sympathy.* Or—to use a more convenient and somewhat more accurate expression suggested by Comte—it is a gradual supplanting of *egoism* by *altruism.*

In the course of our inquiry into the causes of organic evolution, it was shown that all the processes cooperating in the development of higher from lower forms of life, are in the widest and deepest sense processes of equilibration. The all-important truth was there demonstrated, that the progress of life on the earth has been the continuous equilibra-

[1] See above, chapters xii. and xiii.

tion of the organism with its environment. In the maintenance of such an equilibrium life has been shown to consist. Accordingly, as we have seen, if the environment is suddenly and violently altered, the organism perishes; but when it is altered slowly, the organism slowly adapts itself to it. If the adaptation is not completed within a single generation, nevertheless a sufficient number of generations will complete it, just as the children and grandchildren of an emigrant become more and more thoroughly acclimated to their new home.

It is now to be shown that civilization is a slow process of breeding, of adaptation, of acclimatization—mental and moral, as well as physical,—of equilibration between the Community and the Environment. From age to age the environment is slowly but incessantly changing, and to its gradual changes the human race, embodied in communities, is continually adapting itself. As just observed, I am not referring to the physical environment alone; for in dealing with society we have to take into the account those psychological factors which have been shown to be by far the most considerable of all. Leaving out of the account all minor considerations of climate, food, or other physical circumstances, and looking at the psychological factors alone, we must admit that the environment is slowly but constantly changing. Every city that is built, every generalization that is reached, every invention that is made, every new principle of action that is suggested, alters in some degree the social environment,—alters the sum-total of external relations to which the community must adjust itself by instituting new internal relations. The entire organized experience of each generation, so far as it is perpetuated by literature or oral tradition, adds an item to the environment of the next succeeding generation; so that the sum-total of the circumstances to which each generation is required to conform itself, is somewhat different from the sum-total of circumstances to which the immediately preceding generation was required to conform itself. Thus the community, by the inevitable results of its own psychical activity, is continually modifying the environment; and to the environment, as thus continually modified, the community must reciprocally conform itself.

Now in the primitive, isolated, savage condition of mankind, what was the environment of each family or petty tribe, and what kind of emotional activity was it fitted to awaken? The unanimous testimony of scientific explorers, and others who have carefully studied the primitive phases of society, leaves us in little doubt as to this question. As Mr. M'Lennan concisely expresses it, "The state of *hostility* is the normal state of the race in early times."[1] The environment of each little tribe is a congeries of neighbouring hostile tribes; and the necessity of escaping captivity or death involves continual readiness for warfare, and the continual manifestation of the entire class of warlike unsocial passions. While, on the other hand, the tribe is so small and homogeneous, that the opportunity for the exercise of sympathetic and social feelings is confined chiefly to the conjugal and parental relations. *Nevertheless in the exercise of these feelings in these relations are contained the germs of all subsequent social progress.* While without the limited sphere of the tribe all is hatred, revenge, and desire to domineer, within the limits of the tribe there is room for the rudimentary display of such feelings as loyalty, gratitude, equity, family affection, personal friendship, and regard for the claims of others. Since these feelings can be exercised only within family or tribal limits, it follows that the sphere for their exercise is relatively small; while as the hostile or egoistic feelings are conformed to the whole environment outside of the tribe, it follows that the sphere for their exercise is large. Hence, in this primitive state of society, the egoistic feelings, being

[1] *Primitive Marriage*, p. 134.

oftenest called into play in the habitual occupations of life, will be most active and will overbalance the altruistic feelings. While, on the other hand, as the kindlier sympathies are but nascent, even the altruistic feelings, such as they are, will be strongly tinged with egoism. The highest emotion attainable will be clannishness, and the highest rule of duty will be that which enjoins loyalty to the tribal patriarch. This is actually found to be the emotional and ethical condition of primitively organized communities, wherever they have been attentively studied by competent observers. Such, for example, has been the state of things existing from time immemorial among the American Indians, among the Polynesians, and among the Arabs of the desert; and these aspects of clan-society, in a somewhat later stage, among the Scottish Highlanders, are well pourtrayed in several of the Waverley Novels.

Now what is it that chiefly determines the slow development of the altruistic feelings and the gradual atrophy of the egoistic feelings? Obviously it is the growth of the community in size and complexity,—the gradual enlargement of the area over which the altruistic feelings extend, and the gradual increase in the number of social situations which demand the exercise of those feelings. These conditions are partly fulfilled when the tribal community grows to a vast size, remaining structurally a tribe with a patriarchal head,—as was the case in ancient Egypt, Assyria, Persia and India, and as is still the case in China. But they are still better fulfilled when the community increases in the complexity of its internal relations, and, instead of remaining a tribe, becomes a federation of civic bodies, as in ancient Greece, or a single great civic body, uniting various tribal elements, as in ancient Rome. In each of these cases, the increased power of self-protection renders warfare less necessary and frequent, and the partial supplanting of the primitive predatory life by the occupations of agriculture and trade begins to make men more and more dependent on one another over a wider and wider area, and to create a whole class of interests to which warfare and destructiveness are more and more inimical. And in the latter case, where the community assumes a civic character, the rise of a genuine political life begins to make men operate on each other by indirect compulsion, or by persuasion, rather than by direct and brutal compulsion; and the highest attainable ethical feeling is no longer clannishness, but patriotism, in the exalted sense in which that word was understood by the Greeks and Romans. Note also that under the influence of this high ethical feeling, even military life loses its primitive purely egoistic character, and becomes a school of self-discipline and self-sacrifice, nourishing in no slight degree the altruistic feelings. If we compare the campaigns of Marathon and Thermopylai with the expedition of a band of Highlanders in execution of a blood-feud, or with the excursion of a party of Red Indians on the war-path, we shall find no difficulty in realizing the force of these considerations.

But, like other phenomena in nature, our ethical feelings are not sharply marked off from each other. There is a selfish as well as a sympathetic side to patriotism (understanding the word always as the Greeks and Romans understood it.) At the one extreme, patriotism is akin to clannishness; at the other extreme, it becomes so wide as to resemble cosmopolitanism. As long as the purely civic structure of society lasted, the clannish element was distinctly present in patriotism. Greek history, after the expulsion of the Persians, is the history of the struggle between the higher and the lower patriotism,—between the two feelings known to the Greeks as Pan-Hellenism and Autonomism, represented respectively by Athens and by the Doric communities. The mournful history of Thukydides tells us how autonomism won the day, entailing the moral and political failure of Greek civilization.

But when Rome had extended her beneficent sway over all the precincts of the Mediterranean, uniting communities hitherto autonomous and hostile by common interests of culture and of commerce, and bringing aggressive warfare to an end in the *Pax Romana*, then there became possible a cosmopolitan spirit, a Christian feeling, which regarded all men as legally and ethically equal,—equal before the Emperor, and equal before God. To trace the slow growth of this feeling in the annals of Roman law and of Stoic philosophy, and to observe its culmination in the genesis of Christianity,[1] is to obtain the key to Roman history.

But great political changes were necessary before Rome could carry to the end its great work,—partly because it had increased in size so much faster than it increased in structure. It crushed autonomism too rapidly. It developed imperialism at the expense of nationality. And hence the time at last arrived when the mutual cohesion of its provinces became too slight to withstand those barbaric assaults from without, which—as we should be careful to remember—had all along been intermittently attempted from the days of Brennus to those of Alaric. For a time, European society seemed likely to disintegrate into a set of tribal communities. But the old Empire had done its work too thoroughly for that. Roman principles, embodied in the Catholic Church, and in the renovated Empire of Charles the Great, exerted an organizing power which prevailed over the spirit of clannish isolation, and by effecting the grand series of compromises which we vaguely designate as the feudal system, laid the basis of modern society.

If now we examine the ethical circumstances of that vast modern fabric which has been reared upon material supplied

[1] Of course it is not meant to imply that other elements were not at work in the genesis of Christianity. The growth of what Matthew Arnold calls the "spirit of Hebraism," not in Judæa merely, but throughout the Græco-Roman world, is an interesting phenomenon in this connection, but the treatment of it does not fall within the scope of the present exposition.

in the older days of Rome—and which owes so much of its permanent character to the labours of the great Catholic and Imperial statesmen of the Middle Ages—we shall find that the process here described has been continually going on. For the primitive normal state of warfare there has been gradually substituted a normal state of peace. While in primitive times the interests of men were supposed to coincide only throughout the limited area of a petty clan, they are now seen to coincide throughout vast areas, and the railway, the steamship, and the telegraph are daily bringing communities into closer union, and, as George Eliot well expresses it, "making self-interest a duct for sympathy." The spirit of Christianity, first rendered possible by Roman cosmopolitanism, has made, and is ever making, wider and deeper conquests as civilization advances. By the primitive savage moral duties were imperfectly recognized, but only within the limits of the clan. By the Greek the ethical code was enlarged, but it was a code not applicable to barbarians. The mediæval Christian had a still longer list of duties owed by him to all mankind, his brethren in the sight of God; and to the ancient conception of justice thus materially widened, he added, in elementary shape, the conception of benevolence or the "enthusiasm of humanity;" but the familiar maxim that "no faith need be kept with heretics" shows that even to his conception of duty there were practical limits narrower than would now be admitted. The modern, on the other hand, recognizes that he owes certain duties to all men with whom he may be brought into contact, not because they are his kindred, or his neighbours, or his countrymen, or his fellow-Christians, but because they are his fellow-men. Such is our ethical standard, however imperfectly conformed to; and neither ancient nor mediæval had such an ethical standard. Compare also the ideal types of perfect manhood at the two extremes of civilization within our ken. The primitive type is the man of intense personality, with an enormous sense of his own importance, easily roused to paroxysms of anger, brooking no contradiction, disregardful of the feelings of others, domineering over all within his reach. The modern type is the man of mild personality, shunning the appearance of self-assertion, slow to anger, patient of contradiction, mindful of the feelings of those about him, unwilling to "make trouble." Such is the contrast between the typical ancient and the typical modern; and it implies a prodigious alteration in the dominant ethical feelings of the progressive portion of our race.

This change, as we now see, has been wrought by the slow but incessant modification of the social environment to which each generation of men has had to conform its actions. The altruistic feelings, finding at each successive epoch a wider scope for action, have become gradually strengthened by use; while the egoistic feelings, being less and less imperatively called into play, have become gradually weakened by disuse. And this change in the environment we perceive to have been wrought by the continuous growth of the community in size and complexity. Where, as among stationary tribes of savages, there has been no such growth, there the moral type of the primeval man is still to be found; and where, as among the stationary communities of Asia, there has been growth in size without corresponding growth in complexity, there the moral type is intermediate between that of the barbarian and that of the inheritor of Roman civilization. Thus the progress of society is a mighty process of equilibration or adjustment, in the course of which men's rules of action and emotional incentives to action become ever more and more perfectly fitted to the requirements arising from the circumstance of their aggregation into communities.

Here we have arrived at a rudimentary conception of the law of social progress, so far as it can be obtained from a comprehensive historical induction, aided and verified by deduction from a few fundamental truths of biology. The foregoing discussion has brought out one point of fundamental importance, in which the development of social life agrees with the development of organic life: both are continuous processes of adjustment or equilibration. But in all this there is nothing more than might have been anticipated. Since the phenomena of society are really but the phenomena of life, specialized by the addition of new groups of circumstances; we must expect to find that the law of social evolution will be identical with the law of organic evolution, save only that it will require an all-important additional clause to express the results of the action of the superadded circumstances. Let us then seek to ascertain definitely,—*first*, in what respects the two kinds of evolution agree, and *secondly*, in what respects they differ.

In the first place the evolution of society, no less than the evolution of life, conforms to that universal law of evolution discovered by Mr. Spencer, and illustrated at length in earlier chapters. The brief survey just taken shows us that social progress consists primarily in the integration of small and simple communities into larger communities that are of higher and higher orders of composition; and in the more and more complete subordination of the psychical forces which tend to maintain isolation, to the psychical forces which tend to maintain aggregation. In these respects the prime features of social progress are the prime features of evolution in general.

In the second place, the progress of society exhibits those secondary features of differentiation and integration which evolution universally exhibits. The advance from indefinite homogeneity to definite heterogeneity in structure and function is a leading characteristic of social progress. On considering primitive societies, we find them affected by no causes of heterogeneity except those resulting from the establishment of the various family relationships. As Sir Henry Maine has shown, in early times the family and not the individual was the social unit. In the absence of anything like national or even civic organization, each family chief was a monarch in miniature, uniting in his own person the functions of king, priest, judge, and parliament; yet he was scarcely less a digger and hewer than his subject children, wives, and brethren. Commercially, it is needless to say, all primitive communities are homogeneous. In any barbarous tribe the number of different employments is very limited, and such as there are may be undertaken indiscriminately by everyone. Every man is his own butcher and baker, his own tailor and carpenter, his own smith, and his own weapon maker. Now the progress of such a society toward a civilized condition begins with the differentiation and integration of productive occupations. That each specialization of labour entails increased efficiency of production, which reacting brings out still greater specialization, is known to every tyro in political economy. Nor is it less obvious that, with the advance of civilization, labour has been steadily increasing in coherent heterogeneity, not only with regard to its division among different sets of mutually-dependent labourers, but also with regard to its processes, and even its instruments. The distinguishing characteristic of modern machinery, as compared with the rude tools of the Middle Ages or the clumsy apparatus of the ancients, is its definite heterogeneity. The contrast between the steam-engine of to-day and the pulleys, screws, and levers of a thousand years ago assures us that the growing complexity of the objects which labour aims at is paralleled by the growing complexity of the modes of attaining them. Turning to government, we see that by differentiation in the primeval community some families acquired supreme power, while others sank, though in different degrees, to the rank of subjects. The integration of allied families into tribes, and of adjacent tribes into nations, as well as that kind of integration exhibited at a later date in the closely-knit diplomatic inter-relations of different countries, are marked steps in social progress. Next may be mentioned the differentiation of the governing power into the civil and the ecclesiastical; while by the side of these ceremonial government grows up insensibly as a third power, regulating the minor details of social intercourse none the less potently because not embodied in statutes and edicts. Comparing the priests and augurs of antiquity with the dignitaries of the mediæval Church, the much greater heterogeneity of the latter system becomes manifest. Civil government likewise has become differentiated into executive, legislative, and judicial. Executive government has been divided into many branches, and diversely in different nations. A comparison of the Athenian popular government with the representative systems of the present day shows that the legislative function has no more than any of the others preserved its original homogeneity. While the contrast between the *Aula Regis* of the Norman kings and the courts of common law, equity, and admiralty, —county courts, queen's courts, state courts, and federal courts,—which are lineally descended from it, tells us the same story concerning the judicial power. Nor should it be forgotten that the steady expansion of legal systems, to meet the exigencies which civilization renders daily more complex, is an advance from relatively indefinite homogeneity to relatively definite heterogeneity.

Obviously, however, our task is not completed when we have pointed out this general coincidence between the development of society and the development of life. Nor can the universal law here illustrated be the special law of social progress for which we are seeking. By reason of its very comprehensiveness, the law of universal evolution cannot be regarded as supplying the precise kind of information we desire concerning the relations of social to organic phenomena. By its aid we have found it possible to interpret not only the development of life, intelligence, and society, but also the genesis of planetary systems and the evolution of the earth. It is therefore the law not only of social, psychical, and vital changes, but also of inorganic changes. Underlying all the sciences of genesis, and fusing them into one grand science of cosmogony, it utters no truth concerning organic or social development which is not equally true of all development. Thus while it is indeed, in the deepest sense, the ultimate law to which organic and superorganic changes conform, it is silent respecting the differential characteristics by which these changes are distinguished from inorganic changes. Already in treating of the evolution of life we saw that the ultimate and general formula needed to be supplemented by a derivative and special formula, which should describe organic development in terms inapplicable to inorganic phenomena. And this formula we found in the definition of life as the continuous adjustment of inner to outer relations, upon which also was afterwards based our entire theory of the evolution of intelligence.

Now the historic survey into which we were led a moment ago, while inquiring into the progress of moral feelings, showed us that, in this respect also, the evolution of society agrees with the evolution of life in general. The progress of a community, as of an organism, is a process of *adaptation*, —a continuous establishment of inner relations in conformity to outer relations. If we contemplate material civilization under its widest aspect, we discover its legitimate aim to be the attainment and maintenance of an equilibrium between the wants of men and the outward means of satisfying them. And while approaching this goal, society is ever acquiring in its economic structure both greater heterogeneity and greater specialization. It is not only that agriculture, manufactures, commerce, legislation, the acts of the ruler, the judge, and the physician, have since ancient times grown immeasurably multiform, both in their processes and in their appliances; but it is also that this specialization has resulted in the greatly increased ability of society to adapt itself to the emergencies by which it is ever beset. The history of scientific progress is in like manner the history of an advance from a less complete toward a more complete correspondence between the order of our conceptions and the order of phenomena. Truth—the end of all honest and successful research—is attained when subjective relations are adjusted to objective relations. And what is the consummation of moral progress but the thorough adaptation of the desires of each individual to the requirements arising from the coexistent desires of all neighbouring individuals? Thus the phenomena of social and of organic progress are seen to correspond to a degree not contemplated by those thinkers who, from Plato to Hobbes, have instituted a comparison between them. The dominant characteristics of all life are those in which social and individual life agree.

Let us now examine more closely the relations between the Community and the Environment. From the twofold circumstance that life is high according as the organism is heterogeneous, and also according as it is adjusted to surrounding conditions, may be derived the corollary that *the heterogeneity of the environment is the chief proximate determining cause of social progress.* Thus we may understand why civilization advances so much more rapidly in modern than it did in ancient times.[1] As Sir Charles Lyell observes; "We see in our own times that the rate of progress in the arts and sciences proceeds in a geometrical ratio as knowledge increases, and so, when we carry back our retrospect into the past, we must be prepared to find the signs of retardation augmenting in a like geometrical ratio; so that the progress of a thousand years at a remote period may correspond to that of a century in modern times, and in ages still more remote Man would more and more resemble the brutes in that attribute which causes one generation exactly to imitate in all its ways the generation which preceded it."[2] That the process is here the same in social and in

[1] See above, p. 72.

[2] *Antiquity of Man*, p. 377.

organic life, Sir Charles Lyell already suspects; for he elsewhere observes that the lower the place of organic beings "in a graduated scale, or the simpler their structure, the more persistent are they in form and organization. In whatever manner the changes have been brought about, the rate of change is greater where the grade of organization is higher." And this fact results from the more complex relations of the higher beings to their environment. Applying these considerations to history, it will be seen that, owing to the political isolation of ancient communities, the heterogeneity of their environments must have been inconsiderable. Holding little intercourse with each other, and accommodating their deeds and opinions mostly to the conditions existing at home, their progress was usually feeble and halting. Owing to the enormous heterogeneity of the environment to which modern communities are forced to adjust themselves, progress in later ages has been far more rapid and far more stable than of old. The physical well-being of an ancient Greek was not enhanced by an invention made in China, nor could his philosophy derive useful hints from theories propounded in India. But in these days scarcely anything can happen in one part of our planet which does not speedily affect every other part. The physical environment of a modern European extends over a great part of the earth's surface, and his psychical environment is scarcely limited in time or space. His welfare is not unfrequently affected by accidents occurring at the antipodes, while his plans for the coming year are often shaped with conscious or unconscious reference to events which happened centuries ago. That the rapid and permanent character of modern progress is in great measure due to this circumstance, will be denied by no one. And thus is explained the wonderful civilizing effect of various events which have from time to time brought together distant sections of mankind; among which it will be sufficient merely to name the campaigns of

Alexander, the spread of Roman dominion, the Arabian conquests, the Crusades, and the voyages of Columbus, Magellan, and De Gama. The invention of printing, increasing the rapidity and the frequency with which the thoughts of various minds are brought into contact, offers another illustration ; and in a similar way is to be explained the civilizing agency of railroads and telegraphs.

Comparing these deductions with the historical survey of ethical development above taken, we arrive at a set of mutually harmonious conclusions. We see that the process of intellectual and moral adaptation which constitutes social progress is determined by the steadily increasing heterogeneity of the social environment. And we see that this increased heterogeneity of the environment is caused by the integration or growing interdependence of communities that were originally isolated. We have now to examine this process of integration somewhat more in detail. By instituting a novel comparison between the processes of organic and of social life, we shall be led directly to the special law of progress for which we are seeking.

Observe first that the living beings which are lowest, or next to the lowest, in the scale of organization—as, for example, the protococcus and the amœba—are nothing but simple cells. It has been shown, by Mr. Spencer, that progress in morphological composition, both in the animal and in the vegetable kingdoms, consists primarily in the union of these simple cells into aggregates of higher and higher orders of complexity. Now in the study of social evolution we are met by precisely similar phenomena. Let us consider what is implied by the conclusions at which Sir Henry Maine has arrived, in his profound treatise on "Ancient Law," by an elaborate inquiry into early ideas of property, contract, and testamentary succession, and into primitive criminal legislation. "Society in ancient times," says Sir Henry Maine, "was not what it is assumed to be at present, a collection of *individuals.* In fact, and in the view of the men who composed it, it was an aggregation of *families.* The contrast may be most forcibly expressed by saying that the *unit* of an ancient society was the *family,* of a modern society the *individual.*"[1] But originally the family-government excluded not only individual independence, but also state supremacy. The sole government actual or possible was that exercised by the male head of a family-group. By slow stages various family-groups closely akin in blood appear to have become integrated into tribes or clans, community of descent being still the only conceivable bond which could hold together a number of individuals in the same political aggregate. At a later stage the limits of the tribe were further enlarged by the important legal fiction of "adoption," or the pretence that newly-added members were descended from some conspicuous common ancestor of the tribe. Vestiges of a time when there were no aggregations of men more extensive than the tribal community thus constituted, and when there was no sovereign authority save that exercised by the head of the tribe, may be found in every part of the world,[2] and among totally-savage races this state of things still continues. Now we shall find something more than an instructive analogy in the comparison of the primitive family-group to a unicellular organism, for such a comparison will enable us to realize that in social and in organic evolution the process of integration has been substantially the same. The first well-marked stage in coalescence is the formation of the tribe or clan,

[1] *Ancient Law,* p. 126.

[2] "The *γένος* of Athens, the *gens* of Rome, the *mark* or *gemeinde* of the Teutonic nations, the village community of the East . . . the Irish clan, are all essentially the same thing."—Freeman, *Comparative Politics,* p. 102.

See, among other authorities, Volney's *View of the United States,* p. 397; Phillipp on *Jurisprudence,* p. 207; Charles Comte, *Traité de Législation,* liv. iii., chap. 28; Grote, *History of Greece,* vol. iii., pp. 49—69; Gibbon (Paris edit.), vol. iii., p. 243; Vico, *Scienza Nuova, Opere,* tom. iv., pp. 23, 35, 40; Aristotle, *Eth. Nikom.* viii. 14; Tacitus, *Germania,* vii.; Cæsar, *Bell. Gall.* vi. 22, 23.

which may be compared to those lowly organisms made up by the union of amœba-like units with but little specialization of structure or function. At this stage social organization is but one step removed from that absolute and ferocious anarchy which characterizes the non-social life of brutes. "Mistrust, jealousy, secret ambushes, and implacable vengeances" characterize the mutual relations of these social "aggregates of the first order." Hostility is the rule, and peace the exception. The repulsive forces are stronger and the cohesive forces weaker than at any subsequent period. As we have seen above, the selfish impulses which tend to maintain savage isolation are as yet unchecked save by instinctive loyalty within the tribal limits.

The coalescence of such tribes into civic communities is the formation of social "aggregates of the second order." For a long time these higher aggregates retain conspicuous traces of their mode of composition, as in Greece and Rome,[1] until increasing social heterogeneity obliterates the original lines of demarcation; while new divisions spring up, resulting from the integration of like parts, as is seen in the guilds of mediæval Europe, and still better in the localization of industries which marks the present time.

The coalescence of civic and tribal communities into the nation—an "aggregate of the third order"—is well exemplified in the history of France, which, from a disorderly collection of independent baronies, has passed by well-defined transitions into a perfectly integral nation. The attainment of this stage is indispensable to a career of permanent progress. As hinted above, the premature overthrow of the Hellenic political system is to be attributed

[1] The structure of the Amphiktyonic union shows "that the system of cities with which we are so familiar in Grecian history grew out of an earlier system of tribes." Freeman, *Comparative Politics*, p. 88. Further evidence, in abundance, may be found in the succeeding pages of that excellent book, which reads, from beginning to end, almost like a commentary upon this chapter.

to its very incomplete integration. An aggregate of the national type was in process of formation by the extensive coalescence of maritime cities under the leadership of Athens, when the Peloponnesian war intervened, vindicating the superiority of selfish autonomy, and showing by its result that the civilizing spirit of nationality was as yet too feeble to prevail.

It was first under Roman dominion that national aggregation and the feeling of national solidarity began to be brought to something like completeness. By absorbing nearly all the petty communities then existing within the limits of the Mediterranean world, and by gradually extending to their members the privileges of citizenship, Rome succeeded in dealing to the passion for autonomy a blow from which it has never recovered; while the enormous extent of the Empire, and its ethnic heterogeneity, imparted to the national spirit thus evoked, a cosmopolitan character destined to be of prodigious service to civilization. The influence of these circumstances upon the attitude of Christianity I have already alluded to, and it cannot be too strongly insisted upon. No human mind could have even conceived, much less have carried into execution, the idea of a universal religion, if the antique state of social isolation had not previously been brought to a close in universal empire. If Christianity had appeared four centuries earlier than it did, it would, like Buddhism, have assumed the garb of a local religious reformation. Or if it could have aimed at anything higher and more comprehensive than this, its preaching would have fallen upon ears not ready to receive it. All the Oriental enthusiasm, all the Hellenic subtlety, of Paul, could have effected nothing, had he visited Athens in the days of Plato and Diogenes. But the cosmopolitan element in Roman civilization was just that which Christianity most readily assimilated, and which it intensified by setting up a new principle of common action in place of the primeval principle of community of race. From this happy concurrence of circumstances there was formed, upon the ruins of Paganism, that religious organization which alone, of all churches that have existed, has earned the glorious name of Catholic. Disgusted at some of her high-handed proceedings in later times, Protestant historians have too generally forgotten that the Roman Church, by co-ordinating the most vigorous and progressive elements of ancient life, prepared the way both for the ubiquity and for the permanence of modern civilization. Had the ecclesiastical system of the Empire perished, along with the breaking up of its political system; had there been really that wreck of ancient institutions in the fifth century which was formerly supposed to have occurred, until Mr. Bryce and Mr. Freeman dispelled the gross error; it is difficult to see how mediæval European history could have been politically anything more than a repetition of Grecian history, save only in the extent of its geographical range. Whoever is disposed to doubt so emphatic an assertion will do well duly to ponder the fact that the newly-arriving Teutonic subjects of the Empire (who would, in such case, have come as foreign conquerors) had not advanced beyond the stage of tribal organization. On their further aggregation into rural and civic bodies, the autonomous spirit would have acquired an ascendency which it might well have taken another more fortunate Athenian federation, or another all-absorbing Roman domination, thoroughly to destroy. Even as it was, it required all the immense power of the Church, unflinchingly exercised through many generations, to prevent European society from disintegrating into a mere collection of mutually repelling tribal communities. But the Church not only preserved the best social results of Roman dominion, by hastening the consolidation of each embryonic nationality; it also, by its peculiar position as common arbiter between the different states thus arising, assisted in the formation of a new social aggregate of a yet higher order. The modern system of independent nationalities held in virtual federation—not by international codes, but by the possession of guiding principles of conduct more or less heartily reverenced by all—is chiefly the work of the Roman Church. Here, finally, we have reached a system whose structure bears in the highest degree the marks of permanence. It is sustained by the ever-deepening sentiments of cosmopolitan philanthropy and universal justice,—the most cohesive of social forces, as the spirit of local selfishness was the most disruptive.

Here it might seem that we have obtained all the data requisite for enunciating our law of social progress. But something is still wanting. Our law of progress, if now enunciated, would be too general. It would cover alike the phenomena of social and of organic life. In both there is an advance from indeterminate uniformity to determinate multiformity; in both there is a continuous adaptation of the organism or the community to its environment; and in both there is a continuous integration, entailing an advance from incoherence to coherence of structure. We must now start in search of that all-important clause which shall express the essential difference between organic and social progress.

In the ancient family-community, as delineated by Sir Henry Maine, the separate existence of the individuals was almost submerged and lost in the corporate existence of the aggregate. Personal freedom was entirely unrecognized. To family duties all individual rights were subjected. By a tie, religious no less than political, the members of the family were all held in allegiance to its oldest male representative. The father might abandon his son in infancy, and when grown up might sell him as a slave, or put him to death for disobedience. And the wife was to an equal extent in the power of her husband, to whom she legally stood in the relation of a daughter, so that marriage was but the exchange of one form of servitude for another. No transfer of property was valid, unless the persons conducting it swore in the name of some ancestor,—dead ages ago, it might be; for so absolute was the authority of the *paterfamilias* that it could not be conceived as departing from him at death, but must be exercised by him, through the medium of prescriptive ceremonial, over whole generations to come. Nothing, in short, was regulated by *contract*, but everything was determined by *status*.[1] And this is the fact which irretrievably demolishes Rousseau's theory that social aggregation is due to a primitive compact. That theory is merely an illegitimate attempt to explain an ancient phenomenon by causes which have had only a modern existence.[2] The member of a primitive tribal community had no conception of contract; what he was born to do, belonged to his status; and that he must do. The prevalence of this state of things in the empires of the East is chief among many converging proofs that those nations are nothing but immense tribes, or aggregates of the first order.

With the rise of higher aggregates, such as states, civic or imperial, this sinking of the individual in the corporate existence still for some time continued. The rights and duties of the individual were still unrecognized, save in so far as they followed from the status in which he happened to be placed. In republican Rome, and in the Hellenic communities, the welfare of the citizen was universally postponed to the welfare of the state. But circumstances too complicated to be here detailed, of which the chief symptom was the increasing importance assigned by Roman jurisprudence to contracts, resulted, at an advanced period of the empire,

[1] This term is well defined by Heineccius:—"Status est qualitas cujus ratione homines diverso jure utuntur. . . Alio jure utitur liber homo; alio servus; alio civis, alio peregrinus." *Recitationes*, lib. i. tit. 3.

[2] See the discussion of the doctrine in Austin, *Province of Jurisprudence*, pp. 331—371; Kant, *Rechtslehre*, Th. ii., Abschn. i.; Stahl, *Philosophie des Rechts*, ii. 142; Maine, *Ancient Law*, chap. iv

in the more or less complete recognition of individual rights and obligations. On the rise of the feudal system, the relations of vassal to suzerain were, through the influence of Roman conceptions, extensively regulated by contract; and it is in this respect that the feudal institutions are most widely distinguished "from the unadulterated usages of primitive races."[1] It was, I believe, mainly owing to this that the integration of feudal lordships into nations was accompanied by the enlargement of individual liberty to a much greater extent than the integration of ancient clans, gentes, and phratries into civic communities. The Roman Church also aided in promoting the freedom of individuals, as well as in facilitating the consolidation of states. By the more or less strict enforcement of clerical celibacy, it maintained in the midst of hereditary aristocracy a comparatively democratic organization, where advancement largely depended upon moral excellence or intellectual ability. And preserving, by the same admirable institution, its independence of feudal patronage, it was often enabled successfully to interpose between the tyranny of kings and the helplessness of subjects. To ecclesiastical celibacy, more than to almost any other assignable institution, we owe our emancipation from ancient patriarchal conceptions of social duty. The development of industry, crossing in various ways the antique divisions of society, has contributed to the same result; until, in modern times, the primitive mode of organization is almost entirely effaced, leaving but few barely traceable vestiges. Individual rights and obligations, from being nothing, have come to be all in all. While originally the individual was thought to exist only for the sake of the state, the state is now regarded as existing only for the sake of the individual.

It will thus be seen that the very same process, which has resulted in the formation of social aggregates of a higher and

[1] Maine, op. cit. p. 365.

higher order, has also resulted in the more and more complete subordination of the requirements of the aggregate to the requirements of the individual. And be it further noticed, that the relative strength of the altruistic feelings which maintain the stability of the highest social aggregation, maintains also to the fullest extent the independence of its individual members; while the relative strength of the egoistic feelings which in early times prevented the existence of any higher organization than the family or tribe, was also incompatible with individual freedom of action. Now this is precisely the reverse of the state of things which we find in organic evolution. In organic development, the individual life of the parts is more and more submerged in the corporate life of the whole. In social development, corporate life is more and more subordinated to individual life. The highest organic life is that in which the units have the least possible freedom. The highest social life is that in which the units have the greatest possible freedom. This feature of social evolution is most conveniently described by Schelling's term *individuation*, which is employed in a kindred sense both in Mr. Spencer's and in other modern works on biology.

Thus we have at last reached the conclusion in quest of which we set out. Supplementing our previous results, according to which organic and social evolution were seen to agree, by our present result, according to which they are seen to differ, we obtain a formula for social evolution which may be regarded as fundamentally accurate. We obtain the Law of Progress, which may be provisionally stated as follows:—

"*The Evolution of Society is a continuous establishment of psychical relations within the Community, in conformity to physical and psychical relations arising in the Environment; during which, both the Community and the Environment pass from a state of relatively indefinite, incoherent homogeneity to a state of relatively definite, coherent heterogeneity; and during* *which, the constituent Units of the Community become ever more distinctly individuated.*"

In the next chapter I shall proceed to show how this exceedingly general and technical formula includes and justifies whatever is defensible in sundry less abstract generalizations, expressed in more popular language, by Comte and Buckle. We shall be called upon to pass in review certain phases of social evolution, and to criticize, with the aid of the theorems now at our disposal, the claims of Comte to be regarded as the founder of sociology.

## CHAPTER XIX.

### ILLUSTRATIONS AND CRITICISMS.

The discussion contained in the foregoing chapter has shown to what a notable extent the phenomena of social evolution may be expressed, with the strictest accuracy, by formulas originally invented to describe the evolution of life in general. Let us briefly review the results which we have already obtained.

*First,* we saw that social as well as organic evolution consists in the continuous adaptation of the community, or organism, to the environment. Or, expressing the same thing in other words, social progress is a continuous establishment of inner relations in conformity to outer relations.

*Secondly,* we saw that in the course of this adaptation the community, like the organism, continually increases in definite heterogeneity, through successive differentiations and integrations.

*Thirdly,* we saw that in the community, as in the organism, the increase in internal heterogeneity is determined by the continuous increase of heterogeneity in the environment.

*Fourthly,* we saw that the increase of heterogeneity in the environment is determined by the successive integration of communities into more and more complex and coherent aggregates. And this law also holds of organic progress.

These four generalizations, expressing the points in which social and organic development coincide, were summed up in the two first clauses of our law of progress. They are immediate corollaries of the law of universal evolution and of the definition of life as adjustment. They are not to be understood as mere expressions of striking analogies. They are to be understood as implying that the evolution of life and the evolution of society are, to a certain extent and in the most abstract sense, identical processes. Such a conclusion, indeed, became inevitable the moment we were brought to admit that the phenomena of society constitute but a specialized division of the phenomena of psychical life.

Nevertheless it would be a grave error to infer, from this necessary coincidence in development, that a community is nothing more than a kind of organism, as Plato imagined in his "Republic," and Hobbes in his "Leviathan." When we go so far as to compare the metropolis of a community to the heart of an organism, its roads to blood-vessels, its circulating commodities to circulating nutritive materials, its money to blood-corpuscles, its channels for transmitting intelligence to nerve-axes, and the individuals of which it is composed to physiologic units; we are instituting a series of analogies, which are no doubt of considerable value in the study both of history and of political economy. In his essay on the "Social Organism," Mr. Spencer has traced a great number of such analogies, which are no less instructive than curious, but they are after all analogies and not homologies. So when M. Littré points out that the study of political economy stands in the same relation to the science of sociology as the study of the nutritive functions to the science of biology, he reveals an analogy of great philosophical value. But we nevertheless feel that there is a wide distinction between an organism and a community, which it would be absurd to ignore; and Hobbe-'s conception of society as a va Leviathan strikes us as grotesque.

This insuperable distinction is the fact that in a community the psychical life is all in the parts, while in an organism the psychical life is all in the whole. The living units of society "do not and cannot lose individual consciousness," while "the community as a whole has no corporate consciousness." "The corporate life must here be subservient to the lives of the parts; instead of the lives of the parts being subservient to the corporate life."[1] The historical induction at the close of the preceding chapter showed us that such has been the case. While during the advance toward greater heterogeneity and coherence, the original lines of demarcation between communities have been ever becoming effaced as the communities have become integrated into higher and higher aggregates, we saw that as a part of the very same process the individualities of the members of society have been ever increasing in definiteness and ever acquiring a wider scope for activity. And we saw that this process not only has ever gone on, but must continue to go on; since, by the law of use and disuse, the sympathetic or social feelings must continue to grow at the expense of the selfish or anti-social feelings; and since this slow emotional modification, which makes possible the higher integration of society, ensures also the higher individuation of its members. "Progress, therefore, is not an accident, but a necessity. Instead of civilization being artificial, it is a part of nature; all of a piece with the development of the embryo or the unfolding of a flower. The modifications mankind have undergone, and are still undergoing, result from a law underlying the whole organic creation; and provided the human race continues, and the constitution of things remains the same, those modifications must end in completeness."[2] As surely as the astronomer can predict the future state of the heavens, the sociologist can foresee that the process of adaptation must go on until

[1] Spencer's *Essays*, 2nd series, p. 154.
[2] Spencer, *Social Statics*, p. 65.

in a remote future it comes to an end in proximate equilibrium. The increasing interdependence of human interests must eventually go far to realize the dream of the philosophic poet, of a Parliament of Man, a Federation of the World,

> "When the kindly earth shall slumber, lapt in universal law,"

and when the desires of each individual shall be in proximate equilibrium with the means of satisfying them and with the simultaneous desires of all surrounding individuals. Such a state implies at once the highest possible individuation and the highest possible integration among the units of the community; and it is the ideal goal of intellectual and moral progress.

Thus the fundamental law of progress, as formulated at the close of the last chapter, contains all the provisions requisite in such a formula. It describes, in a single grand generalization, all the phenomena of social evolution, both in so far as they result from the general laws of life, and in so far as they result from the operation of circumstances peculiar to the aggregation of intelligent organisms in a community. And it includes and justifies all the minor generalizations which may be reached by a direct induction from historical phenomena solely.

This law of progress we find to be exceedingly abstract: it expresses a general truth quite completely disengaged from the incidents of particular cases. Such, as we were led to anticipate, must be the character of a law which generalizes a vast number of complex phenomena. A formula which is to include in one expression phenomena so different as the rise of Christianity and the invention of the steam-engine must needs be eminently abstract. To attempt to make it concrete, so as to appeal directly to the historical imagination, would be to deprive it of its universality, to increase its power of expressing some one set of phenomena by rendering it powerless to express some other equally important set

This consideration explains the manifest failure of all the attempts which have been made to determine the general law of progress by a simple historical induction. Take, for example, the two crude generalizations which pretty nearly sum up the philosophy of history as it is contained in the work of Mr. Buckle; that "scepticism" is uniformly favourable to progress, while the "protective spirit" (or, the spirit of over-legislation) is uniformly detrimental to it. These, in the first place, are generalizations drawn from a peculiar and temporary phase of society and illegitimately extended to all phases of society; and, in the second place, even so far as they go, they have but a limited applicability,—expressing at best certain aspects of intellectual and industrial progress, but leaving quite out of sight that slow moral evolution which underlies the whole. Whatever of truth is contained in these statements is also contained in the formula which I am here expounding, and is much more accurately expressed in the terms of that formula. Scepticism, for instance, in the best sense of the word, is the attitude of mind which is caused by the perception that certain inner psychical relations—say, a given set of beliefs or institutions—have ceased to be adapted to outer relations. The mediæval conception of the world, as presented in Dante's treatise on "The Monarchy," was very closely adapted both to the knowledge and to the social needs of the time. The conception of man as the centre of a universe made solely for his use and behoof, with a sun to give him light by day and a moon and stars to give him light by night, with an Emperor and a Pope divinely appointed to rule him in this life, and an Autocrat in heaven uniting in himself the functions of these two, and ruling nature according to his arbitrary will; this conception, I say, was in harmony both with the best science and with the most urgent social requirements of the time, and the fact of its long duration shows how profound was the harmony. While this state of things lasted, there was but little room for scepticism. But after a while the psychical environment had so far altered as to be out of balance with this conception of the world. The Copernican revolution unseated Man from his throne in the centre of the universe, and advancing physical generalization cast discredit upon the theory of providential government, and so arose the long line of "infidels" from Bruno and Vanini to Voltaire and Diderot. While, on the other hand, the increasing power of monarchy, especially in France, gradually undermined the moral independence of the Papacy, converting it from an upholder of equity and a friend of the people into an unscrupulous ally of regal usurpation and iniquity; and thus arose the Great Schism, followed by the Protestant revolt and the grand democratic movement which culminated in the French Revolution. Now what is all this infidel rebellion against dogma and democratic rebellion against authority, but the intellectual and moral turbulence caused by the growing conviction that the psychical relations comprised in the authorized conception of the world were out of balance with the new aggregate of relations formed by the discoveries of science and the altered requirements of social existence? And this painful attitude of the mind, prompting men to fresh investigation of the order of nature and to new social re-arrangements, is the stimulus to a new and closer adaptation.

Such is the function of scepticism in the community, and such also is its function in the individual. A person, for instance, is educated in an environment of Presbyterian theology, accepting without question all the doctrines of Calvinism. By and by his environment enlarges. Facts in science or in history, methods of induction, canons of criticism present themselves to his mind as things irreconcilable with his old creed. Hence painful doubt, entailing efforts to escape by modifying the creed to suit new mental exigencies. Hence eager study and further enlargement of the environment, causing fresh disturbance of equilibrium and renewed doubt resulting in further adaptation. And so the process continues until, if the person in question be sufficiently earnest and sufficiently fortunate, the environment enlarges so far as to comprehend the most advanced science of the day, and the process of adaptation goes on until an approximate equilibrium is attained between the order of conceptions and the order of phenomena, and scepticism, having discharged its function, exists no longer, save in so far as it may be said to survive in the engrained habit of weighing evidence and testing one's hypotheses.

Now to say that scepticism is one of the causes of progress is to make a historical induction which is valuable as far as it goes; but it is at best an empirical generalization. To make it a scientific law, we need to express the function of scepticism in terms of some formula which covers all the phenomena of progress. And who does not see that in so expressing it we are obtaining a far more definite and accurate and serviceable notion than when we merely state vaguely that scepticism is a cause of progress?

Just so with the statement that the protective spirit is a hindrance to progress. By the colloquial phrase "protective spirit," Mr. Buckle means the control, or at least the undue control, of the community over its individual members. Now in estimating the effect of this circumstance upon progress, everything depends upon the precise amount of such control which we are to regard as excessive. But this varies with each epoch of civilization. What would now be intolerable despotism was once needful restraint. You cannot have a constitutional democracy of Vandals or Moguls. So long as men's altruistic feelings are not powerful enough to make them spontaneously respect the claims of their fellows, the only force which can make society hold together is that hero-worship which enjoins implicit obedience to the head of the tribe or state. But, as we have already seen, the steady growth of altruism at the expense of egoism, which renders possible a more complete social aggregation, renders possible also a more complete development of individual liberty. So that what in one age is a needful control exercised by the community over its members becomes in the next age an undue control. All this is expressed in the law of progress, as here formulated; but it is not expressed, with any approach to accuracy, in the crude statement that the protective spirit is an obstacle to civilization.

Indeed the longer we study this general formula, the more we shall be convinced that it includes and justifies all sound inductions which can be derived from a survey of historical phenomena. As we apply it to the facts of history one after another, we shall see ever more clearly that its very abstractness is its excellence, and that the initial difficulty in thoroughly realizing its import arises from its very fulness of meaning. And we shall become ever more deeply impressed with the belief that no amount of mere historic induction can give us a universally applicable law of social progress, unless our results be deductively interpreted as corollaries from the general laws of life.

We are now in a position to examine the claims of Comte to be regarded as the founder of sociology. And first let us note that a law of social progress answering so many requirements as are met by the law above expounded could not have been obtained earlier than the present generation or even than the present decade.

To conceive of sociogeny as a specialized branch of psychogeny, itself a specialized branch of biogeny, was not possible until a general science of genesis had been at least partially instituted. The very idea of a science of genesis as applied to organic phenomena was not elaborated until the appearance of Von Baer's great treatise in 1829 And the conception was then altogether too novel to be worked into the web of philosophy which Comte was weaving. Considering how, throughout the latter part of his life, he steadfastly refrained from the study of contemporary scientific literature, I do not think it likely that Comte ever became aware of the growing prominence of this conception of genesis; and if he had become aware of it he would doubtless have scornfully repudiated it, as he repudiated almost every new conception which was distinctly in advance of the limited scientific knowledge of 1830. The knowledge which Comte was not prepared to utilize at that date, he was certainly not in a condition to utilize at any later period of his life. It was in 1857, the year of Comte's death, that Mr. Spencer, in an essay entitled "Progress: its Law and Cause," first definitely extended the law of organic development to historic phenomena; although he had ever since 1851 been visibly working toward that result, and had in 1855 reached that grand generalization of the development of both life and intelligence, regarded as processes of adjustment, which underlies the law of social progress here expounded. It was this splendid series of researches, culminating in the announcement of the universal law of evolution, in 1861, which supplied a new basis for all the sciences which treat of genesis, and rendered possible the discovery of the special laws of sociogeny. And finally, in 1861, the further clue to these special laws was given by Sir Henry Maine, whose immortal treatise on "Ancient Law" threw an entirely new light upon the primitive structure of society, and demonstrated—what before could only have been surmised—that human society, as earliest organized, consisted of a congeries of tribal communities by the integration of which have arisen the various orders of states and federations known to history.

When, therefore, we inquire whether Comte did or did not create a science of sociology, we need not be surprised if it appears that he did not create such a science. For in sociology, even more than in any other science, the prime requisite is to formulate the law of evolution—in this case, the order of sequence of historic events from epoch to epoch. So far as a science of society could be founded upon purely statical considerations, the work had already been performed; by Adam Smith, as regards political economy, by Bentham, as regards jurisprudence, and by both these great thinkers, as regards ethics. But ethics, jurisprudence, and political economy, put together, do not make up a science of society, as Comte clearly saw. For in sociology the historical element—the question whence we started and whither we are bound—is the element which takes precedence of all others. Even ethics, jurisprudence, and political economy cannot be placed upon a truly rational basis until we understand the order of intellectual and moral change from epoch to epoch. To understand the "tendencies of the age" is an indispensable pre-requisite for sound sociological thinking as well as for sound political acting. Thus that portion of sociology which treats of genesis is, relatively to the whole science, even more important than the corresponding portions of biology and psychology. In biology pure and simple, we can, as we have seen, obtain a tolerably complete notion of the order of changes in the organism, with but occasional reference to the comparatively stable and unchanging environment. In psychology we have to take the environment into account at every step; but unless we are studying the quite special problem of the growth of the mental faculties, we do not need to refer to a definite and persistent succession of changes in the environment. But in sociology we cannot work in this way. As M. Littré has well pointed out, when we come to study humanity we are met by a new phenomenon unknown in biology or in psychology pure and simple. That new phenomenon is Tradition, or the bequeathing of all its organized intellectual and moral experience by each generation to its successor. Here for the first time we have an environment which is rapidly changing in a definite order of sequence, and changing by the very activity of the community itself. The organized experience of each generation becomes a part of the environment of its successor, and since in each successive age "the empire of the dead over the living increases," the environment of each generation consists to a greater and greater extent of the sum-total of traditions bequeathed by all past generations. Hence we cannot hope scientifically to comprehend the simplest feature in any given state of the community without reference to ancestral states. The religious phenomena of the present day, for example, cannot be understood without previous knowledge of the whole history of Christianity, and indeed of human speculative thought since men began to be aware of the universe about them. Our political organization can be scientifically interpreted only as the offspring of ancestral political organizations in a series reaching back to the primitive tribal community.[1] And so with all the aspects of society. Whether we are studying a creed, a code of laws, a dialect, a system of philosophy, a congeries of myths, or a set of manners and customs, we can arrive at the rational solution of our problem only through a historical inquiry. Hence the doctrine of genesis, indispensable as it is in the other two organic sciences, becomes, if one may say so, even more indispensable in sociology. Here the whole science rests upon sociogeny, and until we have reached a scientific conception of progress we cannot stir a step.

Thus, in addition to the unparalleled complexity of its phenomena, and to its general dependence both for doctrine and for method upon the simpler sciences, we perceive still another reason why the science of sociology has been the last to be constituted. Resting as it does upon the law of progress, it has had to wait not only until the preceding sciences

[1] See Mr. Freeman's book, *Comparative Politics*,—the work of a great scholar who inherits the gift of Midas, and makes gold of every subject that he touches.

were founded, but until they were sufficiently advanced to supply it with the general formula of organic development, from which alone the law of social progress could be deduced. It was not enough that Bichat had laid the foundations for a general theory of nutrition, reproduction and innervation, or that James Mill had established the fundamental laws of association ; though this was indeed much. The new science had to wait until Von Baer had traced the order in which organisms develope, until Mr. Darwin had shown how through heredity and natural selection organisms become adapted to their environments, and until Mr. Spencer had shown how associated ideas and emotions are slowly generated and modified in conformity to surrounding circumstances.

All this, of course, could not be foreseen by Comte. But he nevertheless clearly saw—and it does honour to his philosophic acumen—that a comprehensive theory of social changes can be obtained only by studying them in the order of their historical dependence. He saw that the laws of sociology are at bottom the laws of history. And especially, from the practical point of view, he saw that no general theory fit to serve as a basis for the amelioration of society could be deduced from mere abstract reasonings about human nature, or obtained inductively from the mere observation of contemporary social phenomena. All theories formed in this way, without reference to the order of historic progression, are in danger of being stated too absolutely, and are wont to give birth only to utopian projects. Comte was never weary of pointing out the errors of those political economists who deduce general laws of accumulation and distribution from the industrial phenomena presented by a single country at a particular epoch; or of those moralists who base their theories upon that absurdest of aphorisms, that "human nature is always and everywhere the same"; or of those legislators who, in ignorance of the fact that humanity is travelling in a definite and partially ascertainable direction, fondly hope to turn it hither and thither by shrewdly-concocted acts of parliament. Nor, in maintaining this last position, did he ever fall into the opposite error—characteristic of superficial writers like Macaulay and Buckle—that individual genius and exertion is of little or no account in modifying the course of history. He did not forget that history is made by individual men, as much as a coral reef is made by individual polyps. Each contributes his infinitesimal share of effort: nor is the share of effort always so trifling. Considering the course of history merely as the resultant of the play of moral forces, is there not in a Julius Cæsar or a Themistokles as large a manifestation of the forces which go to make history as in thousands of common men? Nevertheless the fact remains that civilization runs in a definite path, that the sum-total of ideas and feelings dominant in the next generation will be the offspring of the sum-total of ideas and feelings dominant in this, and that only by understanding the general course of the *movement* of humanity can we hope to make our volitions count for much as an item in the resulting aggregate of effects.

Holding such views as these, Comte saw that the first aim of the sociological inquirer must be to ascertain the law of progress. And accordingly he set himself to work to perform this task, with the only instrument then at his command,—that of historical induction. I have already remarked upon his wonderful skill in the use of that instrument of research. I doubt if anyone has ever lived who had a keener sense of the significance of historic events, so far as such significance could be perceived without the aid of conceptions furnished by the sciences of organic development. The fifth volume of the "Philosophie Positive" is certainly a marvellous tableau of the progress of society. I know of no concrete presentation of universal history which can be compared with it. The general excellence of the conception is matched by the excellence of the execution even to the smallest details. And amid the host of pregnant suggestions concerning Greek and Roman, and especially concerning mediæval, history, the great fact that there has been and is a determinate order of sequence in human affairs is placed quite beyond cavil on the highest plane of inductive demonstration.

To achieve so much as this was to show that a science of sociology is possible, and to prepare the way very thoroughly for the creation of such a science. But Comte professed to have done more than this. He regarded himself as the founder of sociology, and is so regarded by his disciples. It is part of our business to determine, if we can, whether the claim is a valid one; and in order to do this, we must examine the theorems which Comte propounded as the fundamental laws of progress.

These theorems are two in number,—the first relating to the intellectual, the second to what we may call the material, development of mankind. The first is an old acquaintance, being nothing else than the generalization that all human conceptions must pass through three stages—the theological, the metaphysical, and the positive. We have already (Part I. chapter vii.) examined this theory upon its own merits. Tried by a psychological analysis, we have found it to be only partially true. We saw it to be correct in so far as it asserts that the prevailing conception of the world becomes less and less anthropomorphic from age to age; but incorrect in so far that it asserts that in this deanthropomorphizing process there are three radically distinguishable stages, and also, in so far as it asserts that the process must end in Positivism. We saw that, although without doubt men began by seeing volition everywhere and must end by seeing an inscrutable Power everywhere, nevertheless the mental process has throughout been one and the same, and any appearance of definite stages can be only superficial. Nevertheless, between the primeval savage who prays to his fetish and the modern philosopher who recognizes that he must shape his conduct according to invariable laws or pay the penalty in some form of inevitable suffering, the difference in mental attitude is so vast that we may well have a distinction in terms to correspond to it. It is for this reason that I have frequently contrasted Anthropomorphism and Cosmism as the initial and final terms of a continuous progression. This, however, is not the Comtean doctrine. Again, metaphysics, as Comte understands it, being merely imperfect scientific inquiry conducted by the aid of the subjective method bequeathed by anthropomorphism, cannot be regarded as the peculiar possession of any particular stage.

But while Comte's theorem, in spite of these radical defects, contains a germ of truth and has been found to be eminently useful as a formula for intellectual development, I cannot but be surprised that Comte should have regarded it as the fundamental law of social progress, and still more that such able writers as Mr. Mill and Mr. Lewes should at the present day be found countenancing such an opinion. Does this "law" explain how it was that Greek civilization prematurely failed? Does it throw any light upon the causal connection between Roman universal dominion and the Christian sentiment of the brotherhood of men? Does it recognize the distinction between the growth of a community in size and its growth in structure, or hint to us that the differences between Chinese and European civilization may be summed up in the statement that China is only a stupendous tribal community, while Romanized Europe is virtually a federation of exceedingly heterogeneous national aggregates? And while, as we shall presently see, it unconsciously recognizes that intellectual development is a continous process of adaptation, does it say anything about that slow process of emotional change by which the more harmonious co-operation of societies and the more perfect freedom of individuals are alike rendered possible? Indeed it says nothing about any of these things; and I must think that these are very extensive lacunæ in a theorem which professes to be the fundamental law of social progress.

But this formula, as it stands, is not the whole of Comte's fundamental law of history. With the advance from theological, through metaphysical, to positive conceptions of the world, Comte couples an advance from military to industrial life, through an ill-defined intermediate stage—inserted, doubtless, to complete the threefold parallelism—which he calls the "legal" stage. Thoroughly to explain what he means by this "legal" stage of society, would require more detail than I can here well indulge in. We must be content with observing that he means to designate that epoch, which indeed we have not yet left behind us, in which parliamentary legislation is thought competent to renovate society artificially,—in which it is supposed that legislatures can make men rich by giving them paper-money, intellectual by patronizing literature, temperate by closing dram-shops. As this phase of opinion was very conspicuous in the eighteenth century, coupled with metaphysical systems of political ethics deduced from revolutionary theories of the "inherent rights of man," Comte links this whole set of doctrines together, and makes a so-called metaphysico-legal stage in social progress. But I cannot think this a happy generalization. This "legal" stage is, at the best, a phase of intellectual development, and to introduce it into the midst of a purely social progress from military to industrial life, seems too much like committing the logical fallacy known as cross-division. Omitting this stage, then, and reducing Comte's double formula to its lowest terms,—the only ones, I think, upon which he himself would invariably have insisted,—we have the following, as the Comtean law of progress:—

*The progress of society is a gradual change from anthropomorphic to positive conceptions of the world, and from military to industrial modes of life; and the latter kind of change is determined by the former.*

Such is the form of statement most favourable for Comte, and at the same time I believe it to be the one which best represents his permanent opinion. We shall presently see that the generalization of the change from military to industrial modes of life is one of great value, and it is to the thorough elaboration of it that much of the merit of Comte's social philosophy is due. But I must first call attention to the fatal defect in the above formula, the defect which destroys its claim to be regarded as the law of progress. That fatal defect is its total omission of moral feeling as a factor in social evolution. Though he is far from committing Mr. Buckle's absurdity of denying that there has been any improvement in moral feeling, Comte nevertheless falls into substantially the same error with Mr. Buckle, in attempting to explain all social progress as due simply to a progressive alteration of opinion. The error is one which seems to be shared by two other eminent writers,—Mr. Mill and Mr. Lewes. Here are the statements of the four: Mr. Mill says, "We are justified in concluding that the order of human progression in all respects will mainly depend on the order of progression in the intellectual convictions of mankind."[1] Mr. Lewes says, somewhat more vaguely, "The evolutions of Humanity correspond with the evolutions of Thought."[2] Mr. Buckle says, "The progress of mankind depends on the success with which the laws of phenomena are investigated, and on the extent to which a knowledge of those laws is diffused."[3] Comte says, "It is not to the readers of this work that I think it necessary to prove that ideas govern the world, and that the social mechanism reposes ultimately upon opinions."[4]

Now it is not so much because of what these propositions assert as because of what they omit, that they must be pro-

[1] *System of Logic*, 4th edit., vol. ii. p. 517.
[2] *Philosophy of the Sciences*, p. 23.
[3] *History of Civilization*, vol. ii. p. 1.
[4] *Philosophie Positive*, tom. i. p. 48.

nounced unsatisfactory and misleading. It is beyond question that the progress of mankind does depend upon the progressive conformity of the order of their conceptions to the order of phenomena; but, after the inquiry contained in the preceding chapter, I believe no further proof is necessary to convince us that the progress of mankind also depends upon the progressive conformity of their desires to the requirements arising from their aggregation in communities. If civilization is a process of intellectual adaptation, it is also a process of moral adaptation; and the latter I believe to be the more fundamental of the two. The case is well stated by Mr. Spencer, in the following passage: "Ideas do not govern the world; the world is governed by feelings, to which ideas serve only as guides. The social mechanism does not rest finally upon opinions; but almost wholly upon character. . . . . All social phenomena are produced by the totality of human emotions and beliefs: of which the emotions are mainly predetermined, while the beliefs are mainly post-determined. Men's desires are chiefly inherited; but their beliefs are chiefly acquired, and depend on surrounding conditions; and the most important surrounding conditions depend on the social state which the prevalent desires have produced. The social state at any time existing is the resultant of all the ambitions, self-interests, fears, reverences, indignations, sympathies, etc., of ancestral citizens and existing citizens. The ideas current in this social state must on the average be congruous with the feelings of citizens; and therefore, on the average, with the social state these feelings have produced. Ideas wholly foreign to this social state cannot be evolved, and, if introduced from without, cannot get accepted—or, if accepted, die out when the temporary phase of feeling which caused their acceptance ends." This statement, I may observe in passing, is well illustrated by the abortive attempts of missionaries to civilize the lower races of mankind by converting them to Christianity. Though they sometimes succeed in procuring temporary verbal acceptance for Christian ideas, they almost always fail in effecting a genesis of Christian feeling, and such civilization as they are able to produce is apt to be both superficial and transient. This is simply because civilization is not a mere process of external acquirement, but is a process of slow adaptation or breeding, which requires many generations to effect a permanent modification of character. The Fiji, whose language contains no words expressive of the higher emotions or the more exalted principles of action, cannot be made into a Christian. You may cover him with a very little of the external varnish of civilization; you may astonish him into accepting a few formulas, to him quite unintelligible, concerning the relations of man to his Creator; but, after all, he remains a savage still, in feelings and in habits of thought, bloodthirsty, treacherous and superstitious, with a keen appetite for human flesh. Or suppose you could resuscitate a mediæval baron—one of those innumerable freebooters who lived entrenched in the romantic castles of the Rhine and levied blackmail on every luckless wayfarer—suppose you could resuscitate such a man, and were to endeavour to expound to him in the simplest language a few of the most self-evident modern axioms concerning political rights and the interdependence of human interests: would he understand you? By no means. So vast would be the difference in mental habit, that in all probability he could not even argue with you. "Hence"—to continue with Mr. Spencer—'though advanced ideas when once established act upon society and aid its further advance; yet the establishment of such ideas depends on the fitness of the society for receiving them. Practically, the popular character and the social state determine what ideas shall be current; instead of the current ideas determining the social state and the character. The modification of men's moral natures, caused by the continuous discipline of social life, is therefore the chief proximate cause of social progress."

It is worthy of note that Comte, in his later period, comes partly around to this very point of view. At the beginning of the "Politique Positive," we find him announcing that the increasing tendency in the altruistic impulses to prevail over the egoistic impulses is the best measure by which to judge of the progress of society.[1] Yet the unsteadiness with which he grasped this principle is revealed by the somewhat misty statement, a few pages further on, that "the co-ordination of human nature as a whole depends ultimately upon the coordination of intellectual conceptions." A similar fluctuation in opinion may be noticed in Mr. Buckle; and it was indeed hardly possible for the function of moral feeling as a factor of progress to be thoroughly understood by writers unacquainted with the laws of adaptation upon which the scientific interpretation of that function is based. But whatever Comte's latest opinions may have been, since he never formulated any law to include the action of moral feeling as a factor of progress, his claims to be regarded as the founder of sociology must rest entirely upon his theory of progress as announced and elaborately illustrated in the "Philosophie Positive."

That theory, as we now see, is much too incomplete to serve as the foundation for a scientific study of history. Civilization cannot be summed up in the correct formula that men's occupations begin by being military and end by being industrial, or in the incorrect formula that men's conceptions of the world begin by being anthropomorphic and end by being positive; nor is it true that the former change is determined by the latter. We need to add the formula that men's feelings begin by being almost purely egoistic and must end by being altruistic to a considerably greater extent than will suffice to prevent individual interests from clashing.

[1] *Politique Positive*, tom. i. p. 16.

And even with all three formulas before us, we need something more before we can say that we have obtained the Law of Progress. These formulas are historical generalizations of great value; but as thus announced, they are too isolated with respect to each other. The progress of society is not moral progress, or intellectual progress, or material progress; but it is the combination of all the three. Our three formulas, therefore, must be integrated in a single formula. And this is done, and satisfactorily done, when it is shown that they are all involved in that law of adaptation or adjustment which underlies sociology, as well as psychology and biology.

That the progress from egoism to altruism is involved in that fundamental law, was proved in the preceding chapter, and has been illustrated throughout the whole of this discussion. But the law of adaptation equally involves the progress from Anthropomorphism, not to Positivism, but to Cosmism, as a necessary corollary. For what does that progress depend upon? What is the underlying process of which it is the necessary symptom and result? Why is it that men begin by investing the unknown causes of phenomena with quasi-human attributes and end by recognizing a single Cause which is inscrutable? In treating of deanthropomorphization (Part I. chap. vii.) we examined this point. We perceived the primitive anthropomorphism to be a corollary from the relativity of all knowledge. We saw that, to interpret phenomena at all, men must interpret them in terms of their own consciousness. We saw that before the dawn of science, when events seemed isolated and capricious, the phenomenon itself was by a natural inference—which only the progress of science has taught us to correct—endowed with a quasi-human personality. We traced the manner in which, as phenomena become generalized in wider and wider groups, the causes of phenomena become conceived as more and more abstract, and become stripped by slow degrees of their anthropomorphic vestments. Until finally, when generalization has proceeded to such an extent as to give us a single grand science of Cosmology, dealing with the Universe as an integral whole, there comes to be recognized a single Cause of phenomena, which, as being infinite, cannot be in any anthropomorphic sense personal, and which, as being absolute, must be inscrutable.

Thus we see that Comte's formula is not fundamental, even as a formula for intellectual development. The process of deanthropomorphization is not the fundamental fact. The continuous organization of knowledge and generalization of phenomena is the fundamental fact, of which the continuous deanthropomorphization is the necessary symptom and result. Now in Part I. chap. ii., we traced the outlines of this continuous organization of knowledge; and we found that the advance from incomplete to complete knowledge consists in the continuous establishment of groups of notions which are ever more coherent within themselves, while they are ever more clearly demarcated from one another. Now what is all this but a continuous process of differentiation and integration? When we say that from first to last, from the simplest cognitions of infancy to the widest generalizations of science, we cognize phenomena invariably through difference and likeness, we mean that we are continually differentiating notions answering to unlike phenomena and continually integrating notions answering to like phenomena. Or, to express the same thing in other words, we are continually establishing relations of likeness and unlikeness among our conceptions, that in some way or other definitely correspond to relations of likeness and unlikeness among phenomena. Thus our intellectual progress is at bottom a process of adaptation. And, when treating of the Test of Truth (Part I. chap. iii.), it was shown that Truth, the goal of intellectual progress, is nothing else than the complete adaptation of the order of conceptions to the order of phenomena,—the establishment of inner relations that are in equilibrium with outer relations. Thus we obtain a veritable law of intellectual progress; whereas to say that men's conceptions pass from Anthropomorphism to Positivism is merely to enunciate an empirical generalization, which, besides being empirical, is also radically imperfect.

The gradual change from a military to an industrial life must also seek its rational explanation in the law of progress as above formulated. The diminution of warfare and the concomitant increase of devotion to industrial pursuits are entailed by the growth of communities in size and structure. Among the primitive tribal societies there is no industrial life save that implied in hunting and fishing, and at a somewhat later date in the rearing of domestic animals. Settled agricultural pursuits require a greater power of continuous application and a more developed ability to subordinate present enjoyment to the anticipation of future needs than is to be found in the primitive savage. It is only the mental habit produced by long-continued social discipline which enables us to work to-day that we may enjoy the fruits of our labour at a distant period. The primeval tribe wanders from spot to spot, seeking ever a better hunting-ground or richer pasturage, leading a predatory life which differs in little save in its family organization from that led by the lower animals. In this stage of society constant warfare is inevitable, since each tribe must fight or be crushed out of existence by neighbouring tribes. Over a large part of the earth's surface, such has been the monotonous career of savage man from the earliest times until the present day. Such appears to have been, in its main features, the ancient history of our own country before its conquest by Europeans, as it is admirably delineated in the writings of that acute observer Mr. Parkman.

The exigencies of warfare, however, of themselves facilitate that integration of tribal communities which we have seen to be the indispensable condition of progress. A considerable step toward civilization is taken when tribes begin to aggregate for mutual defence over a wide tract of country. When America was discovered, an aggregation of this sort had apparently begun to be formed among the Iroquois; and such was the highest organization reached by the ancient Turanian tribes of Central Asia. A far more important step is taken when warfare ceases to be purely destructive and becomes acquisitive; or, in other words, when the victors, instead of massacreing the vanquished, begin to make slaves of them. By this step agricultural industry is fairly brought into existence, and the tribal confederacy becomes fixed in location and enabled to increase indefinitely in size at the expense of the less highly organized communities in the neighbourhood. Under these conditions the tribal confederacy may grow until it takes on the semblance of an "aggregate of the third order," as in China,[1] or in ancient Egypt, Assyria, Media, Lydia, and Persia. I am expressing something more than an analogy—I am describing a real homology as far as concerns the process of development—when I say that these communities simulated modern European nations much in the same way that a tree-fern of the carboniferous period simulated the exogenous trees of the present time. The vast growth and the considerable civilization obtained by such communities were rendered possible only through the institution of industrial slavery in place of the primeval indiscriminate slaughter of captives. Only through enforced labour did the continuous culture of the soil and the consequent stability of society become possible;

[1] "In every respect the Chinese constitution of society may be regarded as a gigantic amplification of the constitution of the family. The family is no doubt the constituent element of which all societies are composed; just as, in the body, all tissues, nervous or muscular, are generated from the primitive cellular tissue; but whereas in other societies we find differentiation into classes and institutions which have no direct analogue in the family, in China we find far less of this, far more of adherence to the primitive social tissue, to the patriarchal type. On this type the village and the empire are alike moulded." Bridges, in *Essays on International Polity*, p. 401.

a point which Comte clearly saw, and has brilliantly illustrated.

Thus we see how the exigencies of self-protection entailed by the primitive state of universal warfare furnished of themselves the conditions for the rise of industry. We need not trace in detail the slow growth of the industrial spirit at the expense of the military spirit in the ancient civic communities, in the ancient and mediæval Empire, and in modern times. That has been done, with a masterly hand, by Comte. We may only note briefly how industry—the offspring of slavery, itself the offspring of warfare—has all along, by aiding the differentiation and integration of society, been draining the vitality out of its primeval parent. Let us note, then, that the kind of differentiation, known as "division of labour," by rendering the various portions of the community more and more dependent on each other, renders a state of warfare ever less easy to sustain, and therefore continually, though slowly, diminishes the frequency and shortens the continuance of wars. The statement that in early times a community is, on the whole, better able to endure protracted warfare than in later times, may be illustrated by a comparison between the Punic Wars of Rome and the War of Secession in our own country. The horrible destruction of life and property occasioned by the first and second Punic wars is minutely described in Mommsen's "Roman History." The first of these desperate struggles lasted twenty-three years, during the five severest of which the census of Roman patricians was diminished by one-sixth of the whole number,—a fact terrible to contemplate when its full significance is realized. After twenty-three years of comparative quiet began the still more deadly struggle against Hannibal, which lasted seventeen years. During this war, the total loss of life in all the communities engaged—Italian, Spanish, Sicilian, and African—cannot be estimated at less than 600,000 persons actually slain; a loss which I believe somewhat exceeds that of the Northern and Southern States in the American war. But to make a fair comparison, we must include the circumstance that the population of these ancient communities was not more than one-sixth as great as the population of the United States; and that in ancient times the normal rate of increase of population was very much slower than in such a community as ours. The second Punic war was, therefore, relatively as murderous as our civil war would have been had it continued until between three and four million lives were destroyed. And if we would appreciate the direct damage to industry which it entailed, we have a sufficient datum in the fact that during those seventeen years more than four hundred flourishing towns and villages in Italy alone were blotted out of existence.[1]

Now opinions may differ as to the possibility of our carrying on for seventeen years a war which should drain our resources as the Hannibalic war drained the resources of Italy. Probably no country could so well sustain such a trial as the United States, owing to the favourableness of our social conditions for exceedingly rapid growth in wealth and population. Nevertheless, even omitting foreign interference from the account, I do not believe the thing would be possible. I believe it perfectly safe to assert that a war like the one we have lately passed through would, if prolonged to seventeen years, entail social disintegration throughout the community. Yet the absolute military power of the United States is incomparably greater than that of ancient Rome: wherein, then, lies the difference?

The explanation will be found, and the particular conclusion reinforced, when we consider the enormous increase of heterogeneity and interdependence in the modern as contrasted with the ancient community. In ancient Italy there was but little division of labour: it required but a few simple

[1] Mommsen, *Römische Geschichte,* tom. i. p. 671; see also p. 536.

occupations to supply the wants of the whole community. In the United States considered as a whole, the division of labour is perhaps not quite so extreme as in western Europe, owing to the sparseness of population and the purely agricultural activity of large sections of the country: still, the industrial differentiation is very great, and to supply the wants of each portion of the community a vast number of mutually dependent and highly complicated occupations is indispensably necessary. Obviously the heterogeneous community cannot so well bear the abstraction of units from its mutually dependent parts, as the homogeneous community could bear the abstraction of units from its relatively independent and self-sufficing parts. The difference is much the same as the difference between cutting off portions of a worm and cutting off portions of a vertebrate animal. You may take one of the lower worms and slice away at it for some time without destroying it, but in the case of the vertebrate a comparatively small loss of parts entails destruction. In society the principle is the same. The Romans could lose army after army, while the few who remained at home could carry on all the agricultural and commercial operations necessary to the maintenance of the community. There were no great organized industries, manufacturing or commercial, so linked together that the destruction of any one might cause general financial disaster. But in any large modern community industry has become so heterogeneous that it is difficult for one part to take on the functions of another part, and so completely integrated that a sudden and considerable withdrawal of men from the ordinary pursuits of life can hardly take place without causing widespread suffering. And the contrast is made still greater by the industrial federation of modern communities as compared with the industrial isolation of ancient states. Though the time has perhaps never been, since Mediterranean civilization began, when a war could continue very long in one community without tending to set up disturbance in some other, yet this interaction of different states was far less conspicuous in ancient than it is in modern times. The Hannibalic war might go on for seventeen years, and Athens or Alexandria not be much the worse off for it. But before the war of secession had continued twelve months, the consequent suffering in Lancashire was manifesting itself in riots, and England for a time seemed willing at all hazards to interfere and check the contest.

This single example—out of hundreds that might be taken—must suffice to illustrate the way in which the ever-increasing interdependence of human interests, itself both the cause and the effect of industrial progress, is ever making warfare less and less endurable. To this it must be added that both moral and intellectual factors contribute to bring about the general result. As human interests in various parts of the world become more and more inextricably wrought together, and as communities which lie apart from each other come ever into closer contact, the ancient antagonisms of sentiment between them slowly disappear, and international friendship grows at the expense of the old hostility or distrust. Thus the moral adaptation due to long-continued social discipline diminishes the warlike feelings and strengthens the feelings which maintain an industrial *régime;* while on the other hand, intellectual adaptation, ever adding new complication to industry, arrays the opinion of society more and more decidedly against war, as against an intolerable source of disturbance. Besides which, the very heterogeneity of the military art, the increasing complication both of the implements and of the methods of warfare, due to scientific and industrial progress, renders war ever more costly, and makes the community less willing to engage in it. And these cooperating processes must go on until—probably at no very distant period—warfare shall have become extinct in all the civilized portions of the globe.

In so far as the present chapter has dealt with the claims of Comte to be regarded as the founder of Sociology, I believe it is sufficiently proved that these claims cannot be sustained, though in many ways he did more than anyone else to prepare the way for such an achievement. If a man can ever be properly said to create or found a science, it is only when he discovers some fundamental principle which underlies the phenomena with which the science has to deal, and which thus serves to organize into a coherent ratiocinative body of knowledge that which has hitherto been an incoherent empirical body of knowledge. It was in this way that Newton may be said to have created a science of celestial dynamics, and that Bichat is sometimes, and more loosely, said to have been the founder of modern biology. In no such sense can Comte be said to have created sociology. Standing on the vantage-ground of contemporary science, which enables us to discern in outline the law of progress, we can see not only that Comte was far from detecting that law, but that, with the limited appliances at his command, he could not have been expected to discover it. Nevertheless his contributions to sociology were exceedingly brilliant and valuable, and he did perhaps all that the greatest thinker could have done forty years ago. He arrived at a double generalization of the phenomena of intellectual and material progress, as wide as could then be reached by unaided historical induction; and he verified this double generalization by an elaborate survey of ancient and modern history, which, even had he written nothing else, would alone suffice to make his name immortal. It entitles him, I think, to be ranked first among those sociologists who have proceeded solely on the historical method,—on a somewhat higher plane, perhaps, than Vico or Montesquieu, Turgot or Condorcet. That generalization, in both its branches, and in so far as it is correct, we have here seen to be a corollary from the fundamental law of social evolution obtained in the preceding chapter. We have seen that the continuous adaptation, both moral and intellectual, of the community to its environment, involves, as necessary concomitants, both the progressive deanthropomorphization of men's conceptions of Cause, and the gradual change from military to industrial habits of life. And the harmony between the results thus obtained by pursuing two wholly independent lines of inquiry, adds fresh support both to the fundamental law and to its historic corollaries. In the very act of proving that Comte did not achieve the whole, we do but place what he did achieve upon a deeper and firmer basis.

## CHAPTER XX.

### CONDITIONS OF PROGRESS.

AT the beginning of the chapter on the Evolution of Society we remarked upon the error of those metaphysical writers who have gone so far as to ascribe progressiveness to an occult tendency inherent in human nature. It need not take a very long survey of human societies, past and present, to assure us that beyond a certain point stagnation has been the rule and progress the exception. Over a large part of the earth's surface the slow progress painfully achieved during thousands of prehistoric ages has stopped short with the savage state, as exemplified by those African, Polynesian, and American tribes which can neither work out a civilization for themselves, nor appropriate the civilization of higher races with whom they are brought into contact. Half the human race, having surmounted savagery, have been arrested in an immobile type of civilization, as in China, in ancient Egypt, and in the East generally. It is only in the Aryan and some of the Semitic races, together with the Hungarians and other Finnic tribes subjected to Aryan influences, that we can find evidences of a persistent tendency to progress. And that there is no inherent race-tendency at work in this is shown by the fact that some of the Aryans, as the Hindus and Persians, are among the most unprogressive of men. It becomes apparent, therefore, that the progress of the European Aryans, and of such other races as have from time to time arisen from an immobile condition, can have been due only to a concurrence of favourable circumstances. In order to complete our outline-sketch of the Evolution of Society, we must consider some of these circumstances, and thus, so far as possible, redeem the promise which was implied at the beginning of the discussion. By pointing out some of the conditions essential to progress in civilization, we must endeavour to throw a glimmer of light upon the fact that so small a portion of the human race has attained to permanent progressiveness. A faint glimmer of enlightenment is indeed the most we can hope for, and even this will perhaps be thought to have been obtained by a mere restatement of the problem in other words. Nevertheless, in other departments of study as well as in algebra, much good is often done by reducing a problem from one form of expression to another. For if such a reduction ends in classifying the problem, the first and most important step is taken toward a solution. Let us deal in this way with the problem before us, which is one of the most complex and difficult that the history of the world presents.

It will be obvious to everyone that there is a close kinship between this question in sociology and the biological question why certain species remain unchanged through countless ages. The latter fact has been urged as an obstacle in the way of the development theory, and has been felt to be such by Dr. Bastian, who has endeavoured to dispose of it by an extraordinary application of his favourite theories of archebiosis and heterogenesis.[1] But indeed those who urge this fact as an obstacle, and those who seek to explain it away, show that they have not thoroughly comprehended the Doctrine of Evolution. For example, it is not implied in the general law of evolution, as above expounded in

[1] Bastian, *Beginnings of Life*, vol. ii. pp. 584—640.

Chapter IV., that wherever the integration of matter and concomitant dissipation of motion are going on, there must always ensue a change from indefinite uniformity to definite multiformity of structure. As has already been shown, such a change can be expected to take place only when a number of specified circumstances concur in forwarding it. So it is one of the peculiar merits of Mr. Darwin's theory of natural selection, that it does not allege an unceasing or ubiquitous alteration of animal and vegetal forms, but includes, in a general way, all cases of persistence of type, as well as all cases of progress or retrogression. One and the same general theory accounts for the fact that, while some species thrive in the struggle for life and acquire new capacities, others dwindle in numbers or deteriorate in structure, while others again maintain themselves unchanged throughout immense periods. Throughout all these cases, the general truth is easily discerned that the total result will depend upon a very complex combination of circumstances: the difficulty is in applying the general truth to the special cases that arise. Probably no naturalist could point out all the specific circumstances which have caused any one race of animals to prevail over another in the struggle for life. Such a task would probably demand a more vast and minute knowledge of the details of the organic world than it is as yet possible for the most unremitting industry, inspired by the highest genius, to acquire. Yet no one doubts the general principle that it is natural selection which determines, not only which races shall prevail, but also which races shall vary and which shall remain unmodified. So in dealing with human societies, in the primitive era with which the present discussion is chiefly concerned, the historic data are insufficient to enable us to ascertain the precise circumstances to which the prevalence and the improvability of certain races are to be attributed. Nevertheless we can here, too, point out sundry general principles in accordance with which natural selection has determined the course of events.

In considering the action of natural selection upon the human race, we must first note how that action is, in some respects, materially modified by social conditions. Among inferior animals, even those which are gregarious, as the ruminants and sundry smaller carnivora, the preservation of any individual requires his almost complete adaptation to surrounding circumstances. There is so little division of labour, and consequently so little mutual assistance, that all must be capable who would survive. With the earliest manifestations of true sociality this state of things must be somewhat altered. Even in the rudest actual or imaginable society there is some division of labour, and some mutual assistance. Those who are less swift for hunting or less strong for fighting may at least perform services for the hunters and warriors, and in return will be more or less efficiently fed and protected; so that those who fall below the average capability of the race are no longer sure to be prematurely cut off, and thus the agency of natural selection in keeping up a nearly uniform standard of fitness is to some extent checked. In the highly complex societies which we call civilized, division of labour and cooperation have done much to obscure the effects of this agency. From the cooperation which goes on to a greater or less extent in all societies, and from the enormous heterogeneity of man's psychical organization, it follows that there are innumerable circumstances which may enable individual men to survive, in spite of their falling considerably short of the normal standard of the community and the age to which they belong. This fact, as will hereafter appear, renders it possible for man to have an ideal standard of excellence or successfulness in life, and is closely associated with the genesis of the ethical feelings of approval and disapproval.

But while natural selection among individuals grows somewhat less rigorous, its effects upon rival or antagonist societies are in nowise diminished in their beneficent severity. The attributes which tend to make a society strong and durable with reference to surrounding societies, are the attributes which natural selection will chiefly preserve. As Mr. Wallace has pointed out: "Capacity for acting in concert for protection, and for the acquisition of food and shelter; sympathy, which leads all in turn to assist each other; the sense of right, which checks depredations upon our fellows; . . . self-restraint in present appetites; and that intelligent foresight which prepares for the future, are all qualities that from their earliest appearance must have been for the benefit of each community, and would therefore have become the subjects of natural selection. Tribes in which such mental and moral qualities were predominant, would have an advantage in the struggle for existence over other tribes in which they were less developed, and would live and maintain their numbers, while the others would decrease and finally succumb." [1]

The most conspicuous result of this unceasing operation of natural selection upon rival communities, has been the continuous increase of the aggregate military strength of the human race, and the more and more complete segregation of this military strength into those portions of the race which are most civilized. As Mr. Bagehot has ably shown,[2] however broken or discontinuous the progressive career of the European family of nations may seem to have been in other respects, there can hardly be a doubt that the increase of their aggregate military force has been uninterrupted. There can hardly be a doubt that the total fighting power of the Mediterranean communities was greater

[1] Wallace, *Natural Selection*, p. 312.

[2] See his *Physics and Politics*, London, 1872,—a little book so excellent both in thought and in expression that one cannot but wish there were much more of it.

under Trajan than in the time of Polybios; that the sum of Latin and Teutonic strength in the days of Charles Martel was greater than in the days of Marcus Aurelius; that the united Europe of Pope Gregory VII. could have vanquished the united Europe of Charles the Great, but would have been no match for the united Europe of Philip, Elizabeth, and Henry; or that the existing generation of Aryans in Europe and America represents a greater quantity of military power than any previous generation. This result is partly due to the mere increase of the civilized communities in size and industrial complexity, and partly to the integration, over wider and wider areas, of communities previously isolated. But while there have been periods of intermittence in the operation of these social and political circumstances, as during the Teutonic reconstruction of the Roman Empire, the increase in total fighting power appears to have gone on without intermittence, showing that it has been in great degree due to a cause unremitting in its operation. That cause has been natural selection. In the earlier and ruder times it has operated through the *actual* conquest of the weaker tribes, provinces, or cities, by the stronger. In later and more refined ages, the quieter but equally stringent competition of nation with nation, involving the *possible* conquest or relative humiliation of one by another, has caused a considerable proportion of the ever-accumulating intellectual and industrial acquirements of each nation to be expended (or, as Mr. Bagehot more happily says, "invested") in an increase of military strength.

From the cooperation of these circumstances the aggregate physical strength of civilized society has increased so enormously that in comparison with the military events of our time, the military events of antiquity seem like mere child's play, if we look at physical dimensions alone, and not at world-historic significance. Ignoring the latter point of view, Mr. Robert Lowe has maintained that the battle of Marathon was an event of less importance than "a good colliery accident," because forsooth only 192 lives were lost on the side of the Greeks![1] To him, however, who has acquired the habit of looking at European history as one connected whole, it will not seem extravagant to say that contemporary English civilization is indebted to the victory of Marathon in a far higher degree than to the victories of Crecy or Agincourt, or even of Waterloo. The immense relative importance of some of these ancient military events of small dimensions, is due to the fact that military strength was not then concentrated in the most highly civilized communities, as it is in modern times. In antiquity there was a real danger that the nascent civilization of higher type might be extinguished by the long-established civilization of far lower type, or even by barbarism, through mere disparity of numbers. We do not know how often in prehistoric times some little gleam of civilization may have been put out by an overwhelming wave of barbarism, though by reason of the great military superiority which even a little civilization gives, such occurrences are likely to have been on the whole exceptional. This great superiority is well exemplified in the ease with which the Greeks defeated ten times their own number of Asiatics at Marathon, and afterwards at Kynaxa. Nevertheless it cannot be questioned that the invasions of B.C. 490 and 480 were fraught with serious danger to Grecian independence, and if Datis or Mardonios had happened to possess the military talent of Cyrus or of Timour, the danger would have been alarming indeed. Now if little Greece had thus been swallowed up by giant Persia, and the nascent political and intellectual freedom extinguished in Athens as it was in the Ionic cities of Asia Minor, the entire future history of Macedonia, of Rome, and of Europe, would have been altered in a way that is not pleasant to contemplate. When we reflect upon the enormous place in human history

[1] See Freeman, *Comparative Politics*, p. 498.

which is filled by the products of Athenian intellectual activity during the two centuries succeeding the victory of Marathon; when we remember that the foundations of philosophy, of exact science, of æsthetic art in all its branches, of historic and literary criticism, and of free political discussion, were then and there for ever securely laid; when we consider the widely ramifying influences, now obvious and now more subtle, of all this intense productivity upon Roman ethics and jurisprudence, upon the genesis of Christianity, upon the lesser Renaissance of the thirteenth century, and the greater Renaissance of the fifteenth; when we see how inseparably the life of Athens runs as a woof through the entire web of European life down to our own times;—when we come to realize all this, we shall begin to realize how frightful was the danger from which we were rescued at Marathon and at Salamis.

Probably at no subsequent time has European civilization been in a position of such imminent peril. In the life-and-death struggle between Rome and Carthage, the military superiority belonged so decidedly to the more highly-evolved community that even the unrivalled genius of Hannibal was powerless to turn the scale.[1] One of the most conspicuous features in Roman history, from the conquest of Spain by Scipio to the conquest of the Saxons by Charles the Great, was the continual taming of the brute force of barbarism, and the enlisting it on the side of civilization. In the earlier times there seems to have been real danger in the invasions of Brennus and of the Cimbri, and perhaps in that of Ariovistus. But with the conquest of Gaul and the more subtle process of Romanization which the Teutons underwent, the danger from these sources disappeared, until. when the great struggle with outer barbarism came in the fifth century, we see the Empire saved on a Gaulish field by the prowess of the West-Goth. The battle of Châlons seems

[1] See Arnold, *History of Rome*, vol. iii. p. 63.

to me to have been the last of the great fights in which the further continuance of European civilization was really imperilled. Though the victory of Attila could hardly have entailed the rebarbarizing of the whole Empire, it might well have caused such a temporary "solution of continuity" between ancient and modern history as the old historians supposed to have been wrought a few years later by the comparatively insignificant intrigues of Odoacer. Many hard-working years might have been needed to recover the ground thus lost. But in passing to the eighth century, I think we may well doubt the soundness of Gibbon's suggestion that the victory of Abderahman at Tours might have led to the Mohammedanization of Europe; for while one great defeat forced the Arab to retire behind the Pyrenees, on the other hand the complete overthrow of the Frankish power would probably have required many battles as fierce as this one. This increased toughness of civilization is still more plainly seen five centuries later, when the overwhelming victory of the Mongols at Liegnitz produced no effect at all beyond a temporary scare. It was not that the invasion under Batu was intrinsically less formidable than the invasion of Attila, but that the physical strength of civilized Europe had been growing throughout the long interval, so that the blow which might once have proved fatal was no longer dangerous. Since the fruitless sieges of Vienna by the Turks, the mere dread of barbaric or semi-barbaric invasion has passed away for ever. Tribally-organized barbarism is henceforth out of the lists entirely, and even the civilization of lower type has ceased to compete, in a military way, with the civilization of higher type.

Thus we see how natural selection, facilitating and cooperating with the integration of the more civilized communities and their increase in size and complexity, has gradually removed one of the dangers to which the earlier civilizations were exposed, and has concentrated the power of making war on a grand scale into the hands of those communities in which predatory activity is at the minimum and industrial activity at the maximum. We are thus again reminded of the curiously cooperating processes, partially illustrated in the preceding chapter, through which warfare or destructive competition, once ubiquitous, is becoming evanescent, and giving place to a competition that is industrial or productive in character. But what now more especially concerns us is to look back to the earlier stages of the struggle for life between communities, and to observe some of the circumstances which must have tended to make some communities prevail over others.

The illustrations just cited show well enough the tendency of the higher type of civilization to prevail, in the long run, over the lower type. They are illustrations of the military advantages of civilization. And Mr. Bagehot has incidentally shown how thoroughly this fact disposes of the old-fashioned doctrine that modern savages are the degraded descendants of civilized ancestors. It was formerly assumed that, instead of mankind having arisen out of primeval savagery, modern savages have fallen from a primeval state of civilization, having lost the arts, the morality, and the intelligence which they once possessed; and of late years some such thesis as this has been overtly maintained by the Duke of Argyll. Such a falling off, upon any extensive scale, is in every way incompatible with the principle of natural selection. Take, for example, the ability to anticipate future contingencies,—to abstain to-day that we may enjoy to-morrow. In the next chapter it will be shown that this is the most prominent symptom of the deepest of all the intellectual differences between civilization and savagery. Now, obviously, the ability to postpone present to future enjoyment is, in a mere economic or military aspect, such an important acquisition to any race or group of men, that when once acquired it could never be lost. The race possessing this capacity could by no possibility yield ground to the races lacking it, unless overwhelmed by sheer weight of vastly superior numbers,—a case which the hypothesis of a universal primitive civilization does not leave room for. Or take the ready belief in omens by which the life of the savage is so terribly hampered. Could a single tribe in old Australia have surmounted the necessity of searching for omens before undertaking any serious business, it would inevitably, says Mr. Bagehot, have subjugated all the other tribes on the continent. In like manner it is obvious that such implements as the bow and arrow and the iron swords or hatchets could never have given place to the boomerang and the knives and hatchets of stone or bronze; and the intellectual capacity implied in monotheism and the discovery of elementary geometry could never have been conquered out of existence by the intellectual capacity implied in fetishism and the inability to count above three or four. So, because the men who possess the attributes of civilization must necessarily prevail, in the long run, over the men who lack these attributes, it follows that there cannot have been, in prehistoric times, a general loss of the attributes, external and internal, of civilization.

Now one of the attributes which will most surely give to any group of men an advantage in the competition with neighbouring groups, is the presence of a powerful bond of union between its members. Our entire survey of social evolution shows that one of the most distinctive characteristics of civilized men is their capacity for acting in concert with one another over wider and wider areas. The next chapter will enable us more fully to understand that the acquirement of this capacity is simply a further prolonging of the extension of correspondences in time and space which has been shown to be a leading characteristic of psychical progress throughout the organic world. The growth of this capacity, during historic times, has been a complex result of the increase of progressive communities, in size, in heterogeneity, and in reciprocity of intercourse. For this many-sided development has not only entailed a relative weakening of the more anti-social impulses and a complicated interlacing of the interests of communities and individuals, but it has also entailed a general widening and diversifying of intellectual experiences, enabling men to realize the desirableness of those remoter ends which are indirectly secured by concerted action over wide areas. Thus in a high state of civilization a large amount of concerted action is ensured by the operation of the ordinary incentives to individual activity, without the aid of extraordinary incentives especially embodied in governmental edicts, political, sacerdotal, or ceremonial. But in a primitive state of society it is quite otherwise. It is notorious that uncivilized men cannot be made to act in concert save under the stimulus of loyalty to a chief, or of reverence for some superstition, or of slavish obedience to time-honoured custom. Hence in early times those communities are most likely to prevail, in which loyalty, reverence, and obedience are most strongly developed. From a military point of view there are hardly any other advantages which can outweigh these. Rigidity in family-relationships is one instance in which these advantages are manifested. A community in which the *patria potestas* is thoroughly established must inevitably subjugate those rival communities in which kinship is reckoned through females only. The common-sense of the old historians perceived and insisted upon the fact that much of the marvellous success of the Roman commonwealth was traceable to strictness of family-discipline. In like manner, as Mr. Bagehot has suggested, we may discern the true social function performed by those dreadful religions of early times which so naturally awakened loathing and horror in such thinkers as Lucretius: they enforced, with tremendous sanctions, such lines of conduct as were prescribed by the necessities of the primitive community; they rendered it easier to ensure concerted action among men by compelling all to act in conformity to some unchangeable rule.

In short, among numerous tribal groups of primitive men, those will prevail in the struggle for existence in which the lawless tendencies of individuals are most thoroughly subordinated by the yoke of tyrannical custom,—the only yoke which uncivilized men can be made to wear. Such communities will grow at the expense of tribes that are less law-abiding. It matters comparatively little, as Mr. Bagehot says, whether the tyrant custom be intrinsically good or bad: the great thing, at first, is to subject men's individualities to a system of common habits. Mr. Mill has complained, in his work on "Liberty" and elsewhere, that one of the characteristics of modern civilization is the disappearance of strongly-marked individualities, such as we find in mediæval and in ancient civilization. But surely he is quite mistaken in this,—and his mistake arises partly from neglect of the circumstance that in ancient and in feudal times the full manifestation of one powerful individuality was achieved only through the utter sinking of many weaker individualities, and partly from the fallacy of taking the unparalleled community of Athens as a type of ancient communities in general. Surely in no previous age has there been anything like so wide a scope for the manifestation of strongly-marked individuality of thought or character as in the present age. It would, indeed, be hardly too much to say that this is the first age in human history which has given us a realizing foretaste of the time when freedom of thought and freedom of action shall not only be acknowledged as a right but insisted upon as a duty for all men. But this is due to the fact that men's natures have, through long ages of social discipline, become in some degree adapted to the social state. This relatively free recognition of idiosyncrasies in thought or demeanour shows that modern society can count upon an organic or instinctive conformity to law on the part of individuals, upon which ancient society could not count. In early times, freedom from the yoke of custom meant simple lawlessness; and against such disintegrating lawlessness all the most formidable sanctions which society could devise were brought to bear. Hence the feeling of corporate responsibility is universal among primitive societies. "Not only the mutilators of the Hermai, but all the Athenians—not only the violator of the rites of the *Bona Dea*, but all the Romans—are liable to the curse engendered; and so all through ancient history." In such a stage of mental development, the community as a whole is beset with perpetual anxiety concerning the words and deeds of its members; and it is to a great extent from this sense of corporate responsibility that persecution for heresy in opinion or eccentricity in behaviour is ultimately derived.

The inference from all these considerations is obvious. Tribes with the strongest sense of corporate responsibility, with the most rigid family-relationships, the most despotic yoke of custom, go on growing through long ages at the expense of rival tribes in which the means for securing concerted action over wide areas are less perfect. Age after age some competing tribes are exterminated or enslaved, while others are absorbed by the victorious tribe and assimilated to it; and thus age after age the bond of tyrannical custom becomes stronger and more rigid, while it extends over wider areas and constrains a larger number of people to uniformity of behaviour. Such a process will naturally result in the formation of a huge social "aggregate of the first order," as in Egypt, Assyria, China, Mexico, and Peru. The common characteristic of these civilizations of lower type is that their growth in size has been out of all proportion to their increase in structural heterogeneity. Though they may contain many cities, they contain nothing like the civic type of social organization, as seen in Greece and Italy; and though they have taken on the semblance of nations, yet they lack the fundamental conception of true Nationality,—the union of individuals through community of interests, rather than through physical community of descent.[1] In all these half-civilized societies, we find that the primitive tribal or patriarchal mode of structure is simply expanded without being essentially altered. The family is still the unit of society, the sense of corporate responsibility is still powerful, individual careers are still determined by status and not by contract, originality in opinion or in demeanour is still prohibited by the most formidable legal or social penalties; the tyranny of custom, in short, is still paramount, and—to crown all—the three kinds of governmental agency, political, ecclesiastical, and ceremonial, are still concentrated in the person of the patriarchal ruler, who is at once king, chief-priest or vice-deity, and master of ceremonies.

Observe, now, the dilemma which seems to confront us. In the operation of natural selection upon primitive tribes, we seem to have found a satisfactory explanation of the growth of such social "aggregates of the first order" as China or old Mexico. But now, how are we going to get past this stage? How shall we account for the formation of social aggregates of a higher type? The problem now

[1] In antiquity the only conceivable bond of social union was community of descent, actual or fictitious. Even the conception of territorial proximity as a source of common action did not gain currency in Europe till towards the tenth century of the Christian era. Theodoric the East-Goth, whom the old historians called "King of Italy," would not have understood the meaning of the phrase. In those days a man could be king of a group of kindred people, without reference to locality, but such a thing as kingship of a geographical area was unintelligible. The modern nationality (of which the United States is perhaps the most perfect type) is founded upon the thorough subordination of the patriarchal theory of community in blood to the modern theory of community in interests. The so-called "doctrine of nationalities," about which so much sentimental nonsense has been written, ought rather to be called the "doctrine of races," since it is virtually a revival of the patriarchal theory. It may be truly said that, in spite of greater ethnic diversity, Switzerland, for example, is in many respects more completely a nationality than Spain.

before us is how to relax the tyranny of custom, and thus afford a chance for social reorganization, without entailing a retrogression toward primeval lawlessness. It is one of the puzzles of sociology that the very state of things which is pre-eminently useful in bringing men out of savagery is also likely to be pre-eminently in the way of their attaining to a persistently progressive civilization. "No one," says Mr. Bagehot, "will ever comprehend the arrested civilizations unless he sees the strict dilemma of early society. Either men had no law at all, and lived in confused tribes, hardly hanging together, or they had to obtain a fixed law by processes of incredible difficulty. Those who surmounted that difficulty soon destroyed all those that lay in their way who did not. And then they themselves were caught in their own yoke. The customary discipline, which could only be imposed on any early men by terrible sanctions, continued with those sanctions, and killed out of the whole society the propensities to variation which are the principle of progress."[1]

Mr. Bagehot shows that this problem has never been successfully solved except where a race, rendered organically law-abiding through some discipline of the foregoing kind, has been thrown into emulative conflict with other races similarly disciplined,—a condition which has been completely fulfilled only in the case of the migrating Aryans who settled Europe. But before we can extricate ourselves from our seeming dilemma, we need to point out, more distinctly than Mr. Bagehot has done, that in all probability none of the progressive Aryan races has ever passed through anything corresponding to the Chinese or Egyptian stage, and that when a community has once got into such a state of fixity, it is really questionable whether it can ever get out of it, unless under the direct tuition of other communities. It would at present be premature to speculate upon the results which

[1] *Physics and Politics*, p. 57.

are likely to flow from British dominion in Hindustan, or from the intrusion of European ideas into Japan and China. Looking to the past only, it is safe to say that when the "cake of custom" has become so firmly cemented, and on such a great scale, as in these primitively-organized communities, there is but little likelihood of its getting broken. The Oriental stage—if one may so call it—is not a stage through which progressive nations pass, but it is a stage in which further progress is impossible, save through the occurrence of some deep-reaching social revolution. The progressive races are just those which have in some way avoided this dilemma,—which have succeeded in securing concerted action among individuals without going so far as to kill out the tendency to individual variations. Historically we find no traces of primitive political despotism among the European Aryans. Alike among Greeks, Italians, Teutons, and Slaves, we find the elements of a free constitution at hand, and the "age of discussion" inaugurated, at the very beginnings of recorded history. Though society is still constructed on the patriarchal type, there is nevertheless an amount of relative mobility among the social units such as is not witnessed either in Oriental despotisms or among modern savages.

I believe, therefore, that the character of the dilemma is somewhat inadequately represented by Mr. Bagehot. It is not quite true that in a progressive society the "cake of custom" must first be cemented as firmly as possible, and then afterwards broken. For when the cementing passes beyond a certain point, the breaking becomes impracticable. The dilemma consists rather in the fact that in a progressive society the cementing and the breaking of the "cake of custom" must go on simultaneously. Observe the seeming contradiction.

While it is perfectly true that the power of concerted action on a large scale gives to the community possessing it a decided military advantage, and while it is true that in early times this power of cooperation can hardly be gained save through the uniformity of discipline prescribed by tyrannical custom, it is also true that a considerable amount of individual variability is, even in early times, a source of military strength to the community. For in all stages of progress the law holds good that, in order to ensure a permanent supply of first-rate individual excellence, whether in intellect or in character, there must be perpetual variation,—the members of the community must not all conform to precisely the same standard of belief or action. It is not simply that out of the conflict of opinions there comes an increase of mental power, but it is that where absolute uniformity of opinion is enforced, the very individuals most capable of serving the community by reason of superior mental power are neglected, thwarted, or killed off. The truth is not yet wholly trite that the most valuable men of every age are its heretics. For this truth is obscured by the kindred truth that the heresy of one age is the orthodoxy of the next,—so that complacent orthodoxy, ignoring the historical point of view, is wont to claim as its allies to-day the very men whom it burnt or crucified in days gone by. Obviously it is in the nature of things that this should be so. If old-established ideas were never to be unsettled, new truths would cease to find recognition, and progress would be at an end. But in any age the discoverers and promulgators of new truths are to be found only among those who possess the superior mental flexibility requisite for shaking themselves loose from the network of old-established ideas. And wherever there is such mental flexibility, there is sure to be heresy. Above all is this true in early communities, for in these later times we have become so far accustomed to variations in belief and practice, and have so far substituted individual for corporate responsibility, that there is a great deal of variation which we do not count as heresy, but which formerly would have been regarded as such. Hence in an early community, the enforcement of absolute uniformity of belief and practice must establish a kind of natural selection tending to weed out all superior flexibility of mind. As a direct result the community closes up a prolific source of military superiority in the shape of individual political and military genius; for men of the Themistokles type are not produced, as a rule, in such states of society. The indirect result will be more fully appreciated when the next chapter has shown us how closely mental flexibility is implicated with that power of representing objects and relations remote from sense which also underlies the invaluable power of anticipating future emergencies. To weed out superior flexibility of mind is to check further development in forethought or longheadedness, —a truth of which the entire history of the Oriental communities, so unlike each other in many respects, is one long and reiterated confirmation. Still further, when we recall the patent fact that the efficiency of any community is measured by the efficiency of its individual members, and that this efficiency is kept up by a kind of natural selection which is none the less potent for not working with the death-penalty as among lower animals, we shall realize how great is the military advantage entailed by free variation and competition. In illustration of all this we may recur to a historical event already cited for other purposes. When the Mede, whose laws were quoted as the very type of unchangeableness, sought to add to his overgrown dominions the modest patrimony of the Athenian, of whom it was said that he was ever curious after new and unheard-of things, the wager of battle resulted in no doubtful verdict. When it is asked how Miltiades, with his ten thousand, could so quickly put to flight Datis, with his hundred thousand, the unhesitating reply is that the result was due to the superior social organization under which the ten thousand were reared. But this superiority of organization consisted mainly in the fact that the individual career of the Mede was prescribed by unvarying tradition, while the maxim upon which the Athenian implicitly acted was *La carrière ouverte aux talents.*

These are some of the military advantages of Mr. Bagehot's "age of discussion." But in truth they are advantages which do not belong exclusively to any age or to any epoch of development, but are operative at all times, though in different ages and communities their action is diversely complicated with the action of the opposite advantages previously considered. Mr. Bagehot's error—if it be real and not merely apparent—lies in describing as purely successive circumstances which must have been in great degree simultaneous. The "strict dilemma of early society" is not that the fetters of tyrannical custom must first be riveted and afterwards unriveted, but that they must be riveted and unriveted at the same time in communities which are destined to attain to permanent progressiveness. On the one hand we have seen that primitive societies in which uniformity of belief and practice is most sternly enforced, will prevail in the struggle for life. On the other hand we have seen that primitive societies in which flexibility of mind is most encouraged, will come out uppermost. And herein lies the seeming dilemma or contradiction.

In reality, however, as the whole question is one of warfare, so it is practically a struggle for life between these two principles. Into the numberless combinations of circumstances which have given the victory now to one side and now to the other, we cannot inquire, from lack of historical data. On general grounds we may admit that, at the outset, uniformity must have been a more important possession than flexibility; we can plainly see how those communities that conquered by means of uniformity became caught, as it were, in their own toils, and were estopped from further progression; and we can see how those communities that won the day by preserving a modicum of flexibility have been rewarded by unlimited progressiveness. We can thus dimly discern the way in which China has become immobile, while Europe has become ever more and more mobile. But beyond these most general indications of what has happened, we can discern but little. We cannot tell precisely, for example, why the European Aryans won the day by preserving a modicum of flexibility, rather than by enforcing such a monotony of disposition as would kill out all flexibility. At the earliest dawn of history the European portion of the Aryan race already surpasses all other races, both in individual variety of character and in longheadedness. The details of the process by which this superiority was gained are hidden from us in the night of time. Upon one point, however, we may profitably speculate. Among all the historic civilizations, the European is the one of which we can most decidedly assert that it is not autochthonous. The Aryans who conquered Europe in successive Keltic, Italo-Hellenic, Teutonic, and Slavonic swarms, were not the quiet, conservative, stay-at-home people of prehistoric antiquity, but were rather the elect of all the most adventurous and flexible-minded portions of the tribally-organized population of Central Asia. Their invasion of Europe was in this respect like the subsequent invasion of England by the miscellaneous hordes roughly described as Angles and Saxons, Danes and Normans, and like the still later colonization of North America by the most mobile and adventurous elements of West-European society. We may fairly suppose that the Aryan invaders of Europe were the most supple-minded of their race,—the "come-outers," perhaps, for whom the cake of custom at home was getting too firmly cemented, but who had undergone sufficient social discipline to enable them to get along with a less solid cake in future. However this may be, the main point is that they were not aborigines but colonizers, and as such were subjected to a great heterogeneity of environing circumstances from the time when we first catch sight of them. They were the pioneers or Yankees of prehistoric antiquity, in whom unusual flexibleness of mind was the natural result of continual change in the sets of relations to which they were obliged to make their theories and actions conform. Prehistoric antiquity presents no other case like this. The great immobile civilizations appear to have grown up in comparatively well-protected regions, where competition with outlying communities was checked at an early date. Screened in this way from intercourse with the outside world, and adapting themselves to an environment which altered but little, there was nothing which could serve to shake them loose from their monotony of discipline. A more extreme instance of a kindred phenomenon is seen in the fact that in those protected corners of the world where competition has always been at a minimum, we find the smallest conceivable amount of progress from utter bestial savagery. That same isolation which has kept the flora and fauna of Australia in such a backward state that they are now melting away before the imported plants and animals of Europe as snow melts under a vernal sun,—that same isolation has retained the Australian man until this day at the lowest level of humanity. Similar things might be said of the Fuegians, the Andaman Islanders, and some of the hill-tribes of aboriginal non-Aryan Hindus. Where there has been least competition and least natural selection, there has been least progress from savagery. Now returning to the immobile civilizations, when we bear in mind that of the two conflicting elements of military advantage, uniformity was likely to be of most importance at first and flexibility afterwards, we may begin to discern, I think, that where competition ceased at an early date, uniformity may well have carried the day and crushed out flexibility altogether. Herein we have an excellent explanation of the immobility of Egypt, China, Peru, and Mexico; and with some further qualifications an analogous case might be made out for Assyria and Northern India. But no such early cessation of competition could have occurred in the case of our Aryan forefathers. Little as we know concerning the circumstances of their prehistoric development, we know at least that it took place on the great highway between the teeming mainland of Asia and the coveted peninsula of Europe. In this swarming region there was kept up until quite recent times that intense competition of tribe with tribe which had all but died out in Egypt and China before the dawn of history. All this entailed for each winning tribe a greater heterogeneity of environment than in any other instance. Under such circumstances uniformity could hardly have carried the day so far as to crush out flexibility. Continual change of foes to be overcome, and of natural obstacles to be surmounted, must have given the advantage at last to those tribes which had gained enough uniformity to ensure concerted action, without sacrificing their versatility of mind in the process.

To some such considerations as these we must look for the partial explanation of the fact that at the beginnings of recorded history we find in the European Aryans all the essential elements of progressiveness. The continuance of this progressiveness during the historic period is a fact which need not long detain us. Since the beginnings of Mediterranean civilization, the heterogeneity of the environment has been too great, and the changes in the environment too rapid, to allow of general stagnation; while the assaults of outer barbarism have been for the most part warded off by the military superiority which this higher civilization has entailed. At times there has been an appearance of danger that much of this hard-won advantage might be lost, not merely through assaults from without, but through causes internally operating. After the earlier incentives to noble and varied activity connected with the autonomous spirit had been destroyed by the universal hegemony of Rome, the need for protection from the threatening barbarian began to bring about a retrogression, in which for a time uniformity seemed likely to flourish at the expense of individuality. It is instructive, from this point of view, to observe the gradual change toward an Oriental type of government which went on from the time of Augustus to that of Diocletian. In the eastern half of the Empire, after its final political severance from the western half at the end of the eighth century, this change became really consummated, and after a while defeated itself by culminating in a social stagnation and military feebleness which invited the sharp scimitar of the Mussulman. But in the West this fatal growth of patriarchal despotism was early checked by the rise of Christianity as an independent spiritual power, by the immigration of the German tribes, and by the union of these two circumstances. Europe was in no immediate danger of lapsing into an Oriental condition when an Ambrose could say to a Theodosius, "Thus far shalt thou go and no farther." The German tribes, by their direct coalescence into national aggregates, without passing through the civic stage of organization, furnished, in various degrees of completeness, the principles of representation and federation, thus adding important elements of new life to the Empire. While finally the Christianization of these tribes, leading to the famous compact by which the Head of the Church transferred the lordship of the western world from the degenerate Byzantine to the strong-armed Frank, inaugurated a balance of powers which preserved Europe henceforth from any danger of becoming either a sultanate or a caliphate. In this twofold supremacy of Church and Empire during the Middle Ages, we have one of the most remarkable compromises between antagonist forces known to history; for while the tendency of either set of forces acting alone would have been toward absolute despotism, either in the spiritual or in the temporal form, on the other hand their joint action and counter-action was in a high degree conducive to the development of individual liberty of thought and behaviour.

The various hints here given thus combine to show how, both in historic and in prehistoric times, the European Aryans would seem to have profited by circumstances tending to encourage individuality without weakening concentration. Hence the peculiarly plastic consistency—the flexibility combined with toughness—of West-Aryan civilization. Hence the European races all possess the capacity of innovating without revolution. The English and the old Romans have exhibited this capacity in the highest degree; the Spaniards and the French, in recent times, owing to previous reversion toward a despotic *régime*, have shown themselves partially deprived of it. But while it is thus manifested in quite various degrees, all alike possess it in a high degree as compared with those races which have been arrested in the Oriental stage of civilization.

The successful achievement of innovation without revolution depends mainly upon an artifice which derives its validity from one of the most deep-seated tendencies of the human mind, and which has unquestionably been one of the chief agencies in forwarding social progress. I refer to the artifice of "legal fiction," as shown in the pretence that the novelty of belief or practice just inaugurated has its warrant in time-honoured precedent. The disposition to justify all innovation by means of this artifice is so strongly rooted in human nature that it is likely to be manifested for a long time to come,—probably until the millennial victory of that "pure reason" about which sentimental philosophers have prated, but which hitherto has played a very subordinate part in shaping human affairs. It is this disposition which leads the orthodox, after resisting some scientific heresy until resistance is no longer possible, to discover all at once that the heresy was really taught by Suarez, or St. Augustine, or Moses. It is this which enables changes to be made "constitutionally," or in accordance with a system of edicts framed in an age when the changes in question could not possibly have been contemplated or provided for. Yet among ourselves, where the dread of novelty is comparatively slight, there is some difficulty in realizing how all-essential is this kind of artifice in early times. "To this day many semi-civilized races have great difficulty in regarding any arrangement as binding and conclusive unless they can also manage to look at it as an inherited usage. Sir Henry Maine, in his last work, gives a most curious case. The English Government in India has in many cases made new and great works of irrigation, of which no ancient Indian Government ever thought; and it has generally left it to the native village community to say what share each man of the village should have in the water; and the village authorities have accordingly laid down a series of most minute rules about it. But the peculiarity is, that in no case do these rules 'purport to emanate from the personal authority of their author or authors, which rests on grounds of reason, not on grounds of innocence and sanctity; nor do they assume to be dictated by a sense of equity; there is always, I am assured, a sort of fiction under which some customs as to the distribution of water are supposed to have emanated from a remote antiquity, although, in fact, no such artificial supply had ever been so much as thought of.' So difficult does this ancient race—like, probably, in this respect so much of the ancient world—find it to imagine a rule which is obligatory, but not traditional."[1]

Now among the European Aryans, within historic times, this species of artifice assumed a form which made it in a very high degree conducive to the permanent progressiveness of the race. If we look into the great writers who in the seventeenth century illustrated with exquisite beauty and clearness the doctrines of Public Law, we find their heads filled with the notion of a primitive natural code, fit for

[1] Bagehot, *Physics and Politics*, p. 142.

regulating international concerns, and for supplying everywhere the shortcomings of civil legislation, its degenerate offspring, whose worth must be rated according to the degree in which it approaches the perfection of its parent. The influence of this conception may be best appreciated by reflecting on the extent to which contemporary legal literature, whether embodied in expository treatises or in judicial decisions, is impregnated by it. The appeals to "right reason" and "natural reason" which since Blackstone's time have filled a considerable place in juristic dissertation, bear unequivocal marks of their origin. Nowhere better than here can we see exemplified the mighty influence of the ideas of Roman jurisprudence upon modern thought. Sir Henry Maine has well delineated the process by which, from the constantly felt want of a system of principles fit for settling disputes between Roman citizens and aliens or foreigners, there gradually arose in the Prætorian courts an equitable body of law founded upon customs common (or assumed as common) to all peoples alike. But far from comprehending the really progressive character of the noble juristic system steadily growing up under their own supervision—daily attaining grander proportions as the grotesque and barbarous elements hallowed by local usage were one by one eliminated from the body of equitable ideas which formed their common substratum—the Prætors of the Republic and the great Antonine jurisconsults, under the immediate influence of Stoic conceptions, supposed themselves to be merely restoring to their original integrity the disfigured and partially obliterated ordinances of a primeval state of nature. The state of faultless morality and unimpeachable equity which constituted the ideal goal of their labours, they mistook for the shadow of a real though unseen past.

But this form of the unconscious artifice—due in general to the great heterogeneity of the Roman environment, and in particular to the continual interaction between Greek and

Roman ideas—was very different from the form of it exemplified by the Hindu who refers his modern edicts about water-supply to some remote era of primitive legislation. Between the two there is a world-wide difference,—all the difference between stagnation and progress. For the abstract and impersonal form in which the Roman conceived his *Jus Naturæ* made it possible for him to appeal to it, not simply in justification of particular departures from ancient custom, but in justification of the general principle of departure from ancient custom. It constituted, as it were, a court of appeal before which time-honoured customs must be called upon to establish their validity. It opened men's minds to the distinction between *mala prohibita* and *mala in se.* It prepared the way for the recognition of a "higher law" of God as distinct from the local and temporary laws of man. And in this way it no doubt contributed largely toward the establishment of Christianity as an independent spiritual power in the Empire.

To deal adequately with these interesting illustrations would require us to extend this part of our discussion to disproportionate length. Our purpose is sufficiently subserved by the foregoing fragmentary statement, in which the problem of human progressiveness, though not fully solved, is at least so far classified that the solution of it is facilitated. We have seen that permanent progressiveness is found where the social aggregate is characterized by a cohesion among its parts which is neither too little nor too great. An excess and a deficiency of individual mobility have been shown to be alike incompatible with that persistent tendency toward internal rearrangement which we call progressiveness. The sociological puzzle to which Mr. Bagehot has called attention, and with which we have been concerned in the present chapter, is substantially the same thing as the dynamic paradox which confronted us when, in the fourth chapter, we were seeking to determine the conditions which enable Evolution in general to result in continuous increase of structural and functional complexity. The present case is, indeed, but a special form of the more general case. How to secure a compromise between fluidity and rigidity is in both cases the essential desideratum. Where the units which make up the aggregate have too much individual freedom of motion, the result is a fluid state in which there is no chance for stable structural arrangements. Where they have too little freedom of motion, the result is a solid state in which there is no chance for structural rearrangements. In the first case, where there is so little dissipation of motion, there is little or no Evolution. In the second case, where so little internal motion is retained, the Evolution which occurs is simply or chiefly a process of consolidation, unattended by any considerable advance from indeterminate uniformity toward determinate multiformity.

Bearing in mind that we are dealing, not with a mere series of striking analogies, but with a group of real resemblances which result from a fundamental homology between the special process here considered and the more general process which includes it, let us observe that one chief circumstance which secures mobility without loss of coherence is a heterogeneous and ever-changing social environment, to the heterogeneous changes of which the community is continually required to adjust itself. The illustrations above given unite in showing that where circumstances have afforded such a heterogeneous environment (as a perpetual external excitant of internal rearrangements), the communities which have survived through relatively-complete adjustment have manifested a permanent capacity for progress. Thus is our problem completely connected with the more general problem of natural selection, and with the most general problem of Evolution as manifested in all orders of phenomena. And thus the essential continuity of the processes of Nature is again strikingly illustrated.

In the following chapter we shall have frequent occasion to refer to this circumstance of heterogeneity of the social environment as manifested psychologically, in its effects upon the intellectual mobility of men regarded as individuals. To pursue the problem of progressiveness into this psychological region is the way in which to obtain a basis for the explanation of the progress from Brute to Man; and to this crowning inquiry we must now address ourselves.

## CHAPTER XXI.

### GENESIS OF MAN, INTELLECTUALLY.

THE chief difficulty which most persons find in accepting the Doctrine of Evolution as applied to the origin of the human race, is the difficulty of realizing in imagination the kinship between the higher and the lower forms of intelligence and emotion. And this difficulty is enhanced by a tendency of which our daily associations make it hard to rid ourselves. There is a tendency to exaggerate the contrasts which really exist, by leaving out of mind the intermediate phenomena and considering only the extremes. Many critics, both among those who are hostile to the development theory and among those who regard it with favour, habitually argue as if the intelligence and morality of the human race might be fairly represented by the intelligence and morality of a minority of highly organized and highly educated people in the most civilized communities. When speaking of mankind they are speaking of that which is represented to their imagination by the small number of upright, cultivated, and well-bred people with whom they are directly acquainted, and also to some extent by a few of those quite exceptional men and women who have left names recorded in history. Though other elements are admitted into the conception, these are nevertheless the ones which chiefly give to it its character. Employing then this conception of mankind, abstracted from these inadequate instances, our critics ask us how it is possible to imagine that a race possessed of such a godlike intellect, such a keen æsthetic sense, and such a lofty soul, should ever have descended from a race of mere brutes. And again they ask us how can a race endowed with such a capacity for progress be genetically akin to those lower races of which even the highest show no advance from one generation to another. Confronted thus by difficulties which reason and imagination seem alike incompetent to overcome, they too often either give up the problem as insoluble, or else—which amounts to nearly the same thing—have recourse to the *deus ex machinâ* as an aid in solving it.

Influenced, no doubt, by some such mental habit as this Mr. St. George Mivart declares that, while thoroughly agreeing with Mr. Darwin as to man's zoological position, he nevertheless regards the difference between ape and mushroom as less important than the difference between ape and man, so soon as we take into the account "the totality of man's being."[1] In this emphatic statement there is a certain amount of truth, though Mr. Mivart is not justified in implying that it is a truth which the Darwinian is bound not to recognize. The enormous difference between civilized man and the highest of brute animals is by no one more emphatically recognized than by the evolutionist, who holds that to the process of organic development there has been superadded a stupendous process of social development, and who must therefore admit that with the beginning of human civilization there was opened a new chapter in the history of the universe, so far as we know it. From the human point of view we may contentedly grant that, for all practical purposes, the difference between an ape and a mushroom is of less consequence than the difference between an ape and an educated European of the nineteenth century. But to take this educated European as a typical sample of mankind

[1] *Nature*, April 20, 1871.

and to contrast him directly with chimpanzees and gibbons, is in the highest degree fallacious; since the proceeding involves the omission of a host of facts which, when taken into the account, must essentially modify the aspect of the whole case.

When we take the refined and intellectual Teuton, with his one hundred and fourteen cubic inches of brain, and set him alongside of the chimpanzee with his thirty-five cubic inches of brain, the difference seems so enormous as to be incompatible with any original kinship. But when we interpose the Australian, whose brain, measuring seventy cubic inches, comes considerably nearer to that of the chimpanzee than to that of the Teuton, the case is entirely altered, and we are no longer inclined to admit sweeping statements about the immeasurable superiority of man, which we may still admit, provided they are restricted to civilized man. If we examine the anatomical composition of these brains, the discovery that in structural complexity the Teutonic cerebrum surpasses the Australian even more than the latter surpasses that of the chimpanzee, serves to strengthen us in our position. And when we pass from facts of anatomy to facts of psychology, we obtain still further confirmation; for we find that the difference in structure is fully paralleled by the difference in functional manifestation. If the Englishman shows such wonderful command of relations of space, time, and number, as to be able to tell us that to an observer stationed at Greenwich on the 7th of June, A.D. 2004, at precisely nine minutes and fifty-six seconds after five o'clock in the morning, Venus will begin to cross the sun's disc; on the other hand, the Australian is able to count only up to five or six, and cannot tell us the number of fingers on his two hands, since so large a number as ten excites in him only an indefinite impression of plurality.[1] Our conception of

[1] The Dammaras, according to Mr. Galton, are even worse off than this. "When they wish to express four, they take to their fingers, which are to

the godlike intellect evidently will not apply here. If the emotions of the German and his intellectual perceptions of the fitness of harmonious sounds for expressing emotion are so deep and subtle and varied as to result in the production of choruses like those of Handel and symphonies like those of Beethoven, on the other hand the crude emotions of the Australian are quite adequately expressed by the discordant yells and howls which constitute the sole kind of music appreciable by his undeveloped ears. We look in vain here for traces of the keen æsthetic sense which in a measure links together our intellectual and moral natures. Again, if the American student has been known to be actuated by such noble ethical impulses and guided by such lofty conceptions of morality as to leave his comfortable home and his

them as formidable instruments of calculation as a sliding rule is to an English school-boy. They puzzle very much after five, because no spare hand remains to grasp and secure the fingers that are required for units. Yet they seldom lose oxen; the way in which they discover the loss of one is not by the number of the herd being diminished, but by the absence of a face they know. When bartering is going on, each sheep must be paid for separately. Thus, suppose two sticks of tobacco to be the rate of exchange for one sheep, it would sorely puzzle a Dammara to take two sheep and give him four sticks. I have done so, and seen a man put two of the sticks apart, and take a sight over them at one of the sheep he was about to sell. Having satisfied himself that that one was honestly paid for, and finding to his surprise that exactly two sticks remained in hand to settle the account for the other sheep, he would be afflicted with doubts; the transaction seemed to come out too 'pat' to be correct, and he would refer back to the first couple of sticks; and then his mind got hazy and confused, and wandered from one sheep to the other, and he broke off the transaction until two sticks were put into his hand, and one sheep driven away, and then the other two sticks given him, and the second sheep driven away. . . . Once while I watched a Dammara floundering hopelessly in a calculation on one side of me, I observed Dinah, my spaniel, equally embarrassed on the other. She was overlooking half-a-dozen of her new-born puppies, which had been removed two or three times from her, and her anxiety was excessive, as she tried to find out if they were all present, or if any were still missing. She kept puzzling and running her eyes over them, backwards and forwards, but could not satisfy herself. She evidently had a vague notion of counting, but the figure was too large for her brain. Taking the two as they stood, dog and Dammara, the comparison reflected no great honour on the man."—Galton, *Tropical South Africa*, p. 132, cited in Lubbock, *Origin of Civilization*, Amer. ed., p. 294. See also Tylor, *Primitive Culture*, vol. i. pp. 218—246. Probably the dual number, in grammar, "preserves the memorial of that stage of thought when all beyond two was an idea of indefinite number." Id. p. 240.

favourite pursuits, and engage in rough warfare, at the risk of life and limb, solely or chiefly that he might assist in relieving the miseries of far inferior men, whose direct claim upon his personal sympathies could never be other than slight, on the other hand the Australian has no words in his language to express the ideas of justice and benevolence, and no amount of teaching can make him comprehend these ideas. For although, like some brute animals, he is not wholly destitute of the primary feelings which underlie them, yet these feelings have been so seldom repeated in his own experience, and that of his ancestors, that he is unable to generalize from them. The lofty soul, which is too sweepingly attributed to man in distinction from other animals, is here as difficult to discover as the godlike intellect or the keen æsthetic sense.

In similar wise is made to disappear the sharp contrast between human and brute animals in capability of progress. Hardly any fact is more imposing to the imagination than the fact that each generation of civilized men is perceptibly more enlightened than the preceding one, while each generation of brutes exactly resembles those which have come before it. But the contrast is obtained only by comparing the civilized European of to-day directly with the brute animals known to us through the short period of recorded human history. The capability of progress, however, is by no means shared alike by all races of men. Of the numerous races historically known to us, it has been manifested in a marked degree only by two,—the Aryan and Semitic. To a much less conspicuous extent it has been exhibited by the Chinese and Japanese, the Copts of Egypt, and a few of the highest American races. On the other hand, the small-brained races—the Australians and Papuans, the Hottentots, and the majority of tribes constituting the widespread Malay and American families—appear almost wholly incapable of progress, even under the guidance of higher races. The most that can be said for them is, that they are somewhat more imitative and somewhat more teachable than any brute animals. In the presence of the Aryan, even under the most favourable circumstances, they tend to become extinguished, rather than to appropriate the results of a civilization which there is no reason to suppose they could ever have originated. The two great races of Middle Africa, the Negroes and the Kaffirs,[1] have shown, by their ability to endure slave labour, their superiority to those above mentioned; but their career, where it has not been interfered with by white men, has been but little less monotonous than the career of a brute species. Of all these barbarian races, we commonly say that they have no history; and by this we mean that throughout long ages they have made no appreciable progress. In a similar sense we should say of a race of monkeys or elephants, that it has no history.

Of like import is the fact, that as we go backward in time we find the progressiveness of the civilized races continually diminishing. No previous century ever saw anything approaching to the increase in social complexity which has been wrought in America and Europe since 1789. In science and in the industrial arts the change has been greater than in the ten preceding centuries taken together. Contrast the seventeen centuries which it took to remodel the astronomy of Hipparchos with the forty years which it has taken to remodel the chemistry of Berzelius and the biology of Cuvier. Note how the law of gravitation was nearly a century in getting generally accepted by foreign astronomers,[2] while

[1] It is Haeckel who asserts a distinction of race between the Negroes and Kaffirs. It is not necessary, however, to insist upon the distinction.

[2] It was still on trial in France in 1749, when Clairaut and Lalande magnificently verified it by calculating the retardation of Halley's comet. It may be said that the French are notoriously slow in adopting ideas which have originated in other countries, and that they now ignore natural selection much as they formerly ignored gravitation. Nevertheless, in spite of the Academy and M. Flourens, there are plain indications that the doctrine of special creations is doomed speedily to suffer the fate in France which it has already suffered in Germany, England, and America.

within half a dozen years from its promulgation, the theory of natural selection was accepted by the great majority of naturalists. How small the difference between the clumsy waggons of the Tudor period and the mail-coach in which our grandfathers rode, compared to the difference between the mail-coach and the railway train! How rapid the changes in philosophic thinking since the time of the *Encyclopédistes*, in comparison with the slow though important changes which occurred between the epoch of Aristotle and the epoch of Descartes! In morality, both individual and national, and in general humanity of disposition and refinement of manners, the increased rapidity of change has been no less marked.

But these considerations are immensely increased in force when we take into account those epochs which, in the light of our present knowledge, can alone properly be termed ancient. Far beyond the comparatively recent period at which human history began on the eastern shores of the Mediterranean, extend the ages during which, as palæontology shows us, both the eastern and the western hemispheres were peopled by races of men. Ten thousand centuries before the time of Homer and the Vedic poets, wild men, with brute-like crania, carried on the struggle for existence with mammoths, tigers, and gigantic bears, long since extinct. And recent researches make it probable that even this enormous period must be multiplied six- or eight-fold before we can arrive at the time when men first appeared upon the earth as creatures zoologically distinct from apes. The significance of these conclusions, even when we take into account only the shorter epoch of a single million of years, cannot be too strongly insisted upon. They show us that it is only in recent times that man has become widely distinguished from other animals by his capability of progress. If, as evidence of our present progressiveness, we cite the superiority of our Whitworth guns and Chassepot

U 2

rifles over the howitzers and flintlocks used by our grandfathers, we must also remember that more than twenty thousand generations lived and died before the primitive stone hatchets and stone-pointed arrows were superseded by battle-axes and javelins headed with bronze. During these long ages, each generation must have imitated its predecessor almost as closely as is the case with brute animals. The godlike intellect, of whose achievements we are now so justly proud, was then being acquired by almost infinitely minute increments. In the face of the proved fact of man's immense antiquity, no other conclusion is admissible.

I have introduced these considerations, not so much to confirm the theory of the descent of man from an ape-like animal,—which I regard as already sufficiently proved by the evidence presented in the ninth chapter,—as to illustrate the true point of view from which the evolution of humanity should be regarded. In treating of the Doctrine of Evolution in general, we saw it to be a corollary from the persistence of force that the process of evolution, which at first goes on with comparative slowness, must, owing to the multiplication of effects, go on with increasing rapidity.[1] We have seen, besides, that those most conspicuous aspects of evolution which consist in increase of definite complexity in structure and function must be much more conspicuous in the more compound than in the more simple kinds of evolution. In illustration of these closely allied truths, we may note that in all cases a long period of time elapses before any lower order of evolution gives rise to a distinctly higher order. Long ages must have passed before the slow integration of our solar nebula into a planetary system resulted in the appearance of distinctly geologic phenomena upon the several planets. Again, it was a long time before geologic

[1] See above, vol. i. p. 354. This was also hinted at the close of the chapter on Life as Adjustment.

evolution had proceeded sufficiently far to admit of the evolution of life: upon Saturn and Jupiter, as we have seen, the genesis of anything like what we know as life would appear still to be impossible. Again, after the first appearance of life upon our earth, a long time must have elapsed before protists, simple plants, and nerveless animals, were succeeded by animals sufficiently complex to manifest even the most rudimentary phases of psychical life. And again, as we can now see, the evolution of physical and psychical life to the very high degree exemplified in the primeval ape-like man, was followed by a somewhat long period, during which the still higher psychical changes constituting social evolution were slowly assuming their distinctive characteristics.

Social evolution, therefore, regarded as a complicated series of intellectual and emotional changes determined by the aggregation of men into communities, is a new order of evolution, more highly compounded than any that had gone before it. When, in the course of the struggle for existence, men began to unite in family groups of comparatively permanent organization, a new era was begun in the progress of things upon the earth's surface. A new set of structural and functional changes began, which for a long while proceeding with the slowness characteristic of the early stages of every order of evolution, are at last proceeding with a rapidity only to be slackened when some penultimate stage of equilibrium is approached. Hence it is in the highest degree unphilosophical to attempt to explain the present position of civilized man solely by reference to the laws of organic and psychical evolution as obtained by the study of life in general. It is for biology to explain the differences between the human hand and foot and the hands and feet of the other primates;[1] but the chief differences between civilized man and the other members of the order to which

[1] See Prof. Huxley's admirable monograph on *Man's Place in Nature.*

he belongs are psychological differences, and the immense series of psychical changes to which they are due has been all along determined by social conditions.

*The all-important contrast, therefore*—for our present purpose—*is not between man and other primates, extinct and contemporary, but between civilized man and primitive man.* Already we have found that the lowest contemporary man, whose social organization has never reached any higher form than that of the simplest tribal community, exhibits but scanty traces of the godlike intellect, the refined tastes, or the lofty soul which we are accustomed to ascribe to humanity in general as its distinctive attributes. Humanity, zoologically considered, exists to-day, to which these attributes cannot be ascribed without a considerable strain upon the accepted meanings of our words. Zoologically, the Australian belongs to the genus *Homo,* and is therefore nearer to us than to the gorilla or gibbon; psychologically, he is in many respects further removed from us than from these man-like apes. No one will deny that the intellectual progress implied in counting up to five or six, though equally important, is immeasurably inferior in quantity to the subsequent progress implied in the solution of dynamical problems by means of the integral calculus,—an achievement to which the average modern engineer is competent. But in going back to the primeval man, we must descend to a lower grade of intelligence than that which is occupied by the Australian. We must traverse the immensely long period during which the average human skull was enlarging from a capacity of thirty-five inches, like that of the highest apes, to a capacity of seventy inches, like those post-glacial European skulls, of which the one found at Neanderthal is a specimen, and which are about on a par with the skulls of Australians. And when we have reached the beginning of this period—possibly in the Miocene epoch—we may fairly represent to ourselves the individuals of the human genus as animals differing in little save a more marked sociality from the dryopithecus and other extinct half-human apes. We may represent primitive man as an animal in whom, physical and psychical changes having hitherto proceeded *pari passu*, intelligence had at length arrived at a point where variations in it would sooner be seized on by natural selection than variations in physical structure. When among primates possessed of such an intelligence, the family groups temporarily formed among all mammals began to become permanent, then we must say that there began the career of humanity as distinguished from animality. For countless ages our ancestors probably were still but slightly distinguished from other primates, save that their increasing intelligence, their use of weapons, and their habits of combination, rendered them more than a match for much larger and stronger animals. In the later Pliocene times these primitive men may have come to bear some resemblance to the lowest contemporary savages. Human remains and relics of the still later glacial period supply clear proof of such a resemblance; yet the absence of any improvement in weapons and implements for many ages longer shows that as yet there was but little capability of progress. Of the career of mankind during the eight hundred thousand years which would seem to have elapsed since the era of the cave bear and woolly rhinoceros,[1] we possess many vestiges. But every-

[1] In assigning this conjectural date, I follow the theory which connects the great glacial epoch with that notable increase in the eccentricity of the earth's orbit which, as calculated by Mr. Croll, began about 950,000 years B.C., and lasted 200,000 years. But while the fact of this great increase of eccentricity is, I presume, well established, and while it can hardly fail to have wrought marked climatic changes, it is by no means proved that the glaciation of Europe and North America was produced solely or chiefly by this circumstance; and accordingly I do not care to insist upon the chronology which I have adopted in the text. Nor is it necessary for the validity of my argument that it should be insisted on. What we do know is, that men existed both in Europe and in North America at the beginning of the glacial period; that this extensive dispersal implies the existence of the human race for a long time previous to this epoch; and that thus we obtain a dumb antiquity in comparison with which the whole duration of the voice of historic tradition shrinks to a mere point of time. And this is all that my argument requires.

thing indicates the most extreme barbarism; nowhere does there appear a trace of anything like even the rudest civilization, until we reach that comparatively recent epoch antecedent to the dawn of history, but accessible to philology. The partial restoration of the Aryan mother-tongue enables us to go back perhaps a dozen or fifteen centuries beyond the age of Homer and the Vedas, and catch a few glimpses of the prehistoric Aryans, — an agricultural race completely tribal in organization, but acquainted with the use of metals, and showing marks of an intelligence decidedly above that of high contemporary barbarians like the Kaffirs. At the same time the deciphering of hieroglyphics on Egyptian monuments reveals to us the existence in the valley of the Nile of an old and immobile civilization, organized on a tribal basis, like that of China, already sinking in political decrepitude at the ill-defined era at which we first catch sight of it. Of the beginnings of civilization on the Nile, and also, indeed, on the Euphrates, and of the stages by which the Aryans arrived at the intellectual pre-eminence to which their recovered language bears witness, we know absolutely nothing. But even if we were to allow twenty thousand years for these proceedings,—an interval nearly seven times as long as that which separates the Homeric age from our own time—we should obtain but a brief period compared with the countless ages of unmitigated barbarism which preceded it. The progress of mankind is like a geometrical progression. For a good while the repeated doubling produces quite unobtrusive results; but as we begin to reach the large numbers the increase suddenly becomes astonishing. Since the beginning of recorded history we have been moving among the large numbers, and each decade now witnesses a greater amount of psychical achievement than could have been witnessed in thousands of years among pre-glacial men. Such a result is just what the Doctrine of Evolution teaches us to anticipate; and it thoroughly confirms our statement that, in point of intelligence and capacity for progress, the real contrast is not between all mankind and other primates, but between civilized and primeval man.

Let us now consider some of the leading characteristics of this gradual but increasingly rapid intellectual progress, regarded as a growing correspondence between the human mind and its environment.

In the second chapter of our Prolegomena it was shown that the highest kinds of scientific knowledge differ only in degree from the lowest kinds of what is called ordinary knowledge. In spite of their great differences in mental capacity, it is obvious that the antelope who on hearing a roar from the neighbouring thicket infers that it is high time to run for his life, the Bushman who on seeing the torn carcass of the antelope infers that a lion has recently been present, and the astronomer who on witnessing certain unforeseen irregularities in the motions of Uranus infers that an unknown planet is attracting it, perform one and all the same kind of mental operation. In the three cases the processes are fundamentally the same, though differing in complexity according to the number and remoteness of the past and present relations which are compared. In each case the process is at bottom a grouping of objects and of relations according to their likenesses and unlikenesses. It was similarly shown that all knowledge is a classification of experiences, and that every act of knowledge is an act of classification; that an act of *inference*, such as is involved in simple cases of perception, is "the attributing to a body, in consequence of some of its properties, all those properties by virtue of which it is referred to a particular class"; that the "forming of a *generalization* is the putting together in one class all those cases which present like relations"; and that "the drawing a *deduction* is essentially the perception that a particular case belongs to a certain class of cases previously generalized. So that, as ordinary classification is a grouping together of *like things;* reasoning is a grouping together of *like relations* among things."[1] In this fundamental doctrine the two different schools of modern psychology, represented respectively by Mr. Bain and Mr. Mansel, will thoroughly agree. But from this it inevitably follows that the highest and the lowest manifestations of intelligence consist respectively of processes which differ only in heterogeneity and definiteness and in the extent to which they are compounded.

But while proving that science is but an extension of ordinary knowledge, it was also proved that the higher orders of knowledge differ from the lower in the greater remoteness, generality, and abstractness of the relations which they formulate, in the greater definiteness of their formulas, and in their more complete organization. Our inquiry into the mutual relations of life and intelligence[2] elicited an exactly parallel set of conclusions. It was there shown that psychical life consists in the continuous establishment of subjective relations answering to objective relations; and that, as we advance through the animal kingdom from the lowest to the highest forms, this correspondence between the mind and the environment extends to relations which are continually more remote in space and time, more clearly defined, but at the same time more general; and finally we also traced a progressive organization of correspondences. Continually, while passing in review the various aspects of the progress of intelligence in the animal kingdom, we found ourselves ending with illustrations drawn from that progress of human intelligence which is determined by social conditions. Let us now illustrate this subject somewhat further by tracing out the intellectual correspondence between man and his environment, as increasing in remoteness, in speciality and generality, in complexity, in definiteness, and in coherent organization.

[1] Spencer's *Essays,* 1st series, p. 189; see above, part i. chap. ii; part ii. chap. xv.
[2] See above, part ii. chap. xiv.

The extension of the correspondence in space is a marked characteristic of intellectual progress, which we have already traced through the ascending groups of the animal kingdom, but which is carried much further by man than by any lower animal. It is no doubt true that the direct adjustments of psychical relations to distant objective relations, effected by unaided perception, have a narrower range in civilized men than in uncivilized men or in several of the higher mammals and birds. It is a familiar fact that the senses of civilized man—or at least the three senses which have a considerable range in space—are less acute and less extensive in range than those of the barbarian. It is said that a Bushman can see as far with the naked eye as a European can see with a field-glass ; and certain wild and domestic birds and mammals, as the falcon, the vulture, and perhaps the greyhound, have still longer vision. Among the different classes of civilized men, those who, by living on the fruits of brain-work done indoors, are most widely differentiated from primeval men, have as a general rule the shortest vision. And the rapid increase of indoor life, which is one of the marked symptoms of modern civilization, tends not only to make myopia more frequent, but also to diminish the average range of vision in persons who are not myopic. There may very likely have been a similar, though less conspicuous and less carefully observed, decrease in the range of hearing. And the sense of smell, which is so marvellously efficient in the majority of mammals and in many savages, is to us of little use as an aid in effecting correspondences in space.

In the case also of those simpler indirect adjustments which would seem, perhaps, to involve the use of the cerebellum chiefly, we have partially lost certain powers possessed by savages and lower animals. There are few things in which civilized men differ among themselves more conspicuously than the recollection of places, the identification of landmarks, and the ability to reach a distant point through crooked streets without losing the way. But in these respects the most sagacious of us are but bunglers compared with primitive men or with dogs and foxes. Few things are more striking than the unerring instinct with which the Indian makes his way through utterly trackless forests, seldom stopping to make up his mind, and taking in at a single glance whole groups of signs which to his civilized companion are inappreciable. The loss of this power of coordination, like the decrease in the range of the senses, is undoubtedly due to disuse, the circumstances of civilized life affording little or no occasion for the exercise of these faculties.[1]

But although in these respects the correspondence in space does not seem to have been extended with the progress of civilization, yet in those far more indirect and complicated adjustments which, as involving time-relations of force and cause, depend largely on the aid of the cerebrum, the civilized man surpasses the savage to a much greater extent than the savage surpasses the wolf or lion. "By combining his own perceptions with the perceptions of others as registered in maps," the modern "can reach special places lying thousands of miles away over the earth's surface. A ship, guided by compass and stars and chronometer, brings him from the antipodes information by which his purchases here are adapted to prices there. From the characters of exposed strata he infers the presence of coal below; and thereupon adjusts the sequences of his actions to coexistences a thousand feet beneath. Nor is the environment

[1] In the course of the recent interesting discussion and correspondence in *Nature* concerning the "sense of direction" exhibited in barbarians and lower animals, it was observed that a party of Samoyeds will travel in a direct line from one point to another over trackless fields of ice, even on cloudy nights, when there is accordingly nothing whatever that is visible to guide their course. It would be too much to assert that this faculty is utterly lost in civilized man, so that a temporary recurrence to the conditions of barbaric life might not revive it; but even if retained at all, it is certainly kept quite in abeyance.

through which his correspondences reach limited to the surface and the substance of the earth. It stretches into the surrounding sphere of infinity." In all these respects, the extension of the correspondence achieved during the progress of civilization has been much greater than that achieved during the immediately preceding stages of the evolution of man from an inferior primate. "From early races acquainted only with neighbouring localities, up to modern geographers who specify the latitude and longitude of every place on the globe; from the ancient builders and metallurgists, knowing but surface deposits, up to the geologists of our day whose data in some cases enable them to describe the material existing at a depth never yet reached by the miner; from the savage barely able to say in how many days a full moon will return, up to the astronomer who ascertains the period of revolution of a double star;—there has been" an enormous "widening of the surrounding region throughout which the adjustment of inner to outer relations extends."[1] It only remains to add that the later and more conspicuous stages of this progress have been determined by that increase in the size and heterogeneity of the social environment which results from the growing interdependence of communities once isolated, and which we have already seen to be the fundamental element of progress in general. For this integration of communities has not only directly enlarged the area throughout which adjustments are required to be made, but it has indirectly aided the advances in scientific knowledge requisite for making the adjustments.

Great, however, as has been the extension of the correspondence in space which has characterized the progress of the favoured portion of humanity from barbarism to civilization, the extension of the correspondence in time is a much more conspicuous and more distinctly human phenomenon. As we trace this kind of mental evolution through sundry

[1] Spencer, *Principles of Psychology*, vol. i. pp. 317, 319.

classes and orders of the animal kingdom in an ascending series, it is to be observed that until we reach the higher mammals the two kinds of correspondence advance together, —the distance at which outer relations are cognized forming a measure of the interval by which their effects may be anticipated. But among the higher mammals there is observed a higher order of adjustments to future emergencies, which advances more rapidly than the extension of the correspondence in space, and which in the human race first acquires a notable development. "Not that the transition is sudden," observes Mr. Spencer. "During the first stages of human progress, the method of estimating epochs does not differ in nature from that employed by the more intelligent animals. There are historical traces of the fact that originally the civilized races adjusted their actions to the longer sequences in the environment just as Australians and Bushmen do now, by observing their coincidence with the migrations of birds, the floodings of rivers, the flowerings of plants. And it is obvious that the savages who, after the ripening of a certain berry, travel to the seashore, knowing that they will then find a particular shell-fish in season, are guided by much the same process as the dog who, on seeing the cloth laid for dinner, goes to the window to watch for his master. But when these phenomena of the seasons are observed to coincide with recurring phenomena in the heavens,—when, as was the case with the aboriginal Hottentots, periods come to be measured partly by astronomical and partly by terrestrial changes,—then we see making its appearance a means whereby the correspondence in time may be indefinitely extended. The sun's daily movements and the monthly phases of the moon having once been generalized, and some small power of counting having been reached, it becomes possible to recognize the interval between antecedents and consequents that are long apart, and to adjust the actions to them. Multitudes of sequences in the environment which, in the absence of answering functional periods, cannot be directly responded to by the organism, may be discerned and indirectly responded to when there arises this ability of numbering days and lunations."[1]

In the advance to high stages of civilization, the extension of the correspondence in time is most conspicuously exemplified in the habitual adjustment of our theories and actions to sequences more or less remote in the future. In no other respect is civilized man more strikingly distinguished from the barbarian than in his power to adapt his conduct to future events, whether contingent or certain to occur. The ability to forego present enjoyment in order to avoid the risk of future disaster is what we call prudence or providence; and the barbarian is above all things imprudent and improvident. Doubtless the superior prudence of the civilized man is due in great part to his superior power of self-restraint; so that this class of phenomena may be regarded as illustrating one of the phases of moral progress. Nevertheless there are several purely intellectual elements which enter as important factors into the case. The power of economizing in harvest-time or in youth, in order to retain something upon which to live comfortably in winter or in old age, is obviously dependent upon the vividness with which distant sets of circumstances can be pictured in the imagination. The direction of the volitions involved in the power of self-restraint must be to a great extent determined by the comparative vividness with which the distant circumstances and the present circumstances are mentally realized. And the power of distinctly imagining objective relations not present to sense is probably the most fundamental of the many intellectual differences between the civilized man and the barbarian, since it underlies both the class of phenomena which we are now considering and the class of phenomena comprised in artistic, scientific, and philosophic

[1] Spencer, op. cit. i. 326.

progress. The savage, with his small and undeveloped cerebrum, plays all summer, like the grasshopper in the fable, eating and wasting whatever he can get; for although he knows that the dreaded winter is coming, during which he must starve and shiver, he is nevertheless unable to realize these distant feelings with sufficient force to determine his volition in the presence of his actual feeling of repugnance to toil. But the civilized man, with his large and complex cerebrum, has so keen a sense of remote contingencies that he willingly submits to long years of drudgery, in order to avoid poverty in old age, pays out each year a portion of his hard-earned money to provide for losses by fire which may never occur, builds houses and accumulates fortunes for posterity to enjoy, and now and then enacts laws to forestall possible disturbances or usurpations a century hence. Again, the progress of scientific knowledge, familiarizing civilized man with the idea of an inexorable regularity of sequence among events, greatly assists him in the adjustment of his actions to far-distant emergencies. He who ascribes certain kinds of suffering to antecedent neglect of natural laws is more likely to shape his conduct so as to avoid a recurrence of the infliction, than he who attributes the same kinds of suffering to the wrath of an offended quasi-human Deity, and fondly hopes, by ceremonial propitiation of the Deity, to escape in future.

This power of shaping actions so as to meet future contingencies has been justly recognized by political economists as an indispensable pre-requisite to the accumulation of wealth in any community, without which no considerable degree of progress can be attained. The impossibility of getting barbarians to work, save under the stimulus of actually present necessities, has been one of the chief obstacles in the way of missionaries who have attempted to civilize tribal communities. The Jesuits, in the seventeenth century, were the most successful of Christian missionaries, and their proceedings with the Indians of Paraguay constitute one of the most brilliant feats in missionary annals. Such unparalleled ascendency did the priests acquire over the imaginations of these barbarians that they actually made them cease from warfare. They taught them European methods of agriculture, as well as the arts of house-building, painting, dyeing, furniture-making, even the use of watches; and they administered the affairs of the community with a despotic power which has seldom been equalled either in absoluteness or in beneficence. Nevertheless the superficiality of all this show of civilization was illustrated by the fact that, unless perpetually watched, the workmen would go home leaving their oxen yoked to the plough, or would even cut them up for supper if no other meat happened to be at hand. Examples of a state of things intermediate between this barbaric improvidence and the care-taking foresight of the European are to be found among the Chinese,—a people who have risen far above barbarism, but whose civilization is still of a primitive type. The illustration is rendered peculiarly forcible by the fact that the Chinese are a very industrious people, and where the returns for labour are immediate will work as steadily as Germans or Americans. Owing to their crowded population, every rood of ground is needed for cultivation, and upon their great rivers the traveller continually meets with little floating farms constructed upon rafts and held in place by anchors. Yet side by side with these elaborate but fragile structures are to be seen acres of swamp-land which only need a few years of careful draining to become permanently fit for tillage. So incapable are the Chinese of adapting their actions to sequences at all remote, that they continue, age after age, to resort to such temporary devices, rather than to bestow their labour where its fruits, however enduring, cannot be enjoyed from the outset.[1] The contrast proves that the cause is the intellectual inability to realize vividly a group of

[1] See Mill, *Political Economy*, book i. chap. xi.

future conditions, involving benefits not immediately to be felt.

Of the correspondence in time, even more forcibly than of the correspondence in space, it may be said that its extension during the process of social evolution has been much greater than during the organic evolution of the human race from some ancestral primate. Between the Australian, on the one hand, who cannot estimate the length of a month, or provide even for certain disaster which does not stare him in the face, and whose theory of things is adapted only to events which occur during his own lifetime; and, on the other hand, the European, with his practical foresight, his elaborate scientific previsions, and his systems of philosophy, which embrace alike the earliest traceable cosmical changes and the latest results of civilization; the intellectual gulf is certainly far wider than that which divides the Australian from the fox who hides the bird which he has killed, in order to return when hungry to eat it.

It remains to add that the later and more conspicuous stages of this kind of intellectual progress have obviously been determined by the increase in the size and heterogeneity of the social environment. For the integration of communities to which this increase is due has not only indirectly aided the advances in scientific knowledge requisite for making mental adjustments to long sequences, past and future, but it has also directly assisted the disposition to work patiently in anticipation of future returns, by increasing the general security and diminishing the chances that the returns to labour may be lost.

The extension of the correspondence between subjective and objective relations in time and in space answers to that kind of primary integration which underlies the process of evolution in general. In treating of the enlarged area, in time and space, throughout which inner relations are adjusted to outer relations, we have been treating of intellectual progress regarded as a growth. But in proceeding to speak of the increasing heterogeneity, definiteness, and coherence of the adjustments, we proceed to treat of intellectual progress regarded as a development. Here, as elsewhere, throughout all save the simplest orders of evolution, quantitative increase is accompanied by qualitative increase. The knowledge is not only greater and the intellectual capacity greater, but the knowledge is more complex, accurate, and unified, and the intellectual capacity is more varied.

The increase of the correspondence in definiteness may be sufficiently illustrated by the following brief citation from Mr. Spencer: "Manifestly the reduction of objective phenomena to definite measures gives to those subjective actions that correspond with them a degree of precision, a special fitness, greatly beyond that possessed by ordinary actions. There is an immense contrast in this respect between the doings of the astronomer who, on a certain day, hour, and minute, adjusts his instrument to watch an eclipse, and those of the farmer who so arranges his work that he may have hands enough for reaping some time in August or September. The chemist who calculates how many pounds of quicklime will be required to decompose and precipitate all the bicarbonate of lime which the water in a given reservoir contains in a certain percentage, exhibits an adjustment of inner to outer relations incomparably more specific than does the laundress who softens a tubful of hard water by a handful of soda. In their adaptations to external coexistences and sequences, there is a wide difference between the proceedings of ancient besiegers, whose battering-rams were indeterminate in their actions, and those of modern artillery officers, who, by means of a specific quantity of powder, consisting of specific ingredients, in specific proportions, placed in a tube at a specific inclination, send a bomb of specific weight on to a specific object, and cause it to explode at a specific moment."[1] It only remains to note that the difference in specific accuracy, here illustrated by contrasting the operations of science with those of ordinary knowledge, is equally conspicuous when, on a somewhat wider scale, we contrast the proceedings, both scientific and artistic, of civilized men with the proceedings of the lowest savages. The most ignorant man in New England probably knows in June that winter is just six months distant; the Australian, to whom, as to the civilized child, time appears to go slowly, knows only that it is a long way off. So, too, the crude knives and hammers and the uncouth pottery of primeval men are distinguished alike by their indefiniteness of contour, and by their uselessness in operations which require specific accuracy. And here, as before, in the extreme vagueness and lack of speciality, both in his knowledge and in the actions which are guided by it, the primeval man appears to stand nearer to the highest brutes than to the civilized moderns.

Along with this increase in specialization, entailing greater definiteness of adjustment, there goes on an increase in generalization, involving an increased power of abstraction, of which barely the germs are to be found either in the lowest men or in other highly organized mammals. The inability of savage races to make generalizations involving any abstraction is sufficiently proved by the absence or extreme paucity of abstract expressions in their languages. As Mr. Farrar observes, "The Society-Islanders have words for dog's tail, bird's tail, and sheep's tail, yet no word for tail; the Mohicans have verbs for every kind of cutting, and yet no verb 'to cut.' The Australians have no generic term for fish, bird, or tree. The Malays have no term for tree or herb, yet they have words for fibre, root, tree-crown, stalk, stock, trunk, twig, and shoot. Some American tongues have separate verbs for 'I wish to eat meat,' and 'I wish to eat soup,' but no verb for 'I wish'; and separate words for a blow with

[1] Spencer, op. cit. i. 340.

a sharp and a blow with a blunt instrument, but no abstract word for blow."[1] Between the stage of intellectual progress thus illustrated and that in which an unlimited capacity for generalization produces such words as "individuation" or "equilibration," the contrast is sufficiently obvious; and it fully confirms our theorem, that the amount of intellectual progress achieved since man became human far exceeds that which was needed to transfer him from apehood to manhood.

The increase of the correspondence in complexity, already illustrated incidentally in the treatment of these other aspects of the case, is still further exemplified in the growing complication of the interdependence between science and the arts. When tracing the complexity of correspondence through the lower stages of the evolution of intelligence in the animal kingdom, Mr. Spencer hints that the evolution of the executive faculties displayed in the organs of prehension and locomotion is closely related to that of the directive faculties displayed in the cephalic ganglia and in the organs of sense. The parallelism may be summed up in the statement that in most, if not all, the principal classes of the animal kingdom, the animals with the most perfect prehensile organs are the most intelligent. Thus the cuttle-fish is the most intelligent of mollusks, and the crab similarly stands at the head of crustaceans, while the parrot outranks all other birds alike in sagacity and in power of handling things, and the ape and elephant are, with the exception of man, the most sagacious of mammals.[1] Of the human race, too, it may be said that, although Anaxagoras was wrong in asserting that brutes would have been men had they had hands, he might safely have asserted that without hands men could never have become human. Now this interdependence of the directive and executive faculties is continued throughout the process of social evolution in the shape of the inter-

[1] *Chapters on Language*, p. 199.
[1] Spencer, op. cit. i. 368—372.

dependence of the sciences and the arts. "We may properly say that, in its higher forms, the correspondence between the organism and its environment is effected by means of supplementary senses and supplementary limbs. . . . . The magnifying-glass adds but another lens to the lenses existing in the eye. The crow-bar is but one more lever attached to the series of levers forming the arm and hand. And the relationship, which is so obvious in these first steps, holds throughout." We may, indeed, go still deeper, and say that science is but an extension of our ordinary sense-perceptions by the aid of reasoning, while art is but an extension of the ordinary function of our muscular system, of expressing our psychical states by means of motion. Hence it is that "each great step towards a knowledge of laws has facilitated men's operations on things; while each more successful operation on things has, by its results, facilitated the discovery of further laws." Hence the sciences and arts, originating together,—as in the cases of "astronomy and agriculture, geometry and the laying out of buildings, mechanics and the weighing of commodities,"—have all along reacted upon each other, in an increasing variety of ways. It is sufficient to mention the reciprocal connections between navigation and astronomy, between geology and mining, between chemistry and all the arts; while telescopes and microscopes illustrate the truth that "there is scarcely an observation now made in science, but what involves the use of instruments supplied by the arts; while there is scarcely an art-process but what involves some of the previsions of science." Just as in organic evolution we find the mutual dependence of the directive and executive faculties ever increasing, so that "complete visual and tactual perceptions are impossible without complex muscular adjustments, while elaborate actions require the constant overseeing of the senses"; so in social evolution we find between science and art an increasing reciprocity "such that each further cognition implies elaborate operative aid, and each new operation implies sundry elaborate cognitions." I need only add that, in this as in the other aspects of intellectual progress, the increase in complexity of adjustment achieved during the process of social evolution is far greater than that achieved during the immediately preceding stages of the process of organic evolution. Between the ape and the primitive man, with his rude levers and hatchets and his few simple previsions, the difference in complexity of correspondence is obviously less than between the primitive man and the modern, with his steam-hammers and thermo-electric multipliers, and his long list of sciences and sub-sciences, any one of which it would take much more than a lifetime to master in detail.

We have thus passed in review the various aspects of intellectual progress, regarded as a process of adjustment of inner to outer relations, and we have seen that in all the most essential features of this progress there is a wider difference between the civilized man and the lowest savage than between the savage and the ape. It appears that those rare and admirable qualities upon which we felicitate ourselves as marks which absolutely distinguish us from brute animals, have been slowly acquired through long ages of social evolution, and are shared only to a quite insignificant extent by the lowest contemporary races of humanity. As long as we regard things statically, as for ever fixed, we may well imagine an impassable gulf between ourselves and all other forms of organic existence. But as soon as we regard things dynamically, as for ever changing, we are taught that the gulf has been for the most part established during an epoch at the very beginning of which we were zoologically the same that we now are.

The next step in our argument will be facilitated by an inquiry into the common characteristic of the various intellectual differences between the civilized and the primitive man which we have above enumerated. The nature of this characteristic was hinted at when we were discussing the improvidence of the barbarian. It was observed that the power of distinctly imagining objective relations not present to sense is the most fundamental of the many intellectual differences between the civilized man and the barbarian. Making this statement somewhat wider, we may now safely assert that the entire intellectual superiority of the civilized man over the savage, or of the modern man over the primeval man, is summed up in his superior power of *representing* that which is not present to the senses. For it is not only in what we call providence that this superiority of representation shows itself, but also in all those combinations of present with past impressions which accompany the extension of the correspondence in space and time, and its increase in heterogeneity, definiteness, and coherence. It is his ability to reproduce copies of his own vanished states of consciousness, and of those of his fellows, that enables the civilized man to adjust his actions to sequences occurring at the antipodes. It is this same power of representation which underlies his power of forming abstract and general conceptions. For the peculiarity of abstract conceptions is that "the matter of thought is no longer any one object, or any one action, but a trait common to many"; and it is, therefore, only when a number of distinct objects or relations possessing some common trait can be represented in consciousness that there becomes possible that comparison which results in the abstraction of the common trait as the object of thought. Obviously, then, the greater the power of abstraction and generalization which is observed, the greater is the power of representation which is implied. The case is the same with that definiteness of the intellectual processes which we have noted as distinguishing modern from primitive thinking. For the conception which underlies definiteness of thinking is the conception of *exact likeness*,—a highly abstract conception which can only be framed after the comparison of numerous represented cases in which degree of likeness is the common trait that is thought about. Hence not only the improvidence of the savage, but likewise the vagueness of his conceptions, his inability to form generalizations involving abstraction, and the limited area covered by his adjustments, are facts which one and all find their ultimate explanation in his relative incapacity for calling up representative states of consciousness.

From this same incapacity results that inflexibility of thought in which the savage resembles the brute, and which is one of the chief proximate causes of his unprogressiveness. "One of the greatest pains to human nature," says Mr. Bagehot, "is the pain of a new idea." This pain, which only to a few of the most highly cultivated minds in the most highly civilized communities has ceased to be a pain and become a pleasure, is to the savage not so much a pain as a numbing or paralyzing shock. To rearrange the elements of his beliefs is for the uncivilized man an almost impossible task. It is not so much that he does not dare to sever some traditional association of ideas which he was taught in childhood, as it is that he is incapable of holding together in thought the clusters of representations with the continuity of which the given association is incompatible. This important point is so ably and succinctly stated by Mr. Spencer, that I cannot do better than to quote his exposition entire. After reminding us that "mental evolution, both intellectual and emotional, may be measured by the degree of remoteness from primitive reflex action," Mr. Spencer observes that "in reflex action, which is the action of nervous structures that effect few, simple, and often-repeated coordinations, the sequent nervous state follows irresistibly the antecedent nervous state; and does this not only for the reason that the discharge follows a perfectly permeable channel, but also for the reason that no alternative channel exists. From this stage, in which the psychical life is automatically restrained within the narrowest limits, up through higher stages in which increasing nervous complexities give increasing varieties of actions and possibilities of new combinations, the process continues the same; and it continues the same as we advance from the savage to the civilized man. For where the life furnishes relatively few and little-varied experiences, where the restricted sphere in which it is passed yields no sign of the multitudinous combinations of phenomena that occur elsewhere, the thought follows irresistibly one or other of the few channels which the experiences have made for it, —cannot be determined in some other direction for want of some other channel. But as fast as advancing civilization brings more numerous experiences to each man, as well as accumulations of other men's experiences, past and present, the ever-multiplying connections of ideas that result imply ever-multiplying possibilities of thought. The convictions throughout a wide range of cases are rendered less fixed. Other causes than those which are usual become conceivable; other effects can be imagined; and hence there comes an increasing modifiability of opinion. This modifiability of opinion reaches its extreme in those most highly cultured persons whose multitudinous experiences include many experiences of errors discovered, and whose representativeness of thought is so far-reaching that they habitually call to mind the various possibilities of error, as constituting a general reason for seeking new evidence and subjecting their conclusions to revision.

"If we glance over the series of contrasted modes of thinking which civilization presents, beginning with the savage who, seized by the fancy that something is a charm or an omen, thereafter continues firmly fixed in that belief, and ending with the man of science whose convictions, firm where he is conscious of long-accumulated evidence having no exception, are plastic where the evidence though abundant is not yet overwhelming, we see how an increase in freedom of thought goes along with that higher representativeness accompanying further mental evolution."[1]

If now we inquire for a moment into the causes of this higher representativeness of civilized thinking, we shall see most beautifully exemplified the way in which intellectual progress, as it goes on in the human race, is determined by social evolution. Intellectual progress is indeed a cause as well as a consequence of the evolution of society; but amid the dense entanglement of causes and effects our present purpose requires us to single out especially the dependence of progress in representativeness upon social complexity, since herein will be found the secret of the mental pre-eminence of civilized man. Now the integration of small tribes into larger and more complex social aggregates, which is the fundamental phenomenon in civilization, tends directly to heighten representativeness of thinking by widening and varying the experiences of the members of society. The member of a savage tribe must think indefinitely, concretely, rigidly, improvidently, because his intellectual experiences are so few in number and so monotonous in character. Increase in social complexity renders possible, or indeed directly produces, fresh associations of ideas in greater and greater variety and abundance, so that the decomposition and recombination of thoughts involved in abstraction and generalization is facilitated; and along with this, the definiteness and the plasticity of thought is increased, and the contents of the mind become representative in higher and higher degrees. Thus in every way it is brought before us that sociality has been the great agent in the achievement of man's intellectual pre-eminence, and that it has operated by widening and diversifying human experience, or in other words by increasing the number, remoteness, and heterogeneity of the environing relations to which each individual's actions have had to be adjusted. An inquiry into the

[1] Spencer, op. cit. ii. 524.

genesis of sociality will therefore best show us how the chasm which divides man intellectually from the brute is to be crossed.

But before we proceed to this somewhat lengthy and circuitous inquiry, we may profitably contemplate under a new aspect the intellectual difference which we have assigned as the fundamental one between civilized and primeval man. We have observed that the intellectual superiority of man over brute and of the civilized man over the barbarian essentially consists in a greater capacity for mentally representing objects and relations remote from sense. And we have insisted upon the point that in this capacity of representation the difference between the highest and lowest specimens of normal humanity known to us far exceeds the difference between the lowest men and the highest apes. Now in closest connection with these conclusions stands the physical fact that the chief structural difference between man and ape, as also between civilized and uncivilized man, is the difference in size and complexity of cerebrum. The cerebrum is the organ especially set apart for the compounding and recompounding of impressions that are not immediately sensory. The business of coordinating immediately presentative impressions is performed by the medulla and other subordinate centres. The cerebrum is especially the organ of that portion of psychical life which is entirely representative.[1] Obviously, then, the progress to higher and higher representativeness ought to be accompanied by a well-marked growth of the cerebrum relatively to the other parts of the nervous system. Now, in the light of the present argument, how significant is the fact that the cranial capacity of the modern Englishman surpasses that of the aboriginal non-Aryan Hindu by a difference of sixty-eight cubic inches,[2] while between this Hindu skull and the skull of the gorilla the difference

[1] See above, p. 137.
[2] Lyell, *Antiquity of Man*, p. 84.

in capacity is but eleven cubic inches! That is to say, the difference in volume of brain between the highest and the lowest man is at least six times as great as the difference between the lowest man and the highest ape. And if we were to take into the account the differences in structural complexity, as indicated by the creasing and furrowing of the brain-surface, we should obtain a yet more astonishing contrast. Yet, powerfully as this anatomical fact confirms the position we have all along been upholding, its full value will not be apparent if we are so dazzled by it as to overlook the significance of the lesser difference between the gorilla and the aboriginal inhabitant of India. As the Duke of Argyll very properly observes, we do right in setting a higher value in classification upon the eleven inches which intervene between the gorilla and the Hindu than upon the sixty-eight inches which intervene between the Hindu and the Englishman. For "the significance set by the facts of nature upon that difference of eleven cubic inches . . . . is the difference between an irrational brute confined to some one climate and to some limited area of the globe,—which no outward conditions can modify or improve,—and a being equally adapted to the whole habitable world, with powers, however undeveloped, of comparison, of reflection, of judgment, of reason, with a sense of right and wrong, and with all these capable of accumulated acquisition, and therefore of indefinite advance." Though somewhat exaggerated in what it denies to the brute, and much more in what it claims for the aboriginal man, this statement contains a kernel of truth which is of value for our present purpose, and which is further illustrated by the fact that a minimum of brain-substance "is constantly and uniformly associated with all the other anatomical peculiarities of man. Below that minimum the whole accompanying structure undergoes far more than a corresponding change,—even the whole change between the lowest savage and the highest ape. Above that minimum, all subsequent variations in quantity are accompanied by no changes whatever in physical structure."[1] Here again, though the antithesis is a little too absolutely stated, we have set before us a real distinction. Up to a certain point, the brain and the rest of the body are alike alterable by natural selection and such other agencies as may be concerned in the slow modification of organisms. But when the brain has reached a certain point in size and complexity, the rest of the body ceases to change, save in a few slight particulars, and the agencies concerned in forwarding the process of evolution seem to confine themselves to the brain, and especially to the cerebrum,—the result being marked psychical development, unattended by any notable physical alteration. Here we have reached a fact of prime importance. We may grant to the Duke of Argyll that when those eleven additional cubic inches of brain had been acquired, some kind of a Rubicon had been crossed, and a new state of things inaugurated. What was that Rubicon?

The answer has been furnished by Mr. Wallace, and must rank as one of the most brilliant contributions ever yet made to the Doctrine of Evolution. Since inferior animals respond chiefly by physical changes to changes in their environment, natural selection deals chiefly with such changes, to the visible modification of their bodily structure. In the case of sheep or bears, for instance, increased cold can only select for preservation the individuals most warmly coated; or if a race of lions, which has hitherto subsisted upon small and sluggish ruminants until these have been nearly exterminated, is at last obliged to attack antelopes and buffaloes, natural selection can only preserve the swiftest and strongest or most ferocious lions. But when an animal has once appeared, endowed with sufficient intelligence to chip a stone tool and hurl a weapon, natural selection will take advantage of variations in this intelligence, to the comparative neglect of purely physical

[1] Duke of Argyll, *Primeval Man*, pp. 57—64.

variations. Communities whose members are best able to meet by intelligent contrivances the changes in the environment will prevail over other communities, and will also be less easily destroyed by physical catastrophes. Still more strikingly must this superior availability of variations in intelligence be exemplified, when the intelligence has progressed so far as to sharpen spears, to use rude bows, to dig pitfalls, to cover the body with leaves or skins, and to strike fire by rubbing sticks, according to the Indian version of the myth of Prometheus.

So soon, in short, as the intelligence of an animal has, through ages of natural selection and direct adaptation, become so considerable that a slight variation in it is of more use to the animal than any variation in physical structure, then such variations will be more and more constantly selected, while purely physical variations, being of less vital importance to the species, will be relatively more and more neglected. Thus, while the external appearance of such an animal, and the structure of his internal nutritive and muscular apparatus, may vary but little in many ages, his cerebral structure will vary with comparative rapidity, entailing a more or less rapid variation in intellectual and emotional attributes.

Here we would seem to have the key to the singular contrast in the relations of man to contemporary anthropoid apes. We may now understand why man differs so little, in general physical structure and external appearance, from the chimpanzee and gorilla, while, with regard to the special point of cerebral structure and its correlative intelligence, he differs so vastly from these, his nearest living congeners, and the most sagacious of animals save himself. Coupled with what we now know concerning the immense antiquity of the human race, Mr. Wallace's brilliant suggestion goes far to bridge over the interval, which formerly seemed so impracticable, between brute and man. If we take the thousands of centuries during which the human race has covered both the eastern and the western hemispheres, and compare with them the entire duration of recorded human history, we shall have set before us a profitable subject of reflection. *Since the period during which man has possessed sufficient intelligence to leave a traditionary record of himself is but an infinitesimal fraction of the period during which he has existed upon the earth, it is but fair to conclude that, during those long ages of which none but a geologic record of his existence remains, he was slowly* ACQUIRING *that superior intelligence which now so widely distinguishes him from all other animals.*[1] Throughout an enormous period of time, his brain-structure and its correlated intellectual and emotional functions must have been constantly modified both by natural selection and by direct adaptation, while his outward physical appearance has undergone few modifications; and of these the most striking would seem to be directly or indirectly consequent upon the cerebral changes.[2]

[1] The reader will not fail to note that, even were the question otherwise left open, after the conclusive evidence summarized in chapter ix., this point by itself is a point of truly enormous weight in favour of the theory of man's descent from some lower animal. Upon the theory that the human race was created by a special miraculous act, its long duration in such utter silence is a meaningless, inexplicable fact; whereas, upon the derivation theory, it is just what might be expected.

[2] To the general observer, as to the anatomist, the most notable points of difference between civilized and uncivilized man, as well as between man and the chimpanzee or gorilla, are the differences in the size of the jaws and the inclination of the forehead. The latter difference is directly consequent upon increase of intelligence; and the former is indirectly occasioned by the same circumstance. For the diminution of the jaws, entailed by civilization, is, no doubt, primarily due to disuse; and the disuse is occasioned partly by difference in food, and partly by the employment of tools, and the consequent increased reliance upon the hands as prehensile organs. All these circumstances are the result of increased intelligence. And in addition to this, it is probable that increased frontal development has directly tended, by correlation of growth, to diminish the size of the jaws, as well as to push forward the bridge of the nose. To the increased reliance upon the hands as prehensile organs—a circumstance which we have seen to be in an especial degree characteristic of developing intelligence—is probably also due the complete attainment of the erect position of the body, already partially obtained by the anthropoid apes. Cerebral development thus accounts for all the conspicuous physical peculiarities of man except his bare skin,—a phenomenon for which no satisfactory explanation has yet been suggested.

It is a corollary from the foregoing considerations, that no race of organisms can in future be produced through the agency of natural selection and direct adaptation, which shall be zoologically distinct from, and superior to, the human race. As the same causes which physically modify lower species have, for countless ages, modified man directly and greatly in intelligence and only indirectly and slightly in physical constitution, it follows that mankind is destined to advance during future ages in psychical attributes, but is likely to undergo only slight changes in outward appearance. It is by the coordination of intellectual and moral relations that man maintains himself in equilibrium with the physical, intellectual, and moral relations arising in his ever-changing environment. And hence in the future, as in the recent past, the dominant fact in the career of humanity is not physical modification, but CIVILIZATION.

Here we are brought by a new route to the verge of that theory of civilization which I have sought to elucidate in the preceding chapters. We have touched upon a grand truth, of which it would be difficult to overrate the importance. For we can now admit—not as a concession to Mr. St. George Mivart, but as a legitimate result of our own method of inquiry—that when "the totality of man's being" is taken into the account, the difference between ape and mushroom is less important than the difference between ape and man. And without conceding aught to that superlative nonsense known as the "doctrine of special creations," we may admit, with the Duke of Argyll, that the eleven cubic inches of brain-space, by which the aboriginal Hindu surpasses the gorilla, have a higher value, for purposes of classification, than the sixty-eight cubic inches by which the modern Englishman surpasses the Hindu. We now see what kind of a Rubicon it was which was crossed when those eleven cubic inches of brain (or even when four or five of them) had been gained. The crossing of the Rubicon was the point at which natural selection began to confine itself chiefly to variations in psychical manifestation. The ape-like progenitor of man, in whom physical and psychical changes had gone on *pari passu* for countless æons, until he had reached the grade of intelligence implied by the possession of a brain four or five inches more capacious than that of the gorilla, had now, as we may suppose, obtained a brain upon which could be devolved, to a greater and greater extent, the task of maintaining relations with the environment. Then began a new chapter in the history of the evolution of life. Henceforward the survival of the fittest, in man's immediate ancestry, was the survival of the cerebrums best able to form representative combinations. The agencies which had hitherto been at work in producing an organic form endowed with rare physical capacities, now began steadfastly to labour in producing a mind capable to a greater and greater extent of ideally resuscitating and combining relations not present to the senses.

But immense as was the step thus achieved in advance, the progress from brute to man was not yet accomplished. As we have already shown, the circumstances which by widening and diversifying experience have mainly contributed to heighten man's faculty of representativeness, have been for the most part circumstances attendant upon man's sociality, or the capacity of individuals for aggregating into communities of increasing extent and complexity. Here we become involved in considerations relating to the emotions as well as to the intelligence. The capacity for sustaining the various relationships implied by the existence of a social aggregate—whether in the case of a primeval family community or of a modern nation—cannot be explained without taking into the account the genesis of those moral feelings by the possession of which man has come to differ from the highest brutes even more conspicuously than by his purely intellectual achievements. The task now before us, therefore, is to explain the genesis of the moral feelings which lie at the bottom of sociality in the human race; and with reference to this question I shall presently have a suggestion to offer, which will be found as serviceable as it is interesting and novel. Let us for the moment, however, consider the implications of some of the current ethical theories, and especially let us examine the scientific basis of what is too crudely designated as Utilitarianism.

## CHAPTER XXII.

### GENESIS OF MAN, MORALLY.

There are two things, said Kant, which fill me with awe because of their sublimity,—the starry heavens above us, and the moral law within us. From the modern point of view there is interest as well as instruction to be found in the implied antithesis. While in the study of the stellar universe we contemplate the process of evolution on a scale so vast that reason and imagination are alike baffled in the effort to trace out its real significance, and we are overpowered by the sense of the infinity that surrounds us; on the other hand, in the study of the moral sense we contemplate the last and noblest product of evolution which we can ever know,—the attribute latest to be unfolded in the development of psychical life, and by the possession of which we have indeed become as gods, knowing the good and the evil. The theorems of astronomy and the theorems of ethics present to us the process of evolution in its extremes of extension and of intension respectively. For although upon other worlds far out in space there may be modes of existence immeasurably transcending Humanity, yet these must remain unknowable by us. And while this possibility should be allowed its due weight in restraining us from the vain endeavour to formulate the infinite and eternal Sustainer of the universe in terms of our own human nature, as if the highest symbols intelligible to us were in reality the highest symbols, nevertheless it can in no way influence or modify our science. To us the development of the noblest of human attributes must ever remain the last term in the stupendous series of cosmic changes, of which the development of planetary systems is the first term. And our special synthesis of the phenomena of cosmic evolution, which began by seeking to explain the genesis of the earth and its companion worlds, will be fitly concluded when we have offered a theory of the genesis of those psychical activities whose end is to secure to mankind the most perfect fulness of life upon this earth, which is its dwelling-place.

The great philosopher whose remark has suggested these reflections would not, however, have been ready to assent to the interpretation here given. Though Kant was one of the chief pioneers of the Doctrine of Evolution, having been the first to propose and to elaborate in detail the theory of the nebular origin of planetary systems, yet the conception of a continuous development of life in all its modes, physical and psychical, was not sufficiently advanced, in Kant's day, to be adopted into philosophy. Hence in his treatment of the mind, as regards both intelligence and emotion, Kant took what may be called a statical view of the subject; and finding in the adult civilized mind, upon the study of which his systems of psychology and ethics were founded, a number of organized moral intuitions and an organized moral sense, which urges men to seek the right and shun the wrong, irrespective of utilitarian considerations of pleasure and pain, he proceeded to deal with these moral intuitions and this moral sense as if they were ultimate facts, incapable of being analyzed into simpler emotional elements. Now as the following exposition may look like a defence of utilitarianism, it being really my intention to show that utilitarianism in the deepest and widest sense is the ethical philosophy imperatively required by the facts, it is well to state, at the outset, that the existence of a moral sense and moral intuitions in civilized man is fully granted. It is admitted that civilized man possesses a complex group of emotions, leading him to seek the right and avoid the wrong, without any reference to considerations of utility; and I disagree entirely with those utilitarian disciples of Locke, who would apparently refer these ethical emotions to the organization of experiences of pleasure and pain in the case of each individual. So long as the subject is contemplated from a statical point of view, so long as individual experience is studied without reference to ancestral experience, the follower of Kant can always hold his ground against the follower of Locke, in ethics as well as in psychology. When the Kantian asserts that the intuitions of right and wrong, as well as the intuitions of time and space, are independent of experience, he occupies a position which is impregnable, so long as the organization of experiences through successive generations is left out of the discussion. But already, on two occasions of supreme importance, we have found the Doctrine of Evolution leading us to a common ground upon which the disciples of Kant and the disciples of Locke can dwell in peace together. We have seen that the experience-test and the inconceivability-test of truth are, when deeply considered, but the obverse faces of the same thing. We have seen that there is a stand-point from which the experience-theory and the intuition-theory of knowledge may be regarded as mutually supplementing each other. We shall presently see, in like manner, that the so-called doctrine of utilitarianism and the doctrine of moral intuitions are by no means so incompatible with one another as may at first appear. As soon as we begin to study the subject dynamically, everything is shown in a new light. Admitting the truth of the Kantian position, that there exists in us a moral sense for analyzing which our individual experience does not afford the requisite data, and which must therefore be regarded as ultimate for each individual, it is nevertheless open to us to inquire into the emotional antecedents of this organized moral sense as exhibited in ancestral types of psychical life. The inquiry will result in the conviction that the moral sense is not ultimate, but derivative, and that it has been built up out of slowly organized experiences of pleasures and pains.

But before we can proceed directly upon the course thus marked out, it is necessary that we should determine what are meant by pleasures and pains. What are the common characteristics, on the one hand, of the states of consciousness which we call pleasures, and, on the other hand, of the states of consciousness which we call pains? According to Sir William Hamilton, "pleasure is a reflex of the spontaneous and unimpeded exertion of a power of whose energy we are conscious; pain is a reflex of the overstrained or repressed exertion of such a power." That this theory, which is nearly identical with that of Aristotle, is inadequate to account for all the phenomena of pleasure and pain, has been, I think, conclusively proved by Mr. Mill. With its complete adequacy, however, we need not now concern ourselves; as we shall presently see that a different though somewhat allied statement will much better express the facts in the case. Hamilton's statement, however inadequate, is illustrated by a number of truths which for our present purpose are of importance. A large proportion of our painful states of consciousness are attendant upon the inaction, or what Hamilton less accurately calls the "repressed exertion," of certain organic functions. According to the character of the functions in question, these painful states are known as cravings or yearnings. Inaction of the alimentary canal, and that molecular inaction due to deficiency of water in the system, are attended by feelings of hunger and thirst, which vary from slight discomfort to intense agony according as the inaction is prolonged. Of kindred character are the acquired cravings for tobacco, alcohol, and other narcotics. Inaction of the muscles causes great discomfort in children who are compelled to sit still, and grown persons feel similar annoyance when the enforced stillness is long enough kept up. Prisoners kept in dark cells soon feel an intense craving for light, which in time becomes scarcely less intolerable than raging hunger. A similar explanation suffices for the emotional yearnings involved in home-sickness, ennui, deprivation of the approval of our fellow-creatures, or in separation from our favourite pursuits. All these painful states are due to the enforced inaction of certain feelings, social or æsthetic. And in similar wise, as Mr. Spencer observes, the bitter grief attendant upon the death of a friend results from the ideal representation of a future in which certain groups of habitual emotions must remain inactive or unsatisfied by outward expression.

The objection may be made that all this is but an elaborate way of saying that certain pains result from the deprivation of certain pleasures. But since such an objection, in its very statement, recognizes that certain kinds of unimpeded activity, physical or psychical, are pleasures, it need not disturb us, or lead us to under-estimate the value of Hamilton's suggestion. Let us note next that excessive action of any function, equally with deficient action, is attended by pain. Local pain results from intensified sensations of heat, light, sound, or pressure; and though it may be in some cases true, as Mr. Spencer asserts, that sweet tastes are not rendered positively disagreeable by any degree of intensity,[1] the alleged fact seems quite contrary to my own experience, and to that of several other persons whom I have questioned. Other local pains, as in inflammation and sundry other forms of disease, are apparently due to increased molecular activity in

[1] Spencer, *Principles of Psychology*, vol. i. p. 276.

the parts affected. And the feelings of pain or discomfort both local and systemic, attendant upon over-exercise, over-eating, or excessive use of a narcotic, are to be similarly explained.

Thus we may say that pleasure, generally speaking, is "the concomitant of an activity which is neither too small nor too great," and we get at the significance of the Epicurean maxim, *μηδὲν ἄγαν*. But this doctrine, as already hinted, is by no means complete. For, as Mr. Mill and Mr. Spencer ask, "What constitutes a medium activity? What determines that lower limit of pleasurable action below which there is craving, and that higher limit of pleasurable action above which there is pain?" And furthermore, how happen there to be certain feelings (as among tastes and odours) which are disagreeable in all degrees of intensity, and others that are agreeable in all degrees of intensity? The answer, as Mr. Spencer shows, is to be sought in the study of the past conditions under which feelings have been evolved.

If the tentacles of a polyp are rudely struck by some passing or approaching body, the whole polyp contracts violently in such a manner as to throw itself slightly out of the way; but if a fragment of assimilable food, floating by, happens to touch one of the tentacles gently, the tentacle grasps it and draws it slowly down to the polyp's digestive sac. Now between these contrasted actions there is no such psychical difference as accompanies the similarly contrasted human actions of taking food and ducking the head to avoid a blow; for the polyp's contractions, being simply reflex actions of the lowest sort, are unattended by states of consciousness, either agreeable or disagreeable. Nevertheless there is one respect in which the two cases perfectly agree. In both cases there is a seeking of that which is beneficial to the organism, and a shunning of that which is injurious. And while, in the case of the polyp, there is no conscious pleasure or pain, we may fairly surmise that, as soon as any animal's psychical life becomes sufficiently complex to be attended by distinct states of consciousness, the presence of that which is beneficial is accompanied by a pleasurable feeling which leads to the seeking of it, while the presence of that which is injurious is accompanied by a painful feeling which leads to the shunning of it. Our surmise is strengthened as we reconsider the human actions lately enumerated, and observe that the abnormal activity of a function, either in deficiency or in excess, is injurious, while the normal activity of a function in balance with its companion functions is beneficial. As Mr. Spencer says, "in a mutually dependent set of organs having a consensus of functions, the very existence of a special organ having its special function, implies that the absence of its function must cause disturbance of the consensus,—implies too, that its function may be raised to an excess which must cause disturbance of the consensus, —implies, therefore, that maintenance of the consensus goes along with a medium degree of its function." In accordance with this view, we may note that hunger and thirst are feelings attendant upon a kind of functional inaction which is harmful, and even fatal if prolonged; that inaction or excessive action of the muscles is injurious as well as painful; that the intense heat and cold, and the violent pressure, which cause distress, will also cause more or less injury, and may cause death; that the discomfort following repletion and narcosis is the concomitant of a state of things which, if kept up, must end in dyspepsia, or other forms of disease, entailing usually a permanent lowering of nutrition; and that the intense sounds and lights which distress the ear and eye also tend to produce deafness and blindness. And in like manner, the enforced inaction of the social and æsthetic feelings, which is attended by mental discomfort, is also attended in the long run by a diminution of the fulness and completeness of psychical life, which in extreme cases may result in consumption, insanity, or narcotic craving.

It would seem, therefore, that the class of cases upon which Hamilton relied will justify an interpretation much deeper than the one which he proposed for them. They will apparently justify us in asserting that pleasure is a state of consciousness accompanying modes of activity which tend to increase the fulness of life of an organism, while pain is a state of consciousness accompanying modes of activity which tend to diminish the fulness of life. Before considering the objections to this doctrine,—which, though at first sight formidable, will disappear on further analysis,—let us note, with Mr. Spencer, that, on the theory of evolution, "races of sentient creatures could have come into existence under no other conditions." Omitting the cases which, in human psychology, are complicated by the foresight of remote or inconspicuous consequences, Mr. Spencer observes that Pleasure is "a feeling which we seek to bring into consciousness and retain there," while Pain is "a feeling which we seek to get out of consciousness and to keep out." Hence it follows that "if the states of consciousness which a creature endeavours to maintain are the correlatives of injurious actions, and if the states of consciousness which it endeavours to expel are the correlatives of beneficial actions, it must quickly disappear through persistence in the injurious and avoidance of the beneficial." In other words, even supposing a race of animals could come into existence, which should habitually seek baneful actions as pleasurable, and shun useful actions as painful, natural selection would immediately exterminate it. Our supposition is therefore a hibernicism: under the operation of natural selection no such race could ever come into existence. Only those races can exist whose feelings, on the average, result in actions which are in harmony with environing relations. Accordingly we may rest upon a still deeper and firmer basis our doctrine of pleasure and pain, and assert that Pleasure is a state of consciousness accompanying the relatively complete adjustment of inner to outer relations, while Pain is a state of consciousness attendant upon the discordance between inner and outer relations.

We may now consider a class of facts which at first seem inconsistent with the theory, but which in reality serve further to illustrate it. Animals now and then perform self-destructive actions under circumstances which make it difficult to suppose that the performance is not pleasurable. Though the majority of vegetable poisons are disagreeable to the taste, yet this is not always the case; and hence animals have been known to perish after a greedy meal upon some noxious herb. But here, as in the case of the moth which, in Tennyson's phrase, is "shrivelled in a fruitless fire," there is a new relation in the environment for which there is no corresponding adjustment established in the organism. The cases are like that of the child who ignorantly drinks a sweet poison, or satisfies its desire for muscular activity by climbing out of the window. The dynamic theory of life does not imply the pre-existence of internal relations answering to all possible external relations. Were it so, life would be complete from the outset. For new emergencies there have to be new adjustments. Now manifestly if the whole race of moths could be made to live among lighted candles, one of two things must happen: either there must be generated a tendency to avoid the candles, or the race must be exterminated. If an animal migrates to a district where poisonous herbs abound, its existence can be maintained only on one of two conditions: if it be low in intelligence, a disagreeable taste must be generated, so that the noxious food will be instantly rejected, or the odour must become offensive, so that the taste will be forewarned; but if the animal be possessed of high intelligence, like a bird or mammal, it will be enough if the dangerous object is identified by smell or taste, or even by vision or touch, while along with the recognition there occurs an ideal representation of danger. Hence it is not necessary to the maintenance of a race like mankind that all poisons should be bitter, or that injurious actions, newly tried, should painfully affect any of the senses. The work of making the needful adjustments is thrown largely upon the cerebrum, with its power of forming ideal sequences like those formerly experienced, and of directing action so as to anticipate them. Here, indeed, we come suddenly upon one of the conditions of human progressiveness, as above illustrated.

We can now begin to see why man finds pleasure in so many kinds of activity which are noxious to himself. In no other animal are the failures of adjustment between pleasurable and painful states, and beneficial and hurtful actions, so numerous or so conspicuous as in man. Though in the adjustments upon which the maintenance of life immediately depends, the correspondence is of necessity unimpaired, yet in those less essential adjustments concerned in keeping up the greatest possible fulness of life, there is frequent and lamentable imperfection. Thus,—to take one instance out of a hundred,—we continually see pleasurable states of consciousness associated with hurtful actions in the cases of men who ruin themselves by the use of narcotics. The fact that men, who are so much wiser than brutes, should often persist in conduct unworthy of brute intelligence, has long formed the theme of much sage but fruitless moralizing. By Calvinistic theologians such phenomena were formerly cited in proof of the theory that man is morally the lowest of creatures, having been rendered thoroughly unsound by the eating of the apple in Eden. It is needless to say that science offers a very different explanation. It follows from our inquiry into the causes of organic evolution,[1] that the adjustments which tend to maintain the highest fulness of life can be kept up only by natural selection or by direct equilibration. Now we have already had occasion to notice that in

[1] See above, part ii. chap. xii.

the human race, partly on account of the extreme complexity of its individual organization, partly on account of superadded social conditions, the action of natural selection is to a great extent checked. I do not allude to the fact that the supremely important human sympathies, which have grown up in the course of social evolution, compel us to protect the idle and intemperate, so that, instead of starving, they are "enabled to multiply at the expense of the capable and industrious." For far deeper than this lies the circumstance that "there are so many kinds of superiorities which severally enable men to survive, notwithstanding accompanying inferiorities, that natural selection cannot by itself rectify any particular unfitness; especially if, as usually happens, there are coexisting unfitnesses which all vary independently."[1] In a race of inferior animals a function in excess is quickly reduced by natural selection, because, owing to the universal slaughter, the highest completeness of life possible to a given grade of organization is required for the mere maintenance of life. But under the conditions surrounding human development, a function in excess may remain in excess provided its undue exercise is not such as is incompatible with life. Through countless ages, for example, the feelings which insure the maintenance of the race have been strengthened by natural selection, because of their prime importance to every race. But under the conditions of civilized life, the sexual passion has become a function in excess, which natural selection is powerless to reduce, because, although it is probably the source of more crime and misery than any other excessive function, and therefore detracts more from complete individuation or the fulness of human life than any other, it is nevertheless but seldom incompatible with the maintenance of life. In all such cases, mankind has so many other functions, besides the excessive ones, which enable it to subsist and achieve progress in spite of them, that their reduction to the

[1] Spencer, op. cit. i. 284.

normal standard is left for the slow process of direct equilibration.

The action of direct equilibration, in turn, is greatly complicated, among the progressive races, by the rapid and extensive change of the social environment from age to age. A new set of readjustments needs to be made before the old ones are completed; and the result is that there are always a number of functions somewhat out of balance. When civilization is rapidly progressing, each generation of men is forced into kinds of activity to which the inherited emotional tendencies, and in some cases even the inherited physical constitutions, are not thoroughly adapted. Hence the number and variety of pathological phenomena, both mental and physical, is greater in civilized than in savage communities. As might be expected, the present century, which has witnessed a far more extensive revolution in the modes of human activity than any previous age, exhibits numerous instances of these minor failures of adjustment. To take the most conspicuous example,—the progress of science and industry during the past three generations have raised the average standard of comfortable living so greatly and so suddenly, that to attain this standard an excessive strain is put upon men's powers. In many respects, it is harder to live to-day than it was a hundred years ago. As a general rule we are overworked until late in life, in the mere effort to secure the means of maintaining life. Not only does this continual overwork entail a serious disturbance of the normal equilibrium between pleasures and pains and the correlative benefits and injuries, since it involves the undue exertion of certain faculties and the undue repression of others, but there is further disturbance due to the specific character of the overwork. Throughout a very large and constantly increasing portion of the community, the excessive labour is intellectual labour; the abnormal strain comes upon the nervous system. The task of maintaining the correspondence with environing relations, which in the course of organic evolution has been entrusted more and more largely to the nervous system, and which in the course of social evolution has been thrown more and more upon the cerebrum, has during the past hundred years been thrown upon the cerebrum to a formidable extent. The community, therefore, is suffering not simply from overwork, but from excessive brain-work, in the shape of inordinate thinking and planning, and inordinate anxiety. "Further, it is to be observed that many of the industrial activities which the struggle for existence has thrust on the members of modern societies, are in-door activities,—activities not only not responded to by the feelings inherited from aboriginal men, but in direct conflict with those more remotely inherited and deeply organized feelings which prompt a varied life in the open air." Hence manifold disturbance. "A sedentary occupation pursued for years in a confined air, regardless of protesting sensations, brings about a degenerate physical state in which the inherited feelings are greatly out of harmony with the superinduced requirements of the body. Desired foods, originally appropriate, become indigestible. An air pleasure-giving by its freshness to those in vigour, brings colds and rheumatisms. Amounts of exertion and excitement naturally healthful and gratifying are found injurious. All which evils, due though they are to continued disregard of the guidance of inherited feelings, come eventually to be mistaken for proofs that the guidance of inherited feelings is worthless." [1]

Further to pursue this interesting subject would be to convert a set of illustrations, already too elaborately stated, into an unmanageable digression. Summing up the results now obtained, we see that natural selection, acting less rigidly under the limitations imposed by social evolution, fails to

[1] Spencer, op. cit. i. 282, 283. Light is thus thrown upon the misuse of alcohol and tobacco,—one of the most conspicuous of the cases in which men's physical appetites prompt to actions that are injurious.

reduce functions that are in excess, and leaves them to be reduced by direct equilibration. The process is accordingly slow, since direct adaptation to a rapidly changing environment is attended by the appearance of minor unfitnesses which further complicate the emotional disturbance, and disarrange the normal relations between incentives and actions. We need not, therefore, be surprised at the fact that men often find pleasure in detrimental activities; nor need we indorse the Puritanic or ascetic theory, suggested partly by the contemplation of this fact, "that painful actions are beneficial and pleasurable actions detrimental." For if this were to any considerable extent the case, sentient life would inevitably disappear from the face of the earth. The cases which we have cited belong to ethical pathology. And just as pathologic phenomena do not invalidate the laws of physiology, just as the dynamic theory of life is not invalidated by the fact that mal-adjustments are continually met with, so neither do cases of moral disease invalidate the corollary which inevitably follows from the Doctrine of Evolution, "that pleasures are the incentives to life-supporting acts, and pains the deterrents from life-destroying acts."

We are now prepared to deal with the phenomena of Right and Wrong, and to notice how they become distinguished from the phenomena of Pleasure and Pain. Though the foregoing discussion forms the basis for a general doctrine of morality, it is nevertheless an inadequate basis, until properly supplemented. The existence of a moral sense has purposely been as far as possible unrecognized; for I believe that in dealing with these complex subjects, little can be accomplished, save on the plan of separately cornering the various elements in the problem, and flooring them one by one. Any philosophy of ethics, therefore, which might be founded upon the preceding analysis, could be nothing more than a theory of Hedonism, recognizing no other incentive to proper action than the pleasing of one's self. By one of the innumerable tricks which the misuse of current words plays with the understanding, the so-called utilitarian theory has been, and still is, not unfrequently identified with this kind of hedonistic philosophy, which is in truth its very antipodes. The error is much like that involved in the accusation of fatalism, commonly hurled at those who maintain the obvious and harmless assertion that moral actions conform to law. But the difference, comprising the entire difference between the noblest self-sacrifice and the meanest self-fondling, is as follows: In our theory of pleasure and pain, which if taken as ultimate would be hedonism, the well-being of the community has been as far as possible omitted from the account. Wherever I have introduced references to social phenomena, I have considered them only in their effects upon the fulness of life of the individual. In dealing with the incentives to action in a race of brute animals, the foregoing considerations would be sufficient. But in the so-called utilitarian theory as it is now to be expounded, the well-being of the community, even when incompatible with that of the individual, is the all-important consideration. While the actions deemed pleasurable are those which conduce to the fulness of life of the Individual, the actions deemed right are those which conduce to the fulness of life of the Community. And while the actions deemed painful are those which detract from the fulness of life of the Individual, the actions deemed wrong are those which detract from the fulness of life of the Community. According to utilitarianism, therefore, as here expounded, the conduct approved as moral is the disinterested service of the community, and the conduct stigmatized as immoral is the selfish preference of individual interests to those of the community. And bearing in mind that the community, which primevally comprised only the little tribe, has by long-continued social integration come to comprise the entire human race, we have the ultimate theorem of the utilitarian philosophy, as properly understood, that actions morally right are those which are beneficial to Humanity, while actions morally wrong are those which are detrimental to Humanity.

Are we to maintain, then, that when we approve of certain actions, we do so because we consciously and deliberately reason out, in each particular case, the conclusion that these actions are beneficial to mankind? By no means. Not only is it that the highest science cannot always enable us to say surely of a given action that it is useful to mankind, but it is also that we do not stop to apply science to the matter at all. We approve of certain actions and disapprove of certain actions quite instinctively. We shrink from stealing or lying as we shrink from burning our fingers; and we no more stop to frame the theorem that stealing and lying, if universally practised, must entail social dissolution and a reversion to primeval barbarism, than we stop to frame the theorem that frequent burning of the fingers must entail an incapacity for efficient manual operations. In short, there is in our psychical structure a moral sense which is as quickly and directly hurt by wrong-doing or the idea of wrong-doing as our tactile sense is hurt by stinging.

Shall we, then, maintain, as a corollary from the Doctrine of Evolution, that our moral sense is due to the organic registration, through countless ages, of deliberate inferences that some actions benefit Humanity, while others injure it? Shall we say that the primeval savage began by reasoning his way to the conclusion that if treachery were to be generally allowed, within the limits of the tribe, then the tribe must succumb in the struggle for existence to other tribes in which treachery was forbidden; and that, by a gradual organization of such inductions from experience, our moral sense has slowly arisen? This position is no more tenable than the other. Mr. Richard Hutton and Mr. St. George Mivart would seem to have attributed to Mr. Spencer some such doctrine. But Mr. Spencer is too profound a thinker to ignore so completely the conditions under which permanent emotional states are generated. Our moral sense has arisen in no such way. But to understand the way in which it has arisen, we must recur to our fundamental problem, and seek for the conditions which first enabled social evolution, as distinguished from organic evolution, to start upon its career.

It is now time to propose an answer to the question, already twice suggested and partly answered, How did social evolution originate? Starting from the researches of Sir Henry Maine, which are supported by those of Messrs. Tylor, M'Lennan, and Lubbock, we have come to the conclusion that it originated when families, temporarily organized among all the higher gregarious mammals, became in the case of the highest mammal permanently organized. Starting from the deductions of Mr. Wallace, we have seen reason for believing that civilization originated when in the highest mammal variations in intelligence became so much more important than variations in physical structure that they began to be seized upon by natural selection to the relative exclusion of the latter. In the permanent family we have the germ of society. In the response to outer relations by psychical changes, which almost completely subordinate physical changes, we have the germ of civilization. Let us now take a step in advance of previous speculation,[1] and see what can be done by combining these two theorems, so that the permanent organization of families and the complex intelligence of the highest mammal will appear in their causal relations to each other.

Many mammals are gregarious, and gregariousness implies

[1] The latest writer upon these subjects is inclined to give up the problem as insoluble. "I at least find it difficult to conceive of men, at all like the present men, unless existing in something like families, that is, in groups avowedly connected, at least on the mother's side, and probably always with a vestige of connection, more or less, on the father's side, and unless these groups were, like many animals, gregarious, under a leader more or less fixed. It is almost beyond imagination how man, as we know man, could by any sort of process have gained this step in civilization."—Bagehot, *Physics and Politics*, p. 136.

incipient power of combination and of mutual protection. But gregariousness differs from sociality by the absence of definitive family relationships, except during the brief and intermittent periods in which there are helpless offspring to be protected. Now it might be maintained that the complex intelligence of the highest mammal led him vaguely to recognize the advantage of associating in more and more permanent groups for the sake of mutual protection. From this point of view Mr. Darwin argues that men were originally a race of weak and mild creatures like chimpanzees, and not a race of strong and ferocious creatures like gorillas, and were accordingly forced to combine because unable to defend themselves singly. It is undeniable that man is, relatively to his size, a weak animal; and there is much value in Mr. Darwin's suggestion in so far as it goes to explain the origin of gregariousness among those primates who were the ancestors of man. Nevertheless, it can hardly be said to explain Sociality as distinguished from Gregariousness. It may also be argued that the superior sagacity even of the lowest savage makes him quite a formidable antagonist to animals much more powerful than himself. Besides, the study of savage life brings out results at variance with the notion of man's primitive gentleness. A strong case might be made in support of the statement that uncivilized man is an extremely ferocious animal, and that among savage races, which certainly differ very notably in natural ferocity of disposition, the most ferocious tribes are often the most likely to become dominant and assist social integration by subduing other tribes. The earliest annals of the highest of human races, the Aryan, certainly bear witness to extreme ferocity, checked and determined in its direction by a moral sense further developed than that of savages. While recognizing, therefore, the value of Mr. Darwin's suggestion, so far as it goes, I believe that the true explanation lies much further beneath the surface.

It will be remembered that, in treating of the parallel evolution of the mind and the nervous system,[1] it was shown that the increase of intelligence in complexity and speciality involves a lengthening of the period during which the nervous connections involved in ordinary adjustments are becoming organized. Even if the physical interpretation there given should turn out to be inadequate, the fact remains undeniable, that while the nervous connections accompanying a simple intelligence are already organized at birth, the nervous connections accompanying a complex intelligence are chiefly organized after birth. Thus there arise the phenomena of infancy, which are non-existent among those animals whose psychical actions are purely reflex and instinctive. Infancy, psychologically considered, is the period during which the nerve-connections and correlative ideal associations necessary for self-maintenance are becoming permanently established. Now this period, which only begins to exist when the intelligence is considerably complex, becomes longer and longer as the intelligence increases in complexity. In the human race it is much longer than in any other race of mammals, and it is much longer in the civilized man than in the savage.[2] Indeed among the educated classes of civilized society, its average duration may be said to be rather more than a quarter of a century, since during all this time those who are to live by brain-work are simply acquiring the capacity to do so, and are usually supported upon the products of parental labour.

It need not be said that, on the general theory of evolution, the passage from the short infancy of other primates to the relatively long infancy witnessed among the lowest contemporary savages, cannot have been a sudden one.[3] But

[1] See above, part ii. chap. xvi.

[2] Possibly there may be a kindred implication in the fact that women attain maturity earlier than men.

[3] In this connection it is interesting to observe that the phenomena of infancy seem to be decidedly more marked in the anthropoid apes than in other non-human primates. At the age of one month the orang-outang begins

a special reason may be assigned why Nature, which never makes long jumps, must have been incapable of making this particular jump. Throughout the animal kingdom the period of infancy is correlated with feelings of parental affection, sometimes confined to the mother, but often shared by the father, as in the case of animals which mate. Where, as among the lower animals, there is no infancy, there is no parental affection. Where the infancy is very short, the parental feeling, though intense while it lasts, presently disappears, and the offspring cease to be distinguished from strangers of the same species. And in general the duration of the feelings which insure the protection of the offspring is determined by the duration of the infancy. The agency of natural selection in maintaining this balance is too obvious to need illustration. Hence, if long infancies could have suddenly come into existence among a primitive race of ape-like men, the race would have quickly perished from inadequate persistence of the parental affections. The prolongation must therefore have been gradual, and the same increase of intelligence to which it was due must also have prolonged the correlative parental feelings, by associating them more and more with anticipations and memories. The concluding phases of this long change may be witnessed in the course of civilization. Our parental affections now endure through life; and while their fundamental instinct is perhaps no stronger than in savages, they are, nevertheless, far more effectively powerful, owing to our far greater power of remembering the past and anticipating the future.

I believe we have now reached a very thorough and satisfactory explanation of the change from Gregariousness to

---

to learn to walk, holding on to convenient objects of support, like a human infant. Up to this time it lies on its back, tossing about and examining its hands and feet. A monkey at the same age has reached maturity, so far as locomotion and prehension are concerned. See Mr. Wallace's interesting experience with an infant orang-outang, in his *Malay Archipelago*, vol. i. pp. 68—71.

Sociality. Bear in mind that I am not indulging in pure hypothesis. The prolongation of infancy accompanying the development of intelligence, and the correlative extension of parental feelings, are facts established by observation wherever observation is possible. And to maintain that the correlation of these phenomena was kept up during an epoch which is hidden from observation, and can only be known by inference, is to make a genuine induction, involving no other assumption than that the operations of nature are uniform. To him who is still capable of believing that the human race was created by miracle in a single day, with all its attributes, physical and psychical, compounded and proportioned just as they now are, the present inquiry is, of course, devoid of significance. But for the evolutionist there would seem to be no alternative but to accept, when once propounded, the present series of inferences.

For the process here described, when long enough continued, must inevitably differentiate and integrate a herd or troop of gregarious ape-like men into a number of small family communities such as are now found among the lowest savages. The prolonged helplessness of the offspring must keep the parents together for longer and longer periods in successive epochs; and when at last the association is so long kept up that the older children are growing mature while the younger ones still need protection, the family relations begin to become permanent. The parents have lived so long in company, that to seek new companionships involves some disturbance of engrained habits; and meanwhile the older sons are more likely to continue their original association with each other than to establish associations with strangers, since they have common objects to achieve, and common enmities, bequeathed and acquired, with neighbouring families. As the parent dies, the headship of the family thus established devolves upon the oldest, or bravest, or most sagacious male remaining. Thus the little group gradually becomes a clan, the members of which are united by ties considerably stronger than those which ally them to members of adjacent clans, with whom they may indeed combine to resist the aggressions of yet further outlying clans, or of formidable beasts, but towards whom their feelings are usually those of hostile rivalry. It remains to add, that the family groups thus constituted differ widely in many respects from modern families, and do not afford the materials for an idyllic picture of primeval life. Though always ready to combine against the attack of a neighbouring clan, the members of the group are by no means indisposed to fight among themselves. The sociality is but nascent: infants are drowned, wives are beaten to death, and there are deadly quarrels between brothers. So in modern families evanescent barbarism shows itself in internal quarrels, while nevertheless injury offered from without is resented in common. A more conspicuous difference is the absence of monogamy in the primitive clan. It has been, I think, demonstrated,—and for the evidence in detail I would refer to Sir John Lubbock's excellent treatise on the "Origin of Civilization," and to the learned works of M'Lennan and Tylor,—that in the primitive clan all the women are the wives of all the men. Traces of this state of things, which some of our half-educated "reformers" would fain restore, are found all over the world, both in modern savage communities and in traditional observances preserved by communities anciently civilized. There was also, as Sir Henry Maine has proved, entire community of lands and goods, and the individual possessed no personal rights as against the interests of the clan. And let us note, in conclusion, that this state of things, while chiefly brought about by the process of direct equilibration above described, is just that which natural selection must assist and maintain so long as the incipient community is small and encompassed by dangers.

Thus we cross the chasm which divides animality from humanity, gregariousness from sociality, hedonism from morality, the sense of pleasure and pain from the sense of right and wrong. For note that by the time integration has resulted in the establishment of a permanent family group with definite relationships between the members, the incentives to action in each member of the group have become quite different from what they were in a state of mere gregariousness. Sympathy, or the power of ideally reproducing in one's self the pleasures and pains of another person, is manifested in a rudimentary form by all gregarious animals of moderate intelligence. Not unfrequently, as Mr. Darwin shows, a baboon has been known to risk his life to save that of a comrade; and the higher apes habitually take under their care young orphans of their own species. It is evident that this power of sympathy must be strengthened and further developed when a number of individuals are brought into closer and more enduring relationships, even though these come far short of what, from our modern ethical standard, would be termed loving. Affection in the savage clan is but partially preventive of fiendish cruelty; yet there is an ability in the members to understand each other's feelings, and there is a desire for the approbation of fellow-clansmen. Kinship in blood, as well as community of pursuits and interests, promotes these feelings. Even to-day we can usually understand the mental habits, desires, and repugnances of our own immediate kindred better than we can understand those of other people unrelated to us, even though circumstances may now and then have led us to prefer the society of the latter. We can more readily admire their excellences and condone their faults, for their faults and excellences are likely to be in a measure our own.

Given this rudimentary capacity of sympathy, we can see how family integration must alter and complicate the emotional incentives to action. While the individual may still exercise his brute-like predatory instincts upon strangers and lower animals, and will, indeed, be more highly approved the more he does so, on the other hand there is a curb upon his exercise of them within the limits of the clan. There is a nascent public opinion which lauds actions beneficial to the clan, and frowns upon actions detrimental to it; though for this it is not necessary that there should be a generalization of the effects of certain actions, any more than a generalization of the effects of hunger is needed to insure the individual's approval of eating. The mere present sense of collective pleasure or pain is enough to organize the complex feeling. For example, when a marauding expedition upon a neighbouring clan is defeated by the cowardice or treachery of one of the party, the offender is perhaps beaten, kicked, or killed. The present sense of collective pain immediately prompts the actions which tend to repress the cowardice or treachery. On the other hand, the pleasurable states which result in all the members of the clan, in common, after an exhibition of successful bravery, immediately generate approval of the man who is brave, along with the desire to imitate him. In short,—to quote Mr. Spencer,—one of the things that come to be strongly associated in the mind of the young savage, with marks of approval, "which are symbolical of pleasures in general, is courage; and one of the things that comes to be associated in his mind with frowns and other marks of enmity, which form his symbol of unhappiness, is cowardice. These feelings are not formed in him because he has reasoned his way to the truth that courage is useful to his tribe, and by implication to himself, or to the truth that cowardice is a cause of evil. In adult life he may, perhaps, see this; but he certainly does not see it at the time when bravery is thus associated in his consciousness with all that is good, and cowardice with all that is bad. Similarly there are produced in him feelings of inclination or repugnance towards other lines of conduct that have become established or interdicted, because they are beneficial or injurious to the tribe; though neither the young nor the adults know why they have become established or interdicted. Instance the praiseworthiness of wife-stealing and the viciousness of marrying within the tribe."[1] In these ways the establishment of permanent family relationships generates new incentives to action, unknown in the previous epoch of mere gregariousness, which must often, and in some instances habitually, overrule the mere animal incentives comprised in personal pleasures and pains. The good of the individual must begin to yield to the good of the community.

Next in order comes the genesis of the feelings of regret and remorse, which are the fundamental ingredients of conscience. This part of the subject has been ably treated by Mr. Darwin, whose chapter on the Moral Sense is one of the most profound and suggestive chapters in his recent work on the "Descent of Man." Mr. Darwin points to the important fact, that, while the incentives to actions beneficial to the community are always steadily in operation, on the other hand the purely selfish impulses, although frequently strong enough to acquire temporary mastery over the others, are nevertheless accompanied by pleasures that are brief in duration and leave behind memories of comparatively slight vividness. Now, when intelligence has progressed to a point where there is some definite memory of particular past actions, the workings of the mind, with reference to conduct, begin to assume a more strictly moral character. Though at the moment of action a man may yield to the desire of gratifying hunger, or revenge, or cupidity, at the cost of violating the rules enforced by social sanctions, yet afterwards, when "past and weaker impressions are contrasted with the ever-enduring social instincts, retribution will surely come. Man will then feel dissatisfied with himself, and will resolve, with more or less force, to act differently for the future. This is conscience; for conscience looks backward and judges past

[1] Spencer, *Recent Discussions*, p. 23.

actions, inducing that kind of dissatisfaction which, if weak, we call regret, and, if severe, remorse."[1]

All these varieties of incentive are next reinforced by incentives of a mysterious and supernatural character. When intelligence has progressed to the point where some curiosity is felt concerning the causes of phenomena,—a point barely reached by the lowest contemporary savages,—mythologies begin to be framed. A mythology is a rudimentary cosmic philosophy; and let me note, in passing, that an uncivilized race must have attained considerable latent philosophic capacity before it can construct a rich mythology,—instance the luxuriant folk-lore of Greece as contrasted with the scanty mythology of savages. Now, the earliest kind of philosophy is fetishism, by which natural phenomena are attributed to the volitions of countless supernatural agencies. What are these agencies? Recent researches have elicited the fact that they are supposed to be the ghosts of the dead ancestors of the tribe. The dead chief, who appears to the savage in dreams, is supposed to rule the winds and floods, and to visit with his wrath those who violate the rules of action established in the tribe.[2] When one of Mr. Darwin's companions, in Tierra del Fuego, shot some birds to preserve as specimens, a Fuegian present exclaimed, "O Mr. Bynoe, rain much, much wind, blow much!" thus indicating his belief that the wasting of food, condemned by tribal rules, would be visited with condign punishment by the tutelar deities of the tribe. "This transfigured form of restraint," says Mr. Spencer, "differing at first but little from the original form, is capable of immense development." As the fetishistic agencies are generalized into the deities of polytheism, and these in time are summed up in a single anthropomorphic deity, there slowly grows up the theory of a hell in which actions condemned by the community will be punished. The complex

[1] Darwin, *Descent of Man*, vol. i. p. 87.
[2] See *Myths and Myth-Makers*, pp. 75, 237.

conceptions of good and evil are thus so widely differentiated from the simpler conceptions of pleasure and pain, that the traces of the original kinship are obscured. This kind of restraint has not ceased to operate upon numbers of civilized men at the present day; and theologians tell us that, if it were removed, there would ensue a moral retrogression. So doubtless there would, if it could be removed prematurely.

Returning to our savage, it must be observed that these combined agencies have enforced upon him an amount of self-restraint, in view of tribal sanctions, which differentiates him widely from any gregarious animal. Savages are not unfrequently capable of extreme devotion and self-sacrifice when the interests of the tribe are at stake: instances are not rare in which they will deliberately choose to be shot rather than betray the plans of their fellow-tribesmen. It is to such cases as these that we must attribute the discrepancies in the accounts of savage morality given by different travellers.[1] If we do not stop to analyze the matter, such instances may seem to prove that the savage is morally on a level with us. But the analysis of countless seemingly inconsistent observations shows that savage virtues are, in general, confined to the clan. The same savage who will suffer torture with equanimity, rather than betray his comrades, is also capable of the most fiendish cruelty and treachery toward the members of another clan. For the very forces which, during long ages, have brought him to the point at which he can sacrifice his own pleasure to the good of the tribe, have also been impressing upon him the meritoriousness of letting loose all his brutal instincts beyond the tribal limits. The savage has no sense of the wickedness of killing, stealing, and lying, in the abstract, or of the

[1] Between different savage races, moreover, there are undoubtedly great differences in emotional characteristics. While some, as the Fijis, are exceptionally ferocious, others, as the Hawaiians and Eskimos, appear to be comparatively gentle and sympathetic.

horrible cruelty of tying his enemy to a tree and slowly burning him to death with firebrands. To the Indians described by Mr. Parkman, such villany formed the most delightful of recreations.

Thus, though the savage has the germ of a moral sense, which prompts him, irrespective of utilitarian considerations, to postpone his personal welfare to that of his clan, he can by no means be accredited with a fully developed moral sense. And the incentives which influence him are not what we call moral sentiments, in the strict sense of the phrase. "They are simply sentiments that precede and make possible those highest sentiments which do not refer either to personal benefits or evils to be expected from men, or to more remote rewards and punishments." The lower incentives have indeed continued to exert a powerful, perhaps a predominating, influence down to the present time. So long as readers are found for ethical treatises, like that of Jonathan Dymond, in which the sole ground of moral obligation is held to be the supernaturally revealed fiat of an anthropomorphic Deity; "while sermons set forth the torments of the damned and the joys of the blessed as the chief deterrents and incentives, and while we have prepared for us printed instructions 'how to make the best of both worlds'; it cannot be denied that the feelings which impel and restrain men are still largely composed of elements like those operative on the savage,—the dread, partly vague, partly specific, associated with the idea of reprobation, human and divine, and the sense of satisfaction, partly vague, partly specific, associated with the idea of approbation, human and divine."[1] But a sound ethical philosophy regards it as degrading to perform good actions or to refrain from performing bad actions merely in order to win applause or to secure a place in heaven. Something more is needed to complete our account of the moral sense.

[1] Spencer, *Principles of Psychology*, vol. ii. p. 602.

Nevertheless, the more perilous portions of the labyrinth have been traversed, I hope with safety, and we now need only one more clew to bring us to the light. We shall best realize the character of this additional element needed, if we consider for a moment the most general aspects of the two groups of feelings already described. While the feelings of which we first treated under the head of pleasures and pains are purely egoistic or self-regarding feelings, on the other hand the feelings which we have lately described as underlying and forming the groundwork of the moral sense in a state of sociality have been happily characterized by Mr. Spencer as "ego-altruistic" feelings. That is, they concern the happiness of the individual in so far as it depends upon the feelings with which his fellow-creatures regard him. The mixed feeling ordinarily known as generosity, for example, is often to a very large extent ego-altruistic. "The state of consciousness which accompanies performance of an act beneficial to another is usually mixed; and often the pleasure given is represented less vividly than are the recipient's feeling toward the giver and the approval of spectators. The sentiment of generosity proper is, however, unmixed in those cases where the benefaction is anonymous: provided, also, that there is no contemplation of a reward to be reaped hereafter. These conditions being fulfilled, the benefaction clearly implies a vivid representation of the pleasurable feelings (usually themselves representative) which the recipient will have."[1]

This vivid representation of the pleasurable or painful feelings experienced by others is sympathy; and the additional factor to be taken into the account, in order to complete the explanation of the moral sense, is the enormous expansion of sympathy which has been due to the continued integration of communities, and to the accompanying decrease of warlike or predatory activity. A word of passing comment only is

[1] Spencer, *Principles of Psychology*, vol. ii. p. 613.

needed for the cynical theory that sympathy is but an ethereally refined selfishness, and that when we relieve a fellow-creature in distress we do it only because it pains us to see him suffer. This is true; but when the pain occasioned by the sight of another's suffering, or by the idea of suffering and wrong when generalized and detached from the incidents of particular cases, becomes so strong as to determine our actions, then the chasm is entirely crossed which divides us psychically from the brutes. Between the Fiji, who keenly relishes the shrieks of his human victim, and Uncle Toby, who could not kill a fly and pitied even the Devil, the difference has come to be generic. And when this kind of self-pleasing is carried so far as to lead a man to risk his life in the effort to rescue a stranger, or perhaps even an enemy, from fire, or drowning, it is so widely removed from what we mean when we speak of selfishness as to be antithetical to it. We do not describe the workings of Shakespeare's genius as reflex actions, though all intelligence was originally reflex action. Neither are we justified in describing as selfish the actions which are dictated by sympathy, though all sympathy is in its origin a kind of self-pleasing.

As already shown in describing the chief characteristics of the evolution of society, the primary cause which has developed sympathy at the expense of the egoistic instincts has been the continued integration of communities, originally mere tribes or clans, into social aggregates of higher and higher orders of complexity. For by this long-continued process the opportunities for the exercise of the altruistic feelings have been necessarily increased in number and frequency of occurrence, while the occasions requiring the exercise of the anti-social feelings have become less frequent, so that the former set of feelings have become strengthened by use, while the latter have become relatively weakened by disuse. Along with this direct and obvious effect of social integration, another effect has been wrought, indirect and less obvious. A high development of sympathy cannot be secured without a high development of representativeness, so closely inter-related are our intellectual and moral natures. A very feeble faculty of imagining objects and relations not present to sense must necessitate an absence of active sympathetic emotion, save in its crudest form. It is a familiar fact that many men are cruel, in word or deed, because they are incapable of adequately representing to themselves the pain, physical or mental, of which they are the cause. The validity of such an interpretation is confirmed by the fact that even where there is very high representative capacity, the lack of the requisite elements of personal experience will prevent the rise of sympathetic feeling. Thus it is notoriously difficult for strong and healthy people to enter into the feelings of those who are weak and nervous. These facts show that the development of sympathy is largely determined by the development of the representative faculty and by increasing width and variety of experience. With the simplest form of sympathy, such as the painful thrill felt on seeing some one in a dangerous position, contrast such a complex sentiment as the sense of injustice, and it becomes evident that the latter feeling differs from the former mainly in degree and quantity of representativeness. In the former case there is a representation of the injury or death impending over some person immediately in sight; and it is the shrinking from this detriment to the fulness of life of another person which constitutes the sympathetic feeling. In the latter case—supposing, for example, the kind of injustice in question to be that against which English-speaking people have made provision in *habeas corpus* acts—there is the sympathetic excitement of that highly representative egoistic sentiment known as the love of personal freedom. At first a mere recalcitration against whatever impedes the free action of the limbs, this egoistic feeling has, through increased power of representation, developed into a dislike and dread of whatever possible combination of circumstances may in any way, however remotely, interfere with the fullest legitimate exercise of all the functions of physical and psychical life. To have this complex feeling sympathetically excited for persons whom one has never seen, and who are perhaps yet unborn,—and still more, to be so far possessed by this highly generalized and impersonal sympathy as to risk one's own liberty and life in efforts to avert the possible evils which are the objects of its dread,—implies a power of representing absent relations such as has yet been acquired by only two or three of the most highly gifted families of mankind. And manifestly the sentiments which respond to the notions of justice and injustice in the abstract, are still more remotely representative, still more highly generalized, and still more thoroughly disengaged from the consideration of concrete instances of pleasure and pain.

To this expansion of the power of sympathetically representing feelings detached from the incidents of particular cases, until the sphere of its exercise has become even wider than the human race, and includes all sentient existence, is due our instinctive abhorrence of actions which the organically registered experience of mankind has associated with pain and evil, and our instinctive approval of actions similarly associated with pleasure and increased fulness of life. It is not that, as in intellectual progress, there has been a registration of inferences, at first conscious, but finally automatic; but it is that there has been a registration of feelings respectively awakened by pleasure-giving and pain-giving actions. And just as men's intellectual conceptions of the causes of phenomena become more and more impersonal as they are extended over wider and wider groups of phenomena, generating at last an abstract conception of Universal Cause, so free from the element of personality that to less cultivated minds it seems atheistic; so in like manner, as the sympathetic feelings are extended over wider and wider areas, no longer needing the stimulus of present pains and pleasures to call them forth, they generate at last an abstract moral sense, so free from the element of personality that to grosser minds it is unintelligible. The savage cannot understand the justice which he sees among Europeans, and the mercy of the white man is ascribed by him to imbecility or fear. To him some personal end seems necessary as an incentive to action. But the philanthropist finds an adequate incentive in the contemplation of injustice in the abstract.

Thus the ethical theories, as well as the psychology, of the schools of Hume and Kant, appear to be reconciled in the deeper synthesis rendered possible by the theory of evolution. On the one hand, it is a corollary from the laws of life that actions desired by the individual and approved by the community must in the long run be those which tend to heighten the life respectively of the individual and of the community. And on the other hand, it is equally true that there is a highly complex feeling, the product of a slow emotional evolution, which prompts us to certain lines of conduct irrespective of any conscious estimate of pleasures or utilities. In no department of inquiry is the truth and grandeur of the Doctrine of Evolution more magnificently illustrated than in the province of ethics.

Before we conclude, there are one or two further points to which it seems necessary to allude. In asserting that we possess an instinctive and inherited moral sense, it is not meant that we possess, anterior to education and experience, an organic preference for certain particular good actions, and an organic repugnance to certain particular bad actions. We do not inherit a horror of stealing, any more than the Hindu inherits the horror of killing cattle. We simply inherit a feeling which leads us, when we are told that stealing is wrong, to shun it, without needing to be taught that it is detrimental to society. Hence there is a chance for pathological disturbances in the relations between the moral sense and the actions with which it is concerned. Imperfectly adjusted moral codes arise, and false principles of action gain temporary currency. These, nevertheless, come ultimately to outrage our sympathies, and are consequently overthrown; while the principles of action which really tend to heighten the life of society are sustained by our sympathies ever more and more forcibly, and at last become invested with a sacredness which is denied to the others. Hence arises the ethical distinction between *mala prohibita* and *mala in se*.

Finally, it is not to be denied that, when the intelligence is very high, there is likely to arise a deliberate pursuit of moral excellence, attended by a distinct knowledge of the elements in which such excellence consists. Instead of being primeval, as the cruder utilitarianism seems to have imagined, such conscious devotion to ends conducive to the happiness of society is the latest and highest product of social evolution, and becomes possible only when the moral sense is extremely developed. At this stage, ethical conceptions begin to be reflected back upon the conduct of the individual where it concerns solely or chiefly himself; and the self-regarding virtues, as Mr. Darwin calls them, which are quite unknown save in a high state of civilization, come into existence. The injury of one's self, by evil thoughts, intemperate behaviour, or indulgence of appetite, comes to be regarded as not only physically injurious, but morally wrong; and there arises the opinion that it is selfish and wicked for one to neglect one's own health or culture. Here we approach the limits at which morality shades off into religion. For, as I shall hereafter show,[1] Religion views the individual in his relations to the Infinite Power manifested in a universe of causally connected phenomena, as Morality views him in relation to his fellow-creatures. To violate the decrees of Nature comes to be considered a sin, capable of

[1] See below, part iii. chap. v.

awakening keen remorse; for to him whose mental habits have been nurtured by scientific studies, the principles of action prescribed by the need for harmonizing inner with outer relations are, in the truest sense, the decrees of God.

And now, having reached the terminus of our inquiry, let us look back over the course for a moment, that we may see the character of the progress we have achieved. Such a retrospect is here especially needed, because the complexity of our subject has been so great, and the range of our illustrations so wide, that the cardinal points in our argument have perhaps run some risk of getting overlaid and concealed from view, and in particular it may not be sufficiently obvious how completely we have attained the object set before us as the goal of the present chapter and its predecessor, namely, to explain the genesis of the psychical forces which wrought the decisive change from animality to humanity. That we may well appreciate the solid consistency of the entire argument concerning the Genesis of Man, let us therefore contemplate in a single view its various factors.

We have seen that the progress from brute to man has been but slightly characterized by change in general bodily structure in comparison with the enormous change which has been wrought in the cerebrum, and in those highest psychical functions which stand in correlation with the condition of the cerebrum. We have seen that the development of these highest psychical functions, in all their wondrous variety and complexity, has consisted at bottom in the increase of the power of mentally representing objects and relations remote from sense. By the reiterated testimony of many diverse kinds of illustrative facts, we have been convinced that in mere quantity of representative capacity, with its infinitely various consequences, the civilized man surpasses the lowest savage by a far greater interval than that by which the lowest savage surpasses the highest ape; just as the gulf between the cerebral capacity of the Englishman and that of the non-Aryan dweller in Hindustan is six times greater than the gulf which similarly divides the non-Aryan Hindu from the gorilla. And we have indicated in sundry ways how this increase in representative capacity, itself a pre-requisite to any high degree of social combination, has been furthered by each advance in social combination, so that the enormous psychical progress achieved since mankind became distinctly human has been mainly dependent upon that increasing heterogeneity of experience which increasing social integration has supplied.

But in spite of the fact that the psychical progress achieved since mankind became distinctly human is so much greater in quantity than that which was required to carry it from apehood to manhood, we were led to adopt the Duke of Argyll's suggestion, that the boundary was really crossed when this preliminary and less conspicuous psychical progress had been achieved. And working out the happy thought which science owes to Mr. Wallace, we concluded that this comparatively inconspicuous but all-essential step in psychical progress was taken when the intelligence of the progenitors of mankind had reached the point where a slight increase in representative capacity came to be of greater utility to the species than any practicable variation in bodily structure. Here our first line of inquiry ended. So far as the mere subordination of physical to psychical modification is concerned, the character of the progress from apehood to manhood now became intelligible.

But at this point we were confronted with a new question, suggested by some of the conclusions obtained on our first line of inquiry. Having perceived that the intellectual progress, or increase in representative capacity, which distinguishes man from brute, is so intimately connected with man's capacity for social combination, it became needful to search for the circumstances which begot in the progenitors of mankind the capacity for a kind of social combination more definite in the character of its relationships than that quasi-social combination, not uncommon among mammals, which is known as gregariousness. In other words, seeing that such thinkers as Sir Henry Maine have shown that the primordial unit of society, by the manifold compounding of which great tribes and nations have come into existence, was the aboriginal family group, with its nascently ethical relationships between the members, how shall we explain the genesis of these family groups, which have nothing strictly answering to them, either among non-human primates or among other gregarious animals?

The feature by which the most rudimentary human family group is distinguished from any collocation of kindred individuals among gregarious mammals is the permanent character of the relationships between its constituent members. Enduring from birth until death, these relationships acquire a traditionary value which passes on from generation to generation, and thus there arise reciprocal necessities of behaviour between parents and children, husbands and wives, brethren and sisters, in which reciprocal necessities of behaviour we have discerned the requisite conditions for the genesis of those ego-altruistic impulses which, when further modified by the expansion of the sympathetic feelings, give birth to moral sentiments. Accordingly the phenomenon which demands explanation is the existence of permanent relationships, giving rise to reciprocal necessities of behaviour, among a group of individuals associated for the performance of sexual and parental functions.

The explanation, as I have shown, is to be found in that gradual prolongation of the period of infancy, which is one of the consequences, as yet but partially understood, of increasing intelligence. Let us observe the causal connections so far as we can trace them out, recalling some of the conclusions reached in the chapter on the Evolution of Mind.

In an animal whose relations with its environment are very simple, resulting in an experience which is but slightly varied, the combinations of acts requisite for supporting life take place with a regularity and monotony approaching the monotonous regularity with which the functions of the viscera are performed. Hence the tendency to perform these actions is completely established at birth in each individual, just as the tendency of the viscera to perform their several functions is pre-established, all that is required in addition being simply the direct stimulus of outward physical opportunity. And the psychical life of such an animal we call purely instinctive or automatic. In such an animal the organized experience of the race counts for everything, the experience of the individual for nothing, save as contributing its mite towards the cumulated experience of the race. But in an animal whose relations with its environment are very complex, resulting in an experience which is necessarily varied to a considerable extent from generation to generation, the combinations of acts requisite for supporting life must occur severally with far less frequency than in the case of the lower animal just considered. Hence the tendency to perform any particular group of these actions will *not* be completely established at birth in each individual, like the tendency of the viscera to perform their several functions. On the other hand, there will be a multitude of conflicting tendencies, and it will be left for the circumstances subsequent to birth to determine which groups of tendencies shall be carried out into action. The psychical life of such an animal is no longer purely automatic or instinctive. A portion of its life is spent in giving direction to its future career, and in thus further modifying the inherited tendencies with which its offspring start in life. In such an animal the organized experience of the race counts for much, but the special experience of the individual counts for something in altering the future career of the race. Such an animal is capable of psychical progress, and such an animal must begin life, not with matured faculties, but as an infant. Instead of a few actually realized capacities, it starts with a host of potential capacities, of which the play of circumstance must determine what ones shall be realizable.

Manifestly, therefore, the very state of things which made psychical variation more advantageous to the progenitors of mankind than physical variation, this very state of things simultaneously conspired to enhance the progressiveness of primeval man and to prolong the period of his infancy, until the plastic or malleable part of his life came to extend over several years, instead of terminating in rigidity in the course of four or five months, as with the orang-outang. Upon the consequences of this state of things, in gradually bringing about that capacity for progress which distinguishes man from all lower animals, I need not further enlarge. What we have here especially to note, amid the entanglement of all these causes conspiring to educe humanity from animality, is the fact, illustrated above, that this prolongation of infancy was manifestly the circumstance which knit those permanent relationships, giving rise to reciprocal necessities of behaviour, which distinguish the rudest imaginable family group of men from the highest imaginable association of gregarious non-human primates.

In this line of inquiry, which, so far as I know, has never yet been noticed by any of the able writers who have dealt with the origin of the human race, it seems to me that we have the clew to the solution of the entire problem. In this new suggestion as to the causes and the effects of the prolonged infancy of man, I believe we have a suggestion as fruitful as the one which we owe to Mr. Wallace. And the most beautiful and striking feature in this treatment of the problem is the way in which all the suggestions hitherto made agree in helping us to the solution. That same increase in representativeness, which is at the bottom of intellectual progressiveness, is also at the bottom of sociality, since it necessitates that prolongation of infancy to which the genesis of sociality, as distinguished from mere gregariousness, must look for its explanation. In this phenomenon of the prolonging of the period of infancy we find the bond of connection between the problems which occupy such thinkers as Mr. Wallace and those which occupy such thinkers as Sir Henry Maine. We bridge the gulf which seems, on a superficial view, for ever to divide the human from the brute world. And not least, in the grand result, is the profound meaning which is given to the phenomena of helpless babyhood. From of old we have heard the monition, "Except ye be as babes, ye cannot enter the kingdom of heaven." The latest science now shows us—though in a very different sense of the words—that, unless we had been as babes, the ethical phenomena which give all its significance to the phrase "kingdom of heaven" would have been non-existent for us. Without the circumstances of infancy we might have become formidable among animals through sheer force of sharp-wittedness. But, except for these circumstances, we should never have comprehended the meaning of such phrases as "self-sacrifice" or "devotion." The phenomena of social life would have been omitted from the history of the world, and with them the phenomena of ethics and of religion.

# PART III.

## *COROLLARIES.*

> "Was wär' ein Gott der nur von aussen stiesse,
> Im Kreis das All am Finger laufen liesse!
> Ihm ziemt's die Welt im Innern zu bewegen,
> Natur in Sich, Sich in Natur zu hegen;
> So dass was in Ihm lebt und webt und ist
> Nie seine Kraft, nie seinen Geist vermisst."
>
> GOETHE.

"For my thoughts are not your thoughts, neither are your ways my ways. saith the Lord. For as the heavens are higher than the earth, so are my ways higher than your ways, and my thoughts than your thoughts."—ISAIAH.

## CHAPTER I.

### THE QUESTION RESTATED.

A SYNTHESIS of scientific doctrines has now been fairly constructed, in accordance with the plan laid out in the eleventh chapter of our Prolegomena. We have passed in review the sciences which deal with the various orders of phenomena that make up the knowable universe, and we have contemplated the widest truths which these sciences severally reveal, as corollaries of an ultimate truth. Before proceeding to expound our Cosmic Philosophy in its final results, let us briefly sum up the leading conclusions at which we have arrived.

It has been proved to follow from that axiom of the Persistence of Force upon which all physical science is based, that the mere coexistence of innumerable discrete bodies in the universe, exerting attractive and repulsive forces upon each other, necessitates a perpetual rhythmical redistribution of the Matter and Motion of which the phenomenal universe is composed. It has been proved that this eternal rhythm must of necessity be manifested in alternating eras both general and local, of Evolution and Dissolution,— eras in which now the concentration of Matter and dissipation of Motion, and now the diffusion of Matter and absorption of Motion, predominate,—eras which may be short, as in the duration of a snow-crystal or of a butterfly's life, or long, as in the duration of our planetary system. It has been proved that the process of Evolution, during which Matter is chiefly being concentrated while Motion is chiefly being lost, must, under certain assigned conditions, result in a continuous change from a state of homogeneity, indefiniteness, and incoherence to a state of heterogeneity, definiteness, and coherence.

With the aid of these demonstrated truths of Physics, we have surveyed the history of the knowable universe, intent upon finding some provisional answer to the time-honoured question of Philosophy—whence came we, what are we, and whither do we tend? Throughout all the provinces of nature we have traced that aspect of the stupendous process of Evolution, which consists in the transition from indefinite incoherent homogeneity to definite coherent heterogeneity. We have seen it exemplified in the development of our planetary system from a relatively homogeneous ball of vapour. We have witnessed it as shown in the increasing physical and chemical diversity and interdependence of the various portions of the surface of our cooling earth, and in those wonderful differentiations by which solar radiance is metamorphosed into the innumerable forms of energy manifested alike by winds and waves, by growing plants and animals, and by reasoning men. We have described it in some detail as revealed in the gradual change of a seed into a tree and of an ovum into an adult mammal. We have observed it also in the increasing chemical complexity which at a remote epoch resulted in the formation of living protoplasm; and we have seen how from this earliest protoplasm there have arisen, in the course of ages well-nigh infinite in duration, the myriad forms of animal and vegetable life. The progress toward higher complexity and higher organization has likewise been discovered to be taking place in *processes* as well as in *things*. It has been shown that Life is a process, consisting in a series of adjustments between the organism and its environment; and that Mind, objectively considered, is a special form of Life, consisting in a specialized portion of the series of adjustments. In these wondrous processes we have found the Law of Evolution most beautifully exemplified; the degree of Life, or of Mind, being high in proportion not only to the extent which the adjustments cover, but also to their complexity, definiteness, and coherence. That superadded process known as Civilization or social progress, has also been shown to consist in a series of adjustments between the community and its environment, in the course of which society becomes ever more and more complex and more interdependent in its various elements. That moral sense which underlies social progress and renders it possible, has been exhibited as the noble product of the slow organization of those feelings of pleasure and pain which, in highly-developed organisms, are mainly concerned in enhancing the perfectness of the adjustments in which Life consists. And finally we have witnessed the wonderful complication of cooperating processes by which Humanity—the crown and glory of the universe as we know it—has been evolved from a lower type of animal life, in entire conformity to the general law. The direct and relatively-simple processes of physical adjustment became at length almost wholly subordinated to the indirect and relatively-complex processes of psychical adjustment, so that variations in intelligence came to be selected in preference to variations in physique; the increased complexity of psychical adjustments entailed the lengthening of the period required for organizing them; the lengthening of infancy, thus entailed, brought about the segregation, into permanent family-groups, of individuals associated for the performance of sexual and parental functions; the maintenance of such family-groups involved the setting up of permanent reciprocal necessities of behaviour among the members of the group;

in this way the ultimate test of right and wrong action came to be the welfare of the community, instead of the welfare of the individual; the long process of social evolution, thus inaugurated, has all along reacted upon individual evolution, by increasing the power of mental representation, and nourishing sympathy at the expense of egoism; and thus, through one and the same endlessly complicated plexus of causes, has arisen the historic Man, with his Intellect and his Moral Sense. Yet endlessly complicated as the process has been, we see that it is throughout definable as the gradual substitution of adjustments that are relatively-indirect, heterogeneous, and highly organized, for adjustments that are relatively-direct, homogeneous, and slightly organized.

Thus we have fulfilled all the requirements laid down in the concluding chapter of our Prolegomena. We have found a hypothesis which is based upon properties of matter and principles of dynamics that have previously been established; which appeals to no unknown agency and invokes no unknown attribute of matter or motion; and which, accordingly, contains no unverifiable element. This hypothesis has been successfully subjected to both deductive and inductive verification. In every department of nature it has triumphantly borne the supreme test of reconciling the order of conceptions with the order of phenomena. And in our sociological chapters, as well as in the chapters on the Genesis of Man, it has enabled us to detect relations among phenomena which had hitherto remained in obscurity.

It remains to add that this grand hypothesis, for the conception and elaboration of which I have ventured to liken Mr. Spencer to the thinker who conceived and elaborated the hypothesis of gravitation, affords in itself a striking illustration of that process of Evolution which it formulates. Considered as an event in intellectual development, this discovery is an immense *extension in time* of the correspondence between the order of human conceptions and the order of phenomena, as Newton's discovery was an immense extension of the correspondence in space. The one has enabled us to adjust our mental sequences to phenomena as distant as the Milky Way; the other carries back the adjustments till they comprehend the birth of the Solar System. The announcement of a verifiable Law of Evolution is but the most recent phase of a process which has been going on from the time when men first began to speculate about the world of phenomena,—the process of substituting what may be called dynamical habits of thought for statical habits. Clearly the formation of a theory of the universe, whether as expressed in the crude mythologies of barbarians or in the elaborate systems of modern philosophers, is the establishment of a complex group of subjective relations that are either very imperfectly or much more completely adjusted to objective relations. All men now existing, whether civilized or savage, with the exception of idiots and very young children, possess some such theory, however vague and shadowy it may be. Such general statements as may be made by the most ignorant boor obviously imply some dim conception of the world and of his relations to it. Even the beliefs that the moon is about the size of a cheese, or that the devil has bewitched his cattle, are parts of a rudimentary kind of cosmic philosophy. Now among uneducated persons, alike in barbarous and in civilized countries, the crude philosophies current universally imply that the general arrangement of things is everywhere and in all ages substantially the same as it is witnessed by them in their immediate environment. Their theories are not adjusted to remote facts in time and space which only a thorough education could have added to their experience. They take what we may call a statical view of things. Hence they suppose that God created the world a few thousand years ago in nearly the same condition in which we now behold it; traditional observances, such as the keeping of a Sabbath, advanced social institutions, like monogamy, and highly elaborated philosophical doctrines, such as monotheism, are unhesitatingly referred back to the beginning of the world; and it is in general taken for granted that the thoughts and feelings current in past ages were like the thoughts and feelings current in our own. Until within the last three or four generations this statical view of things was shared by cultivated with uncultivated people, though with somewhat different degrees of narrowness. On the other hand the dynamic view of things, represented by the Doctrine of Evolution, which regards the universe and all that is in it as presenting a different aspect from epoch to epoch, obviously results from the adjustment of our theories to longer and longer sequences in the past. The progress of geologic discovery, revealing the immense antiquity of the earth, was one of the circumstances which began to arouse in educated people a tendency to regard things as continually though slowly changing; and the theories of Goethe and Lyell, the revolution in biology wrought by Lamarck and Cuvier, and the application of the comparative method to the historic and philologic interpretation of past states of society, deepened and strengthened this tendency. In no other respect is the present age so widely distinguished from past ages as in this habit of looking at all things dynamically. It is shown in the literary criticism of Sainte-Beuve, and the art-criticism of Taine, and in the historical criticism of Mommsen or Baur, no less than in Mr. Darwin's science, or Mr. Spencer's philosophy. In our concluding chapter we shall observe some of the practical bearings of this great difference in mental habit between the eighteenth and nineteenth centuries, with especial reference to the political utopias of Rousseau, and to the attempts of the *Encyclopédistes* to overthrow Christianity. It is enough for us now to bear in mind that this immense widening of the mental horizon which modern times have witnessed; this power of criticizing sympathetically the relatively rude theories, customs, and prejudices of bygone generations; this ability to realize in imagination a time when forms of life now wholly distinct were represented by a common ancestral type, or a time when the material universe existed in a shape very different from that in which it is presented to our senses; this growing tendency to interpret groups of phenomena by reference to other groups of phenomena long preceding; are all alike explicable, in an ultimate analysis, as a prodigious extension in time of the correspondence between the human mind and its environment.

The Doctrine of Evolution, in which this dynamical habit of viewing things is reduced to a system, represents also the most extensive integration of correspondences that has yet been achieved. The continuous organization of scientific truths by philosophy has all along been a progress in this kind of integration. From the very first crude observations and the earliest cosmical theories, it is true that succeeding observations have all along had their results incorporated with the cosmical theories, or else new cosmical theories have been framed, which, by including the results of more mature observation, have superseded the old ones. In this way the progress of philosophy has on the whole kept pace with that of science. But between the earlier systems and the more modern ones there is a marked difference in the extent to which special truths in different departments of science are made to support and illustrate each other. For the gaps in the scientific knowledge synthesized in older systems were so considerable that, in order to make a synthesis at all, it was necessary to incorporate a large amount of hypothetical speculation which was not only unverified but unverifiable; so that the relations between science and philosophy were much less coherent than at present. To-day the interdependence is more complete than ever before. Our cosmic theories are rapidly modified by the incorporation of the results of countless new observations in all departments of science; and philosophy, refraining more and more from ontological speculations, is becoming more and more thoroughly identified with cosmology. It is recognizing more and more fully that its proper business is to oversee and coordinate those seemingly separate groups of scientific truths which scientific specialists have not the leisure, and often neither the desire nor the ability, to coordinate. And obviously the philosophy most completely organized after this manner, constitutes the most complete integration of correspondences between the order of conceptions and the order of phenomena. It constitutes an integral body of knowledge, the various members of which are at once more distinctly demarcated from each other and more intimately dependent upon each other than in any previous system.

Thus, in accordance with the expectation held out in an earlier chapter,[1] we find that "from the earliest traceable cosmical changes down to the latest products of civilization," there has been going on, and is going on, a ceaseless process of change, of which the main features are simple enough to be clearly deducible from the known physical properties of the universe, but of which the stupendous grandeur is such as to baffle the most strenuous efforts alike of reason and of imagination to follow it out in all its concrete details. Thus, too, we find ourselves amply rewarded for the hope with which we set out upon our inquiry,—namely, that in henceforth abandoning vain ontological speculation we were by no means about to dethrone Philosophy, but were on the point of winning for it even a goodlier realm than that which metaphysics had assigned to it. For in comparison with the sublime synthesis of truths which the foregoing chapters have but unworthily interpreted, all previous philosophic speculation seems fragmentary, crude

[1] See above, vol. i. p. 352.

and unsatisfying. To no other theory of things yet devised by the wit of man can we so well apply the enthusiastic exclamation of Giordano Bruno:—"Con questa filosofia l'anima mi s' aggrandisce, e mi si magnifica l'intelletto."

But while one part of our task has thus been fairly accomplished, another and equally important part still remains to be disposed of. Questions have from time to time been implicitly suggested, to which provisional answers must be given before our Cosmic Philosophy can be regarded as satisfactorily expounded, even in outline. That great Doctrine, for the establishing of which all departments of human knowledge have been laid under contribution, and which in turn is fast remodelling human thinking on all subjects whatever, has relations of the closest sort with religious philosophy. Sundry theological questions raised in the course of our Prolegomena must now be considered in the light of the general principles with which our survey of universal evolution has furnished us. Questions concerning God and the Soul, which the Positive Philosophy simply set aside as unworthy the attention of scientific thinkers, nevertheless cannot be ignored by any philosophy which seeks to bring about a harmony between human knowledge and human aspirations; and though we may confess ourselves unable to settle such questions, as scientific questions are settled, we may yet go as far as is possible without deserting the objective method, and indicate the position which we occupy with reference to them. We have already, in the earlier part of this work, been brought to the conclusion that the phenomenal universe is the manifestation of a Divine Power that cannot be identified with the totality of phenomena:[1] we have now to unfold, somewhat more fully, what is meant by this theistic conclusion. We have,

[1] This is implied in the statements in vol. i. p. 88, and also in the chapter on "Anthropomorphism and Cosmism." See also vol. i. p. 188.

at every fitting opportunity, declared that the phenomena of Mind can in nowise be explained as movements of Matter,[1] while at the same time a law of evolution, expressed in terms of matter and motion, is found to include the order of sequence of psychical phenomena: we must now attempt to clear away the difficulties which, to many minds, no doubt cluster around the seeming paradox. We have also hinted that beside the sphere to be assigned to Morality, there is a wider sphere to be assigned to Religion:[2] it behoves us now to show what are the general functions of religion, in accordance with our fundamental view of Life as an adjustment between inner and outer relations. And after having done what we can to elucidate these points, we must conclude by describing the critical attitude which our Cosmic Philosophy occupies with reference to other systems of belief and other principles of action.

The central problem, which must first occupy us, and the decision of which will affect the treatment of all the others, is the problem of Theism. What kind of theism is it which is compatible with the conclusions reached in the second part of this work concerning the past and present states of the universe? In discussing this question we shall presently find that the phase of theism which has until quite recently been the current phase, and which is still the phase officially defended by theologians, does not appear to be compatible with the conclusions referred to. As in treating of the preliminary evidence for the evolution of the higher forms of life from lower forms, we found ourselves at every step arrayed in opposition to the doctrine of special creations bequeathed to us by ancient mythology, so now upon this wider ground we shall have to note that the Doctrine of Evolution is throughout irreconcilably opposed to the Doctrine of Creation, so that the establishment of the former

[1] See vol. i. pp. 270, 412; vol. ii. pp. 80, 162.
[2] See above, p. 357.

is in fact synonymous with the overthrow and destruction of the latter. In coming to regard the universe as evolved in accordance with discernible physical laws, working throughout a lapse of time to which human thinking can assign neither a beginning nor an end, we cease to regard it as created at any given point of time in accordance with a preconceived plan remotely analogous to the plans by which finite intelligence adapts means to ends. It is not, as we shall see in a moment, that the one conception metaphysically refutes the other, but that it practically supersedes it, and enables philosophy to dispense with it. While upon the time-honoured statical view of things, any given group of phenomena was explained by a reference to the direct creative action of a divine Power extraneous to the Cosmos; on the other hand, upon the modern dynamical view of things, any given group of phenomena is explained by a reference to some antecedent group of phenomena, while all phenomena alike are regarded as the sensible manifestations of a divine Power immanent in the Cosmos. It becomes desirable, therefore, to inquire whether on the new view there is any ground for assuming, as was necessarily assumed on the old view, that the divine Power works by methods analogous to human methods. The question which we have to answer is not whether there exists a God. As was clearly shown in the first part of this work, and as will presently be still more emphatically reiterated, our Cosmic Philosophy is based upon the affirmation of God's existence, and not upon the denial of it, like irreligious Atheism, or upon the ignoring of it, like non-religious Positivism. The question which we have now to answer concerns the existence of a limited personal God, who is possessed of a quasi-human consciousness, from whose quasi-human volitions have originated the laws of nature, and to whose quasi-human contrivance are due the manifold harmonies observed in the universe. Is this most refined and subtilized remnant of primitive anthropomorphism to be retained by our Cosmic Philosophy, or is it to be rejected? And if it is to be rejected, what are the grounds which justify us in rejecting it?

Let us not forget, in stating the question, that we are now in a region of thought where absolute demonstration, in the scientific sense, is impossible. I believe it is beyond the power of science to prove that the divine Power immanent in the Cosmos either does or does not work by anthropomorphic methods. We cannot expect, therefore, to obtain a result which, like a mathematical theorem, shall stand firm through mere weight of logic, or which, like a theorem in physics, can be subjected to a crucial test. We can only examine the arguments upon which the anthropomorphic hypothesis is founded, and inquire whether they are of such a character as to be convincing or satisfactory to thinkers who rigidly adhere to the Doctrine of Evolution, who assert the relativity of knowledge, and who refuse to reason upon the subjective method. If, then, it turns out that these arguments are not thus satisfactory, it will follow that, as the Doctrine of Evolution becomes more and more widely understood and accepted, the anthropomorphic hypothesis will generally fall into discredit, not because it will have been disproved, but because there will be no sufficient warrant for maintaining it. Or—to restate the case—if the hypothesis which represents God as working after quasi-human methods be found harmonious with the scientific truths upon which our Cosmic Philosophy rests, it may survive the complete establishment of that philosophy; but if otherwise, it will perish, as other doctrines have perished, through lack of the mental predisposition to accept it. It is, indeed, generally true that theories concerning the supernatural perish, not from extraneous violence, but from inanition.[1] The belief in witchcraft,

[1] "Ce n'est pas d'un raisonnement, mais de tout l'ensemble des sciences modernes que sort cet immense résultat—il n'y a pas de surnaturel."—Renan. *Etudes d'Histoire Religieuse*, p. 206.

or the physical intervention of the Devil in human affairs, is now laughed at; yet two centuries have hardly elapsed since it was held by learned and sensible men, as an essential part of Christianity. It was supported by an immense amount of testimony, which no one has ever refuted in detail. No one, for example, has ever disproved witchcraft, as Young disproved the corpuscular theory of light. But the belief has died out because scientific cultivation has rendered the mental soil unfit for it. The contemporaries of Bodin were so thoroughly predisposed by their general theory of things to believe in the continual intervention of the Devil, that it needed but the slightest evidence to make them credit any particular act of intervention. But to the educated man of to-day such intervention seems too improbable to be admitted on any amount of testimony. The hypothesis of diabolic interference is simply ruled out; and will remain ruled out. So with what is called "spiritualism," or the belief in the physical intervention of the souls of the dead in human affairs. Men of science decline to waste their time in arguing against it, because they know that the only way in which to destroy it is to educate people in science. "Spiritualism" is simply one of the weeds which spring up in minds uncultivated by science. There is little use in merely pulling up one form of the superstition by the roots, for another form, equally noxious, is sure to take root: the only way of ensuring the destruction of the pests is to sow the seeds of scientific truth. When, therefore, we are gravely told what persons of undoubted veracity have seen, we are affected about as much as if a friend should come in and assure us, upon his honour as a gentleman, that heat is not a mode of motion. The case is the same with the belief in miracles, or the physical intervention of the Deity in human affairs. To the theologian such intervention is *à priori* so probable that he needs but slight historic testimony to make him believe in it. To the scientific thinker it is *à priori* so improbable that no amount of historic testimony, such as can be produced, suffices to make him entertain the hypothesis for an instant. Hence it is that such critics as Strauss and Renan, to the great disgust of theologians, always assume, prior to argument, that miraculous narratives are legendary. Hence it is that when the slowly dying belief in miracles finally perishes, it will not be because any one will ever have refuted it by an array of syllogisms: the syllogisms of the theologian and those of the thinker trained in science have no convincing power as against each other, because neither accepts the major premise of the other: but it will be because the belief is discordant with the mental habits induced by the general study of science. Hence it is that the scientific philosopher is averse to proselytism, and has no sympathy with radical infidelity. For he knows that theological habits of thought are relatively useful, while scepticism, if permanent, is intellectually and morally pernicious. Knowing this, he knows that the only way to destroy theological habits of thought without detriment, is to nurture scientific habits,—which stifle the former, as surely as clover stifles weeds.

The belief that God works after quasi-human methods is akin to those just cited, in being incapable of proof or disproof by mere syllogism. Our business is only to determine whether the arguments in favour of it are calculated to convince those who insist upon the relativity of all knowledge, and whether the belief itself can be made to harmonize with the scientific truths upon which our Cosmic Philosophy is based. Let us begin by examining the doctrine of final causes, as defended by metaphysical arguments; and let us afterwards observe how this famous argument from design is affected by the theory of evolution.

## CHAPTER II.

### ANTHROPOMORPHIC THEISM.

THOUGH the mediæval conception of an arbitrary Providence, overruling natural laws and occasionally setting them aside, influenced by human petitions to bring about special results by extraordinary means, and singling out nations or individuals as the objects of its favour or displeasure, has been partially abandoned for a more refined conception of theism, in which the Deity is represented as working through natural laws; yet the survival of the doctrine of final causes shows that a strong element of anthropomorphism is retained even in the latter conception. The doctrine of final causes ultimately reposes on the assumption that God entertains intentions and purposes closely resembling in kind, though greatly excelling in degree of sagacity, the purposes and intentions of man. In accordance with this view, we are told that it will not do to content ourselves with the discovery of Law, but that we must also look about for indications of Purpose; since Law is not, relatively to our human understanding, an ultimate fact, but may be recognized by us as the expression of the will of a Lawgiver. Everything that exists—it is said—has been created to subserve some design, and as a means to the accomplishment of some end; and the detection of this end, the penetration of this design must assist us greatly in the scientific study of the universe. Not only must we inquire, with Sokrates, into the divine purposes subserved by the structure of the eyes and the position of the alimentary canal;[1] but we shall also find it desirable to interpret the design exhibited in the inclinations of the planetary axes; and our knowledge of chemistry must be deemed incomplete until we have ascertained the creative plan in the arrangement of combining equivalents.[2] Not only will light thus be thrown upon many facts which would else have remained for ever wrapped in impenetrable darkness; but the mere recognition of an anthropomorphic purpose or providence in the constitution of things is said tc afford unfailing consolation amid perplexity and suffering. He who cherishes the belief in the conscious supervision of a personal Deity is held to possess the surest of safeguards against scepticism and despair.

A hypothesis which holds out such brilliant hopes may well be retained in our Cosmic Philosophy, if it can be shown to be in harmony with the demonstrated scientific truths upon which that philosophy rests. But if this cannot be done, then the hypothesis must be discarded, even though it should carry with it all our hopes and wishes in indiscriminate ruin. It has been well said that "we must follow Truth, though she lead us to Hades." The noble quest in which Science engages is the quest, not of faith or of consolation, but of truth; and, with the scientific philosopher, loyalty to truth is the first principle of religion. The disagreeableness of a well-supported conclusion furnishes no sort of justification for not accepting it, save to those minds which are irreligious as well as unscientific. He who is loyal to Truth

[1] Xenophon, *Memorabilia*, i. 4. § 6.

[2] "The inorganic world, considered in the same light, would not fail to exhibit unexpected evidences of thought, in the character of the laws regulating chemical combinations, the action of physical forces, the universal attraction, etc. Even the history of human culture ought to be investigated from this point of view."—Agassiz, *Essay on Classification*, p. 199.

will never harbour the misgiving that her paths may lead to Hades: he will fearlessly follow the guidance of Science, never doubting that consolation must come of knowing the truth. In the present case we shall find reason to conclude that the hypothesis of a quasi-human God is likely to aggravate rather than to relieve the mental distress of scepticism.

The doctrine of final causes we may first contemplate, for a moment, under its logical aspect, and notice that, even if it were true, it could never have the value which is claimed for it as a means of investigation. Even admitting that all things have been created with forethought, and that the harmonious cooperation of phenomena is the fruit of contrivance, it is none the less undeniable that this forethought cannot be perceived, the threads of this contrivance cannot be unravelled by us, until the laws to which phenomena conform have already been discovered. Previous to Newton, for instance, all attempts to detect design in the structure of the solar system must have shared the fate of the quite different guesses of Descartes and others as to its physical conditions. Evidences of design, therefore, in order to be trustworthy, must be deduced from known laws, and cannot safely be employed as stepping-stones to the discovery of new truths. However plausible they may seem as corollaries, they can never be useful as lemmas or postulates. As M. Scherer well observes, God is the cause of all things, but the explanation of nothing.[1] Accordingly unless we are so arrogant as to lay claim to the possession of some direct

[1] "Dieu, comme on l'a très-bien dit, est la cause de tout, mais il n'est explication de rien." Scherer. *Nouvelles Etudes sur la Littérature Contemporaine*, p. 408. See also Geoffroy Saint-Hilaire, *Anomalies de l'Organisation*, tom. iii. p. 608. The only objection which can be made to M. Scherer's statement is its disjunctive form. Obviously that which is the cause of everything *cannot* be the explanation of anything. We cannot explain any particular group of phenomena by a reference to divine action, because such a reference is merely a reference to the source of all phenomena alike, and hence cannot give us specific information concerning any particular group. Laplace was therefore quite justified in saying "Je n'ai pas besoin de cette hypothèse."

means of insight into the Divine purposes,[1] what is left for us but to content ourselves with the humbler means of research lying everywhere at our disposal—with being "servants and interpreters of nature," as the great master of inductive inquiry so wisely and modestly said?

Not only does the teleological theory thus appear to be useless, from a scientific point of view, but its claim to philosophic validity is open to serious doubt. Looking at it historically, we observe that its career has been that of a perishable hypothesis born of primeval habits of thought, rather than that of a permanent doctrine obtained by the employment of scientific methods. From time to time, with the steady advance of knowledge, the search for final causes has been discarded in the simpler sciences, until it is now kept up only in the complex and difficult branches of biology and sociology. As Laplace observes, final causes disappear as soon as we obtain the data requisite for resolving problems scientifically. Even Dr. Whewell, the great champion of the teleological method in our day, admits that it must not be applied to the inorganic sciences; which amounts to the confession that, wherever we know enough, we can very well do without it.[2] Creative design, however, if manifested at all, is probably not confined to a limited department of nature; and therefore the rejection of teleology

[1] As Descartes somewhere says, "Nous rejetterons entièrement de notre philosophie la recherche des causes finales; car nous ne devons pas tant présumer de nous-mêmes que de croire que Dieu nous ait voulu faire part de ses conseils."

[2] Laplace, *Essai sur les Probabilités*, p. 87; Whewell, *History of the Inductive Sciences*, vol. iii. p. 430. Even in biology the principle does not always work well:—"A final purpose is indeed readily perceived and admitted in regard to the multiplied points of ossification in the skull of the human fœtus and their relation to safe parturition. But when we find that the same ossific centres are established, and in similar order, in the skull of the embryo kangaroo, which is born when an inch in length, and in that of the callow bird that breaks the brittle egg, we feel the truth of Bacon's comparison of final causes to the Vestal Virgins." Owen, *The Nature of Limbs*, p. 39. Or, as Prof. Huxley very happily observes, they "might be more fitly termed the *hetairæ* of philosophy, so constantly have they led men astray." *Lay Sermons*, p. 255.

by the most advanced sciences augurs ill for its ultimate chances of survival in any field of inquiry. Previous to the researches of Kant and Laplace, such phenomena as the distribution of satellites and the inclinations of planetary axes were explained teleologically. These phenomena having been at last interpreted by a reference to universal laws of matter and motion, the teleological hypothesis took refuge in biology, where it held for a while a doubtful tenure, as a means of explaining the origination of specific forms of life. The discoveries of Mr. Darwin having gone far toward driving it from this stronghold, replacing the conception of miraculous interposition by the conception of natural selection, it is nevertheless still appealed to by such writers as Mr. Wallace and Mr. Mivart, as furnishing an explanation for sundry phenomena of organic evolution which natural selection, taken alone, seems at present incompetent to account for. In short, the teleological hypothesis derives its apparent confirmation never from the phenomena which were explained yesterday, but always from the phenomena which are awaiting an explanation to-morrow. "I give up phenomenon A," says the theologian, "for that you have explained in terms of matter and motion; but phenomenon B you can never so explain, and upon that I therefore rest my teleological hypothesis." To-morrow phenomenon B is interpreted in terms of matter and motion, and appeal is made to phenomenon C; and so on, to the end of the alphabet. Now the cosmic conception of Deity, as we shall hereafter see, being planted in the region of the Unknowable, which is coextensive with that of the Knowable, has no such precarious tenure, and all that the progress of discovery can do is to enlarge and strengthen it. But the anthropomorphic conception, lodged in that ever diminishing area of the Knowable which is to-day unknown, is driven from outpost to outpost, and robbed of some part of its jurisdiction by every advance of science. Surely that must be an unworthy conception of

Deity which is confessedly based on those limitations alone of finite phenomenal knowledge, which each day's experience proves more and more clearly to be but temporary. Surely the teleological hypothesis is built upon a rotten foundation, when it has to dread the shock of each advancing wave of knowledge. Surely it is no less irreverent than unphilosophical to rest our faith in God's existence upon the alleged impossibility of interpreting in terms of matter and motion the beginnings of life, the cross-relations between marsupials and monodelphia, or the structure of the ears and eyes of a cephalopod.

Further to develope this argument would be premature, in the absence of explanations to be given in the next chapter. Contenting ourselves for the present with this brief indication, let us now approach the subject somewhat more closely, and examine certain metaphysical arguments upon which it has lately been sought to base an elaborate teleological theory. The "Inquiry into the Theories of History," by Mr. William Adam, presents us with what is probably the last form of the attempt to carry on scientific research by theological methods, and two or three of its arguments may here be fitly noticed, as typical of the entire class to which they belong.

Mr. Adam accepts, with some qualifications, the doctrine of Descartes and Spinoza, that causes resemble their effects. He holds that physical, intellectual, and moral causes respectively resemble their physical, intellectual, and moral effects; and hence infers that the Deity, as a moral and intellectual cause, must resemble the effect Man — must therefore purpose, contrive, and exert volition. The conclusion would have more weight, were it not so manifestly begged in the premise. Next, even in this modified shape, the rule that causes resemble their effects is hampered by awkward exceptions, in dealing with which Mr. Adam has not been fortunate. Assuming, for example, that heat is the cause of steam, he maintains the likeness of the cause to its effect, on the ground that both are *in a state* of molecular agitation! The mental confusion which resulted in this extraordinary statement, is still more explicitly revealed in the assertion that "heat is like steam, as being both physical objects." So, then, we get some conception of the kind of science with which anthropomorphism is practically compatible. Heat, it seems, is a physical object in a state of molecular agitation!! The ordinary physicist will certainly object that heat, being the state of molecular agitation, can hardly be called, with propriety, the physical object. And the logician will add that, even if it could be so called, an argument would hardly be thought convincing which should rest upon the alleged resemblance of a billiard-table to a rhinoceros—yet these are both physical objects. Mr. Adam is equally unhappy in his answer to Mr. Mill's humorous criticism of Descartes. Parodying the celebrated maxim,—*Si enim ponamus aliquid in idea reperiri quod non fuerit in ejus causa, hoc igitur habet a nihilo*, Mr. Mill observes that "if there be pepper in the soup, there must be pepper in the cook who made it, since otherwise the pepper would be without a cause." Mr. Adam's reply savours strongly of mediæval realism. The cook, he says, is not indeed the efficient cause of the pepper, but the cook's *intelligence* is the efficient cause of the *intelligence* displayed in the mixture of the ingredients of the soup—so that even here the cause is like the effect! Comment is not needed. Human ingenuity is indeed pushed to the limit of its tether, when by a play upon words it tries to liken a physical combination of salt, pepper, and meat-juice to an intellectual coordination of experiences.

Apart from these ill-chosen and ill-managed examples, the Cartesian argument, as modified by Mr. Adam, appears to stand as follows:—When a physical event, such as the pulling of a trigger, is followed by another physical event,

C C 2

such as the firing of a pistol, the antecedent resembles the consequent, since both are physical events. When an intellectual event, such as the rising into consciousness of the idea of Hamlet, is followed by another intellectual event, such as the ideal representation of a crowded theatre, the antecedent resembles the consequent, since both are intellectual events. When a moral event, such as a fit of ungovernable passion, is followed by another moral event, such as a bitter sense of remorse, the antecedent is like the consequent, since both are moral events. Therefore the primal Cause, antecedent to the whole compound series of intellectual and moral events, must be intellectual and moral in its nature.

Underneath this whole argument there lies an ill-concealed *petitio principii.* Three parallel lines of causal sequence being set up, it is unwarrantably assumed that causal relations hold only between the successive members of each separate series, or in other words, that there are no causal relations between the members of one series and the members of another. A single instance of causal relation between a material event and an intellectual or emotional event—such as the relation between certain atmospheric undulations communicated from violin-strings to the auditory nerve, and the consequent recognition of the triad of A-minor, with the accompanying pleasurable feeling—is fatal to the argument. Waiving this objection, however, and for the moment admitting that the universe, as containing intellectual and moral phenomena, requires an intellectual and moral Cause; we may note that the argument proves altogether too much. Since the universe contains material, as well as psychical phenomena, its First Cause, according to Mr. Adam's argument, must partake of all the differential qualities of those phenomena. If it reasons and wills, like the higher animals, it must also, like minerals, plants, and the lowest animals, be unintelligent and unendowed with the power of volition,—

which requires in the First Cause a more than Hegelian capacity for uniting contradictory attributes. Else we must suppose its causal action to be confined to man, and those other animals which manifest intelligence and volition, while the rest of the universe either seeks another First Cause, or goes without one. All these are alike conclusions which philosophy cannot for a moment tolerate, and which are as shocking to science as to religion.

A still more fatal criticism remains to be made. Considered as a modification of the Cartesian doctrine, Mr. Adam's theory is entirely illegitimate: it is the product of a gross misconception of the Cartesian doctrine. All these causes and effects, so carefully but unskilfully compared by Mr. Adam, are *phenomenal* antecedents and consequents; and even supposing the universal resemblance of phenomenal causes to phenomenal effects to be fully made out, the anthropomorphic argument is not helped in the least. Until a *phenomenal* effect can be brought into juxtaposition and compared with its *noumenal* cause, the argument has no logical validity; but, because of the relativity of all knowledge, this can never be done. To call the First Cause a phenomenon is to make a statement that is self-contradictory; since phenomena exist only by virtue of their relation to human (or animal) consciousness. The First Cause being absolute and infinite, is a noumenon, and no amount of resemblance, alleged or proved, between various orders of its phenomenal effects, can bear witness to any resemblance between a phenomenal effect and the noumenal Cause. The phenomena of motion, for example, exist as phenomena only in so far as they are cognized; and the very constitution of the thinking process renders it impossible for us to assert similarity between the phenomenon and the thing in itself. Indeed a comparison between the various phenomena of motion gives us good ground for believing that there can be no such thing as resemblance between the phenomena and their noumenal cause. At the beginning of this work it was shown that the objective reality underlying the phenomena of heat, light, actinism, and mechanical vibration, cannot be held to resemble one of these sets of phenomena more than another, and accordingly cannot be held to resemble any of them. And this conclusion, thus forced upon us by concrete examples, is the only one consistent with what we know of knowledge. Obviously the phenomena cannot be held to be like the objective reality without ignoring the circumstance that the mind is itself a factor in the process of cognition. Now the Cartesians, with more insight into the exigencies of the case than is shown by Mr. Adam, unflinchingly asserted that phenomenal effects are like noumenal causes,—that whatever is in the subjective conception is also in the objective reality. As a proposition in psychology, this is a denial of the relativity of knowledge. As a canon of logic, this is the proclamation of the subjective method. Hence, though the metaphysician and the theologian may adopt an anthropomorphic hypothesis founded upon such an argument, it is impossible for a scientific philosopher to do so.

The attempt to establish the anthropomorphic hypothesis by means of the volitional theory of causation is, from the scientific point of view, equally futile. From first to last, as was fully demonstrated in the chapter on Causation, the argument of the volitionists is made up of pure assumptions. From the unwarranted ontological postulate that Will is a noumenal or efficient cause of muscular action in animals, it proceeds, by a flagrant *non sequitur*, to the equally unwarranted conclusion that Will is the noumenal or efficient cause of all the dynamic phenomena of the universe, and must therefore be the First Cause. Volition being asserted to be the only source whence motion can originate, it is affirmed that, save on the hypothesis of a Supreme Will, the activity of nature baffles comprehension. The reply of the scientific critic is that, in an ultimate analysis, the activity of nature does, and must ever, baffle comprehension; and that, upon any hypothesis frameable by our intelligence, whether theistic or non-theistic, the origination of motion must remain not only incomprehensible but inconceivable. Relatively to our finite power of apprehension, motion is to be regarded, like matter, as eternal.[1] The unthinkableness of the creation or destruction of matter or motion is involved in the axiom that force is persistent, which is the fundamental axiom of all science and of Cosmic Philosophy. Whether motion, considered apart from our power of apprehension, ever had a beginning or not, is a question which cannot concern us as scientific thinkers. To assert that it had, is to put into words a hypothesis that cannot be translated into thought, and to assume Volition as its primal antecedent, is to frame an additional hypothesis that is essentially unverifiable. Phenomenally we know of Will only as the cause of certain limited and very peculiar kinds of activity displayed by the nerves and muscles of the higher animals. And to argue from this that all other kinds of activity are equally caused by Will, simply because the primal origination of motion is otherwise inexplicable, is as monstrous a stretch of assumption as can well be imagined. While to contend—as many have done—that because human volitions are attended by a sensation of effort, there is therefore effort in each case of causation, is much like identifying gravitative force with the sensation of weight by which the attempt to overcome it is always accompanied.[2]

[1] Or—to state the same thing in another form—the possibilities of thought are limited by experience; and experience furnishes no data for enabling us to conceive a time, either past or future, when the Unknowable would be objectively manifested to consciousness otherwise than in movements of matter. But this, it should be remembered, applies solely to our powers of conception. Thought is not the measure of things, and where the region of experience is transcended, the test of inconceivability becomes inapplicable See above, vol. i. p. 11.

[2] See above, vol. i. p. 157.

The last of the *à priori* arguments which it is necessary to notice in this connection, is that which infers the existence of an intelligent Lawgiver from the omnipresence of Law. "The proofs of necessary law and of an intelligent will . . . . remain undeniable," says Mr. Adam, "and no hardihood of assertion can annul them; and when an attempt is made to bring both into logical connection, the mind, not only without violence to its powers, but on the contrary with a clear perception of necessary congruity, believes that law must proceed from a lawgiver, beneficent laws from a moral ruler. To disjoin an intelligent will from necessary law is to shake our confidence in the perpetuity and salutary operation of law itself. The conception of law without will is that of agency without an agent: the conception of will without law is that of an agent without agency. Necessary law is the constant expression of the divine will." Upon this point Mr. Adam repeatedly insists in the course of his work,[1] asserting again and again that, without admitting "this great central conception of a Supreme Will," the laws of nature must for ever remain unintelligible. Let us not fail to note that Mr. Adam's conception of theism, as here illustrated, is far more refined, and far less hostile to scientific inquiry, than the conception of theism embodied in the accepted creeds of theologians, and officially defended from the pulpit. Those who adopt Mr. Adam's conception will, if consistent, welcome, instead of opposing, every scientific interpretation of phenomena hitherto deemed supernatural; since, in the above passage, God is clearly regarded as manifesting himself in order and not in disorder, in method and not in caprice, in law and not in miracle. With this view our Cosmic Philosophy thoroughly coincides; and, eliminating the anthropomorphism from Mr. Adam's statement, I, for one, will heartily join in the assertion that

[1] Adam, *Theories of History*, pp. 92, 130, 180, 189, 209, 222, 281, 284, 404. The passage just cited is to be found on p. 192.

"necessary law is the constant expression of the divine *working*." But the connection asserted between universal law and a supreme quasi-human Will, is one which a scientific philosophy cannot admit, for it rests upon a mere verbal equivocation. The inference from community of name to community of nature, however appropriate it might have seemed to the realists of the twelfth century, is in our day hardly admissible. Because the word "law" is used to describe alike the generalizations of Kepler and the statutes enacted by a legislative body, we must not infer, with a *naïveté* worthy of the schoolmen, that whatever is true of the one will always be true of the other. That the laws of Justinian emanated from a lawgiver is no reason for believing the same to have been the case with the law of gravitation; for the former were edicts enjoining obedience, while the latter is but a generalized expression of the manner in which certain phenomena occur. A law of nature, as formulated in a scientific treatise, is a statement of facts, and nothing more. Expressed in the indicative mood, it has nothing whatever to do with the imperative. Science knows nothing of a celestial Ukase compelling the earth to gravitate toward the sun. We know that it does so gravitate with a certain intensity, and that is the whole story. Nevertheless, so strong is the realistic tendency that, in speaking of laws of nature, the most careful writers too seldom avoid "a tacit reference to the original sense of the word *law*, . . . the expression of the will of a superior."[1] Indeed, it is immediately after defining a law as "a general name for certain phenomena of the same kind, which regularly recur under the same circumstances," that Mr. Adam alludes to "the Supreme Will which *subjects* (!) all phenomena to law, and *colligates all laws into a universe* (!)." Upon such a confusion of ideas, and amid such a chaos of terminology, is this whole argument, so far as concerns theism, unsuspectingly reared.

[1] Mill, *System of Logic*, vol. i. p. 348.

Strip the phrase "law of nature" of this inherent ambiguity, substitute for it the equivalent phrase, "order of sequence among certain phenomena," and the anthropomorphic inference so confidently drawn from it at once disappears.

Viewed in close connection with the Doctrine of Evolution, this scholastic argument from the Law to the Lawgiver lands us amid strange and terrible embarrassments. For what is a law, in the sense in which the word is used by legislators? It is a set of relations established by the community, or by some superior mind representing and guiding the community, in correspondence with certain environing circumstances. Certain phenomena of crime, for example, tend to detract from the fulness of life of society, and to balance these phenomena a certain force of public opinion is embodied in an edict prescribing due punishments for the crimes in question. Or—slightly to vary the definition and make it more comprehensive—a law is the embodiment of a certain amount of psychical energy, directed towards the securing of the highest attainable fulness of social life. Now if, on the strength of an ambiguous terminology, we proceed to regard the "laws" of nature as edicts enjoined upon matter and motion by a personal Ruler, shall we also, as we are logically bound to do, carry with us the conceptions of legislation with which the Doctrine of Evolution has supplied us? Shall we say that the infinite Deity adjusts inner relations to external contingencies?

Here we come upon the brink of the abyss into which the anthropomorphic hypothesis must precipitate us, if instead of passively acquiescing in it as a vague authoritative formula, we analyze it with the scientific appliances at our command. To those who have acquired some mastery of the physical truths upon which our Cosmic Philosophy is based, the doctrine not only ceases to be intellectually consoling, but becomes a source of ungovernable disturbance. For to represent the Deity as a person who thinks, contrives, and legislates, is simply to represent him as a product of evolution. The definition of intelligence being "the continuous adjustment of specialized inner relations to specialized outer relations," it follows that to represent the Deity as intelligent is to surround Deity with an environment, and thus to destroy its infinity and its self-existence. The eternal Power whereof the web of phenomena is but the visible garment becomes degraded into a mere strand in the web of phenomena; and the Cosmos, in exchange for the loss of its infinite and inscrutable God, receives an anomalous sovereign of mythologic pedigree.

Nor can the theologian find a ready avenue of escape from these embarrassments in the assumption that there is such a thing as disembodied intelligence which is not definable as a correspondence between an organism and its environment, and which is therefore not a product of evolution. Experience does not afford the data for testing such a hypothesis, and to meet it with denial would accordingly be unphilosophic in the extreme. That there may be such a thing as disembodied or unembodied Spirit will be denied by no one, save by those shallow materialists who fancy that the possibilities of existence are measured by the narrow limitations of their petty knowledge. But such an admission can be of no use to the theologian in establishing his teleological hypothesis. For even granting the existence of such unembodied Spirit, the moment we ascribe to it intelligence we are using words to which experience has assigned definite meanings, and we are not at liberty to play fast and loose with these meanings. When we speak of "intelligence," we either mean nothing at all, or we mean that which we know as intelligence. But that which we know as intelligence implies a circumscribed and limited form of Being adapting its internal processes to other processes going on beyond its limits. Save as describing such a correspondence between circumscribed Being and its environment, the word "intelligence" has no meaning whatever, and to employ it is simply to defy logic and insult common-sense. In ascribing intelligence to unembodied Spirit, we are either using meaningless jargon, or we are implicitly surrounding unembodied Spirit with an environment of some kind, and are thus declaring it to be both limited and dependent. The assumption of disembodied intelligence, therefore leaves the fundamental difficulty quite untouched.

Thus in default of all tenable *à priori* support for the anthropomorphic hypothesis, it must be left to rest, if it is to be entertained at all, upon its ancient inductive basis. In spite of the difficulties encompassing the conception, we may fairly admit that if the structure of the universe presents unmistakeable evidences of divine contrivance or forethought, these evidences may be received in verification of the hypothesis which ascribes to God a quasi-human nature. And thus the possible establishment of that hypothesis must depend upon the weight accorded to the so-called "evidences of design."

From the dawn of philosophic discussion, Pagan and Christian, Trinitarian and Deist, have appealed with equal confidence to the harmony pervading nature as the surest foundation of their faith in an intelligent and beneficent Ruler of the universe. We meet with the argument in the familiar writings of Xenophon and Cicero, and it is forcibly and eloquently maintained by Voltaire as well as by Paley, and, with various modifications, by Agassiz as well as by the authors of the Bridgewater Treatises. One and all they challenge us to explain, on any other hypothesis than that of creative design, these manifold harmonies, these exquisite adaptations of means to ends, whereof the world is admitted to be full, and which are especially conspicuous among the phenomena of life. Until the establishment of the Doctrine of Evolution, the glove thus thrown, age after age, into the arena of philosophic controversy, was never triumphantly taken up. It was Mr. Darwin who first, by his discovery of natural selection, supplied the champions of science with the resistless weapon by which to vanquish, in this their chief stronghold, the champions of theology. And this is doubtless foremost among the causes of the intense hostility which all consistent theologians feel towards Mr. Darwin. This antagonism has been generated, not so much by the silly sentimentalism which regards the Darwinian theory as derogatory to human dignity; not so much by the knowledge that the theory is incompatible with that ancient Hebrew cosmogony which still fascinates the theological imagination; as by the perception, partly vague and partly definite, that in natural selection there has been assigned an adequate cause for the marvellous phenomena of adaptation, which had formerly been regarded as clear proofs of beneficent creative contrivance. It needs but to take into the account the other agencies in organic evolution besides the one so admirably illustrated by Mr. Darwin, it needs but to remember that life is essentially a process of equilibration, both direct and indirect, in order to be convinced that the Doctrine of Evolution has once for all deprived natural theology of the materials upon which until lately it subsisted.[1]

These apparent indications of creative forethought are just so many illustrations of the scientific theorem that life, whether physical or psychical, is the continuous adjustment of inner relations to outer relations. "On this fact," says Mr. Barratt, "depends the usual argument to prove the existence of God from design or final *causes*; the whole strength of which is produced by a mere verbal sleight of

[1] That Darwinism has given the death-blow to teleology is admitted by Schleiden,—an unwilling witness. See Büchner, *Die Darwinsche Theorie*, p. 159. Haeckel also says:—"Wir erblicken darin [in Darwin's discovery] den definitiven Tod aller teleologischen und vitalistischen Beurtheilung der Organismen." *Generelle Morphologie der Organismen*, tom. i. p. 160.

tongue—by calling an effect a cause. Any combination of laws would produce its own proper results: hence under any constitution of the universe, good or bad, possible or impossible, as it may seem to us, it would always be true that 'whatever is, is right.' To give an instance—the particular laws of our present universe bring about night, they also cause the phenomenon sleep in animated creatures: these two naturally suit each other, being different results of the same laws—just as any two propositions in Euclid agree together. But to say that either is the final cause of the other is to transfer an idea derived from one part of ourselves, our motives to action, to an entirely different part of ourselves, our primary laws of sensation. *The earth is suited to its inhabitants because it has produced them, and only such as suit it live.*"[1] This last statement, which I have italicized, is the triumphant answer with which science meets the challenge of natural theology. It is not that the environment has been adapted to the organism by an exercise of creative intelligence and beneficence, but it is that the organism is necessarily fitted to the environment because the fittest survive. In no way can the contrast between theology and science, between Anthropomorphism and Cosmism, be more clearly illustrated than in this antithesis. Let us now pursue the argument somewhat farther into detail, but slightly changing for a moment the point of view, in order that we may not only show the superiority of the scientific explanation, but may also show how the anthropomorphic theory finds its apparent justification. A theory may be shattered by refutation; but in order to demolish it utterly it must be accounted for. We shall see that from the very constitution of the human mind, and by reason of the process whereby intelligence has arisen, we are likely everywhere to meet with apparent results of creative forethought; and that thus

[1] *Physical Ethics*, p. 33.

in the evolution of intelligence itself these phenomena find their only satisfactory explanation.

In the chapter on the Evolution of Mind it was shown that the intelligence of any man consists, partly of inner relations adjusted from moment to moment in conformity with the outer relations present in his own environment, and partly of organized and integrated inner relations bequeathed him by countless generations of ancestors, brute and human, and adjusted to the outer relations constantly presented in innumerable ancestral environments. Throughout all time, therefore, since intelligence first appeared upon the earth, the world of conceptions has been maintained in more or less complete correspondence with the world of phenomena. Just as in the mental evolution of each individual there is preserved a certain degree of harmony with the mental evolution of contemporary and surrounding individuals, so the total evolution of intelligence has kept pace more or less evenly with the changes of the environment with which it has interacted. Sense after sense has assumed distinct existence in response to stimuli from without. One set of experiences after another has been coordinated in harmony with combinations existing without. Emotion after emotion has been slowly generated in conformity with the necessities entailed by outward circumstances. And thus the contemplating mind and the world of phenomena contemplated are, if I may so express it, tuned in mysterious unison.

Let us now inquire into the bearing of this fact upon the origin and apparent justification of the teleological theory. We have seen that man has from the earliest times been wont to project ideally his personality into the external world, assimilating the forces of physical nature to the forces displayed in his own volitions, and with unrestrained fancy multiplying likenesses of his own intelligence as means whereby to render comprehensible the agencies ever at work around him. Stronger in the ages of primeval fetishism than at any subsequent time, this aboriginal tendency is nevertheless not yet quite fully overcome. Even as in the crying of an infant at sight of a stranger may be seen still feebly surviving the traces of feelings organized in the race at a time when the strange meant the dangerous, so likewise may we detect evanescent symptoms of a fetishistic style of reasoning in many highly subtilized ontological theories now in vogue; of which the volitional theory of causation, above dealt with, is a notable example. This archaic mode of reasoning, now become exceptional, was once universal. Now applied only to the most abstruse problems, it was at first equally employed in the solution of the simplest. Storm and sunshine, as well as defeat and victory, were regarded as the manifestations of superhuman volition and the achievements of superhuman intelligence. But scientific generalization, steadily arranging in correlated groups phenomena which had hitherto seemed isolated and lawless, was followed by the generalization of presiding divinities. And this went on until, in comparatively modern times the habit of viewing nature as an organic whole has resulted in monotheism. As the most prominent result of this generalizing process we have seen slowly going on an elimination, from the objects of men's worship, of the less noble qualities originally ascribed to them. One by one the grosser sensual passions, the emotions least worthy of reverence, and intellectual shortcomings, such as the liability to make mistakes and to be overreached, have been omitted from the conception of Deity. And the culmination of this purifying process is to be seen in the Deity of the modern metaphysician, which is little more than an abstract embodiment of reason and volition. But in spite of all this progressive change in the form of the conception, its substance still remains the same. It is still the human personality, however refined and etherealized, which is appealed to alike as the source and as the explanation of all phenomena. It is the primitive fetishistic habit of thought, however modified by conflict with scientific habits, which furtively leads us to regard volition as supplying the nexus between cause and effect, and to interpret the harmonious correspondences in nature as results of creative contrivance and indications of creative purpose.

Such being the origin of the teleological hypothesis, its apparent warrant is to be sought in the facts above recounted with respect to the evolution of intelligence. It is the complex and organized correspondence of the mind with its environment, which seems to furnish inductive justification to the thinker who is predisposed to see in nature the workings of a mind like his own. Arranging and combining various experiences received from without, adjusting new inner relations to outer relations established from time immemorial, man reacts upon the environment, and calls into being new aggregations of matter, new channels of motion, new reservoirs of energy. He does not perceive and reflect only—he also contrives and invents. As often as he builds an engine, launches a ship, paints a picture, moulds a statue, or composes a symphony, he creates in the environment new relations tallying with those present within himself. And then, by a natural but deceptive analogy, he infers that what has taken place in the tiny portion of the universe which owns himself as its designer, must also have taken place throughout the whole. All the relations externally existing, he interprets as consequent upon primordial relations shaped in a mind similar to his own. By a subtle realism, he projects the idea of himself out upon the field of phenomena, and deals with it henceforth as an objective reality. Human intelligence made the watch, therefore superhuman intelligence made the flower. Human volitions bring to pass wars and revolutions, divine volitions therefore cause famine and pestilence. So when, in the pervading unity which amid endless variety of detail binds into a synthetic whole the classes and genera of the organic world, an earnest and reverent thinker, like Agassiz, beholds the work of omnipresent thought, he is but unawares contemplating his own personality reflected before him, and mistaking, Narcissus-like, a mirrored image for a substantial object of adoration. Thus is explained, even while it is refuted, the famous argument of the watch, with all its numerous kindred. In the anthropomorphic hypothesis, the bearings of the inner and the outer worlds are exactly reversed. It is not the intelligence which has made the environment, but it is the environment which has moulded the intelligence. In the mint of nature, the coin Mind has been stamped; and theology, perceiving the likeness of the die to its impression, has unwittingly inverted the causal relation of the two, making Mind, archetypal and self-existent, to be the die.

Therefore, to cite the language employed with slightly different but kindred intent by Mr. Barratt, "we protest against the reversal of the true order. . . . We must not fall down and worship as the source of our life and virtue the image which our own minds have set up. Why is such idolatry any better than that of the old wood and stone? If we worship the creations of our minds, why not also those of our hands? The one is indeed a more refined self-adoration than the other; but the radical error remains the same in both. The old idolators were wrong, not because they worshipped themselves, but because they worshipped their creation as if it were their creator; and how can any [anthropomorphic theory] escape the same condemnation?"[1]

The origin of the teleological hypothesis is thus pointed out, and its plausibility accounted for. On the one hand, the primitive tendency in man to interpret nature anthropomorphically, and his proneness to lend to his own ideas objective embodiment, are facts admitting no dispute. All history teems with evidences of their wide-spread and deep-rooted influence. Has not fetishism been at one time the universal theology, and realism at another time the dominant

[1] *Physical Ethics*, p. 225.

philosophy? On the other hand, it is a corollary from the fundamental laws of life that psychical development has followed the course and been determined by the conditions above described. The view here defended may thus far claim at least equal weight with those which maintain the validity of the teleological hypothesis. But we have next to consider a class of phenomena, in the explanation of which that hypothesis appears at a signal disadvantage.

The perfect adjustment of inner to outer relations is that which constitutes perfect life. Were no chemical or mechanical relations to arise without the organism, too sudden, too intricate, or too unusual, to be met by internal adaptations, death from disease and accident would no longer occur. Were there no concurrence of phenomena defying interpretation and refusing to be classified, there would be perfect knowledge. Were no desires awakened, save such as might be legitimately gratified by the requisite actions, there would be perfect happiness. That the ultimate state of humanity will be characterized by a relatively close approach to such an equilibrium between external requirements and internal resources, is a belief which, however paradoxical it may seem to a superficial observer, is justified by all that we know of history and of biology. It is with reason that the modern mind sees its Golden Age in the distant future, as the ancient mind saw it in the forgotten past. But however bright and glorious may be the destination of mankind, its onward progress is marked by irksome toil and bitter sorrow. Though like the crusading children, in Arnold's beautiful simile, we may cry from time to time, "Jerusalem is reached!" it is only to be rudely awakened from our delusion —to realize that the goal is yet far off, and that many a weary league must be traversed before we can attain it. Meanwhile, grinding misery is the lot of many, regret and disappointment the portion of all. The life of the wisest man is chiefly made up of lost opportunities, defeated hopes, half-finished projects, and frequent failure in the ever-renewed strife between good and evil inclinations. So penetrated are the noblest careers by the leaven of selfish folly, that the conscientious biographer is too often constrained to adopt the tone of apology, mingling condemnation with approval. Side by side with deeds of heroism and sympathetic devotion, history is ever recording deeds of violence and selfish oppression. Undisciplined and conflicting desires are continually coming to fruition in hateful and iniquitous actions. The perennial recurrence of war and persecution, the obstinate vitality of such ugly things as despotism, superstition, fraud, robbery, treachery, and bigotry, show how chaotic as yet is the distribution of moral forces. While the prevalence, here and there, of ignorance and poverty, disease and famine, shows how imperfect as yet is our power to adapt ourselves to the changes going on around us.

That this state of things is temporarily necessitated by the physical constitution of the universe and by the process of evolution itself, may readily be granted.[1] The physical ills with which humanity is afflicted are undoubtedly consequent upon the very movement of progress which is bearing it onward toward relative perfection of life, and moral evils likewise are the indispensable concomitants of its slow transition from the primeval state of savage isolation to the ultimate state of civilized interdependence. They are not obstacles to any scientific theory of evolution, nor do they provide an excuse for gloomy cynicism, but should rather be viewed with quiet resignation, relieved by philosophic hopefulness, and enlightened endeavours to ameliorate them. But though

[1] In treating of the special-creation hypothesis (*Principles of Biology*, part iii.) Mr. Spencer calls attention to the numerous cases in which the higher life is sacrificed, without compensation, to the lower, as for example in the case of parasites. This is a formidable objection, not only to the doctrine of special creations, but to anthropomorphic theism in general. But for my present purpose it is quite enough to point out that the constitution of the world is such that even the genesis of higher life involves an enormous infliction of misery upon sentient creatures.

crime and suffering may indeed be destined eventually to disappear, their prevalence throughout the recorded past has none the less been ever the stumbling-block and opprobrium of all anthropomorphic theories of the universe. Just so far as the correspondence between the organism and its environment is complete, does the teleological hypothesis find apparent confirmation. Just so far as the correspondence is incomplete, does it meet with patent contradiction. If harmony and fitness are to be cited as proofs of beneficent design, then discord and unfitness must equally be kept in view as evidences of less admirable contrivance. A scheme which permits thousands of generations to live and die in wretchedness, cannot, merely by providing for the well-being of later ages, be absolved from the alternative charge of awkwardness or malevolence. If there exist a personal Creator of the universe who is infinitely intelligent and powerful, he cannot be infinitely good: if, on the other hand, he be infinite in goodness, then he must be lamentably finite in power or in intelligence. By this two-edged difficulty, Theology has ever been foiled. Vainly striving to elude the dilemma, she has at times sought refuge in optimism; alleging the beneficent results of suffering and the evanescent character of evil, as if to prove that suffering and evil do not really exist. Usually, however, she has taken the opposite course, postulating distinct supernatural sources for the evil and the good.[1] From the Jötuns and Vritras of

[1] "*Οὐκ ἄρα πάντων γε αἴτιον τὸ ἀγαθὸν, ἀλλὰ τῶν μὲν εὖ ἐχόντων αἴτιον, τῶν δὲ κακῶν ἀναίτιον. Οὐδ' ἄρα ὁ Θεὸς, ἐπειδὴ ἀγαθὸς, πάντων ἂν εἴη αἴτιος, ὡς οἱ πολλοὶ λέγουσιν, ἀλλ' ὀλίγων μὲν τοῖς ἀνθρώποις αἴτιος, πολλῶν δὲ ἀναίτιος· πολὺ γὰρ ἐλάττω τἀγαθὰ τῶν κακῶν ἡμῖν· καὶ τῶν μὲν ἀγαθῶν οὐδένα ἄλλον αἰτιατέον, τῶν δὲ κακῶν ἄλλ' ἄττα δεῖ ζητεῖν τὰ αἴτια, ἀλλ' οὐ τον Θεόν.*" Plato, *Republic*, ii. 18 (Bekker). He goes on to refute the Homeric conception of the two jars, *Iliad*, xxiv. 660. See also Aristotle, *Metaphysica*, A. p. 984. b. 17; and compare the views of James Mill, in J. S. Mill's *Autobiography*, p. 40. For those who may wish to revive the Manichæan doctrine, an excellent point of departure has been afforded by Mr. Martineau, in his suggestion that the primary qualities of matter constitute a "datum objective to God," who, "in shaping the orbits out of immensity, and determining seasons out

early Aryan mythology, down to the multiform Manichæism of later times, may be seen the innumerable vestiges of her fruitless attempts to reconcile the fact of the existence of evil with the hypothesis of the infinite power and benevolence of a personal Deity.

It is not for the theologian to seek to stifle such objections by telling us that, in raising them, we are blasphemously judging of the character of the Deity by human standards. Nor is it for him to silence us by pointing to the wondrous process of evolution as itself the working out of a mighty Teleology of which our finite understandings can fathom but the scantiest rudiments.[1] As we shall see in the fifth chapter, the process of evolution, when reverently treated with the aid of such scientific resources as we possess, and when disencumbered of anthropomorphic hypotheses, leads us in the way of no such fearful dilemma as the one by which we are now encountered. It is theology alone which drives us to the brink of this fathomless abyss, by insisting upon the representation of the Deity as a person endowed with anthropomorphic attributes. If goodness and intelligence are to be ascribed to the Deity, it must be the goodness and intelligence of which we have some rudimentary knowledge as manifested in humanity: otherwise our hypothesis is resolved into unmeaning verbiage. "If," as Mr. Mill observes, "in

of eternity, *could but follow* the laws of curvature, measure, and proportion." *Essays, Philosophical and Theological*, pp. 163, 164. In this way Mr. Martineau preserves the quasi-human character of God in the only way in which (as I maintain) it can be preserved,—namely, by sacrificing his Omnipotence. In seeking to escape from Mr. Spencer's doctrine of the Unknowable, Mr. Martineau succeeds only in positing, in his "objective datum," an ulterior Unknowable, by which God's power is limited, and which *ex hypothesi* is not divine. This brings us directly back to Ormuzd and Ahriman. See Mr. Spencer's remarks, *Fortnightly Review*, Dec. 1873; vol. xiv. N.S. pp. 726—728.

[1] For by taking such ground as this, he would virtually abandon his anthropomorphic hypothesis, and concede all that is demanded by the Cosmist. For this conception of teleology implied in the process of evolution, see Huxley, *Critiques and Addresses*, p. 306.

ascribing goodness to God I do not mean what I mean by goodness; if I do not mean the goodness of which I have some knowledge, but an incomprehensible attribute of an incomprehensible substance, which for aught I know may be a totally different quality from that which I love and venerate—what do I mean by calling it goodness? and what reason have I for venerating it? To say that God's goodness may be different in kind from man's goodness, what is it but saying, with a slight change of phraseology, that God may possibly not be good?" With Mr. Mill, therefore, "I will call no Being good, who is not what I mean when I apply that epithet to my fellow-creatures." And, going a step farther, I will add that it is impossible to call that Being good, who, existing prior to the phenomenal universe, and creating it out of the plenitude of infinite power and foreknowledge, endowed it with such properties that its material and moral development must inevitably be attended by the misery of untold millions of sentient creatures for whose existence their Creator is ultimately alone responsible. *In short, there can be no hypothesis of a "moral government" of the world, which does not implicitly assert an immoral government.* As soon as we seek to go beyond the process of evolution disclosed by science, and posit an external Agency which is in the slightest degree anthropomorphic, we are obliged either to supplement and limit this Agency by a second one that is diabolic, or else to include elements of diabolism in the character of the first Agency itself. And in the latter case the blasphemy—if we choose to call it so—lies at the door of those who, by urging upon us their anthropomorphic hypothesis, oblige us to judge the character of the Deity by human standards; and not at the door of those who simply reveal the true character of that anthropomorphic hypothesis by setting forth its hidden implications.

Thus from every point of view the doctrine of a quasi-human God appears equally unsatisfactory to the scientific thinker. It rests upon unsupported theories of causation, upon a mistaken conception of law, and upon a teleological hypothesis whose origin renders it suspicious, and whose evidence fails it in the hour of need. The inductive proof alleged in its support is founded upon the correspondence between the organism and the environment, and where the correspondence fails, just there the doctrine is left helpless. The Doctrine of Evolution thus not only accounts for the origin and apparent justification of the anthropomorphic theory, but also reveals its limitations. And when thus closely scrutinized, the hypothesis appears as imperfect morally as it is intellectually. It is shown to be as incompatible with the truest religion as it is with the truest science. Instead of enlightening, it only mystifies us; and, so far from consoling, it tends to drive us to cynical despair.

In spite of all the care observed in the wording of the foregoing argument—a care directed toward the bringing out of my entire thought, and not toward the concealing of any portion of it—the views here maintained will doubtless by many be pronounced "covertly atheistical." It must be reserved for the next three chapters to demonstrate that they are precisely the reverse, and that the intelligent acceptance of them must leave us in an attitude toward God more reverential than that which is assumed by those who still cling to the anthropomorphic hypothesis. At present we must be content with noting that our choice is no longer between an intelligent Deity and none at all: it lies between a limited Deity and one that is without limit. For, as the foregoing discussion has plainly shown, and as must appear from every similar discussion of the subject in terms of the Doctrine of Evolution, an anthropomorphic God cannot be conceived as an infinite God. *Personality* and *Infinity* are terms expressive of ideas which are mutually incompatible. The pseud·

idea "Infinite Person" is neither more nor less unthinkable than the pseud-idea "Circular Triangle." As Spinoza somewhere says, *Determinatio negatio est*,—to define God is to deny Him; and such being the case, what can be more irrational than to insist upon thought and volition, phenomena only known to exist within quite narrow limitations, as the very nature and essence of the infinite Deity? What theory of physical or moral phenomena, built upon such an inadequate basis, can be other than unsound and misleading? What wonder if it continually land us in awkward and conflicting conclusions, painful to us alike as inquiring and as religious beings? As Goethe has profoundly said, "Since the great Being whom we name the Deity manifests himself not only in man, but in a rich and powerful Nature, and in mighty world-events, a representation of Him, framed from human qualities, cannot of course be adequate, and the thoughtful observer will soon come to imperfections and contradictions, which will drive him to doubt—nay, even to despair—unless he be either little enough to let himself be soothed by an artful evasion, or great enough to rise to a higher point of view."[1] To those whom the habits of thought which science nurtures have led to believe in the existence of an all-pervading and all-sustaining Power, eternally and everywhere manifested in the phenomenal activity of the universe, alike the cause of all and the inscrutable essence of all, without whom the world would be as the shadow of a vision, and thought itself would vanish,—to these the conception of a presiding anthropomorphic Will is a gross and painful conception. Even were it the highest phenomenal conception which can be framed, it would still be inadequate to represent the Ineffable Reality. But we do not and cannot know even that it is the highest. Hegel was rash with all the metaphysician's rashness when he said that Humanity

[1] Eckermann, vol. ii. p. 357.

is the most perfect type of existence in the universe. Our knowledge of the Cosmos has been aptly compared by Carlyle to the knowledge which a minnow in its native creek has of the outlying ocean. Of the innumerable combinations of matter and incarnations of force which are going on within the bounds of space, we know, save a few of the simplest, those only which are confined to the surface of our little planet. And to assert that among them all there may not be forms of existence as far transcending humanity as humanity itself transcends the crystal or the sea-weed, is certainly the height of unwarrantable assumption.

> "Think you this mould of hopes and fears
> Could find no statelier than his peers
> In yonder hundred million spheres?"

Until our knowledge becomes coextensive with the entire world of phenomena, questions like these must remain unanswered. Meanwhile we may rest assured that, could we solve them all, the state of the case would not be essentially altered. Our conception might be relatively far loftier, but from the absolute point of view it would be equally beneath the Reality. We are therefore forced to conclude that the process of deanthropomorphization which has from the first characterized the history of philosophic development must still continue to go on; until the Intelligent Will postulated by the modern theologian shall have shared the fate of the earlier and still more imperfect symbols whereby finite man has vainly tried to realize that which must ever transcend his powers of conception.

## CHAPTER III.

### COSMIC THEISM.

THE conclusions reached in the foregoing chapter were purely negative, and would therefore be very unsatisfactory if we were obliged to rest in them as final. Upon the religious side of philosophy as well as upon its scientific side, the mind needs some fundamental theorem with reference to which it may occupy a positive attitude. According to the theory of life and intelligence expounded in previous chapters, mere scepticism can discharge but a provisional and temporary function. To the frivolously-minded the mere negation of belief may be in no wise distressing; but to the earnest inquirer the state of scepticism is accompanied by pain, which, here as elsewhere, is only subserving its proper function when it stimulates him to renewed search after a positive result. In the present transcendental inquiry it may indeed at first sight seem impossible to arrive at any positive result whatever, without ignoring the relativity of knowledge and proving recreant to the rigorous requirements of the objective method. Nevertheless, as was hinted at the close of the preceding chapter, this is not the case. Although the construction of a theology, or science of Deity, is a task which exceeds the powers of human intelligence, there is nevertheless one supremely important theorem in which science and religion find their permanent reconciliation, and by the assertion of which the mind is brought into a positive attitude of faith with reference to the Inscrutable Power manifested in the universe. The outcome of the present argument is not Atheism or Positivism, but a phase of Theism which is higher and purer, because relatively truer, than the anthropomorphic phase defended by theologians.

This all-important theorem in which science and religion are reconciled, is neither more nor less than the theorem which alone gives complete expression to the truth that all knowledge is relative. In the first chapter of this work it was elaborately proved that as soon as we attempt to frame any hypothesis whatever concerning the Absolute, or that which exists out of relation to our consciousness, we are instantly checkmated by alternative impossibilities of thought, and when we seek to learn why this is so, we are taught by a psychologic analysis that, from the very organization of our minds, and by reason of the very process by which intelligence has been evolved, we can form no cognition into which there do not enter the elements of *likeness*, *difference*, and *relation*,—so that the Absolute, as presenting none of these elements, is utterly and for ever unknowable. Translating this conclusion into more familiar language, we found it to mean, *first*, "that the Deity, in so far as absolute and infinite, is inscrutable by us, and that every hypothesis of ours concerning its nature and attributes can serve only to illustrate our mental impotence,"—and, *secondly*, "that the Universe in itself is likewise inscrutable; that the vast synthesis of forces without us, which in manifold contact with us is from infancy till the close of life continually arousing us to perceptive activity, can never be known by us as it exists objectively, but only as it affects our consciousness."[1]

These are the closely-allied conclusions which were reached

[1] See above, vol i. p. 15.

in our opening discussion, But since such abstruse theorems need to be taken one by one into the mind, and allowed one after the other to dwell there for a while, in order to be duly comprehended, it did not then seem desirable to encumber the exposition with any reference to the third statement in which these two are made to unite; nor, indeed, would it have been possible to illustrate adequately this third statement until we had defined our position in relation to the questions of phenomenality, of causation and deanthropomorphization, of the persistence of force, and of the evolution of the phenomenal world. But now, having obtained definite conclusions upon these points, we are at last enabled to present the case as a whole. Having seen that in certain senses the Deity and the Cosmos are alike inscrutable, let us now see if there is any sense in which it may be legitimately said that the Unknowable contained in our first theorem is identical with the Unknowable contained in our second theorem.

Upon what grounds did we assert the unknowableness of Deity? We were driven to the conclusion that Deity is unknowable, because that which exists independently of intelligence and out of relation to it, which presents neither *likeness, difference,* nor *relation*, cannot be cognized. Now by precisely the same process, we were driven to the conclusion that the Cosmos is unknowable, only in so far as it is absolute. It is only as existing independently of our intelligence and out of relation to it, that we can predicate unknowableness of the Cosmos. As manifested to our intelligence, the Cosmos is the world of phenomena,—the realm of the knowable. We know stars and planets, we know the surface of our earth, we know life and mind in their various manifestations, individual and social. But, as we have seen, this vast aggregate of phenomena exists as such only in relation to our intelligence. Its *esse* is *percipi.* To this extent we have gone with Berkeley. But underlying this aggregate of phenomena, to whose extension we know no limit in space or time, we have found ourselves compelled to postulate an Absolute Reality,—a Something whose existence does not depend on the presence of a percipient mind, which existed before the genesis of intelligence, and would continue to exist though all intelligence were to vanish from the scene. Without making such a postulate, we concluded that it would be impossible to frame any theory whatever, either of subjective or of objective phenomena. Thus the theorem of the relativity of knowledge, when fully expressed, asserts that there exists a Something, of which all phenomena, as presented in consciousness, are manifestations, but concerning which we can know nothing save through its manifestations.

Let us now take a step further, and turning to the conclusions reached in the first chapter of Part **II.**, let us inquire *what is the Force of which we there asserted the persistence?* "It is not," says Mr. Spencer, "the force we are immediately conscious of in our own muscular efforts; for this does not persist. As soon as an outstretched limb is relaxed, the sense of tension disappears. True, we assert that in the stone thrown or in the weight lifted, is exhibited the effect of this muscular tension; and that the force which has ceased to be present in our consciousness, exists elsewhere. But it does not exist elsewhere under any form cognizable by us. It was proved that though, on raising an object from the ground, we are obliged to think of its downward pull as equal and opposite to our upward pull; and though it is impossible to represent these pulls as equal without representing them as like in kind; yet, since their likeness in kind would imply in the object a sensation of muscular tension, which cannot be ascribed to it, we are compelled to admit that force as it exists out of our consciousness, is not force as we know it. Hence the force of which we assert persistence is that Absolute Force of which we are indefinitely conscious as the necessary correlate of the force we know. Thus by the persistence of force, we really mean the persistence of some Power which transcends our knowledge and conception. The manifestations, as occurring either in ourselves or outside of us, do not persist; but that which persists is the Unknown Cause of these manifestations. In other words, asserting the persistence of force is but another mode of asserting an Unconditioned Reality, without beginning or end." Thus as "a subjective analysis proved that while, by the very conditions of thought, we are prevented from knowing anything beyond relative being; yet that, by these very same conditions of thought, an indefinite consciousness of Absolute Being is necessitated,—so here, by objective analysis, we similarly find that the axiomatic truths of physical science unavoidably postulate Absolute Being as their common basis."[1]

Combining, therefore, these mutually harmonious results, and stating the theorem of the persistence of force in terms of the theorem of the relativity of knowledge, we obtain the following formula:—*There exists a* POWER, *to which no limit in time or space is conceivable, of which all phenomena, as presented in consciousness, are manifestations, but which we can know only through these manifestations.* Here is a formula legitimately obtained by the employment of scientific methods, as the last result of a subjective analysis on the one hand, and of an objective analysis on the other hand. Yet this formula, which presents itself as the final outcome of a purely scientific inquiry, expresses also the fundamental truth of Theism,—the truth by which religious feeling is justified. The existence of God—the supreme truth asserted alike by Christianity and by inferior historic religions—is asserted with equal emphasis by that Cosmic Philosophy which seeks its data in science alone. Thus, as Mr. Lewes long ago observed, the remark of Comte, that the heavens declare no other glory than the glory of Hipparchos and

[1] *First Principles*, pp. 189, 190.

Newton, and such others as have aided in detecting the order of sequence among celestial phenomena, seems as irrational to the scientific inquirer as it seems impious to the religious mind. The Cosmist may assert, as consistently as the Anthropomorphist, that "the undevout astronomer is mad." Though science must destroy mythology, it can never destroy religion; and to the astronomer of the future, as well as to the Psalmist of old, the heavens will declare the glory of God.

Before proceeding further to expound this theorem, in which science and religion find their reconciliation, it is desirable to turn aside for a moment and contrast the views here expounded with the views maintained by Comte concerning the true object of the religious feeling. We shall thus the better elucidate our own position, while once more pointing out the world-wide difference between our philosophy and Positivism. Let us examine the conception of Deity formed by the thinker to whom the heavens manifested no other glory than that of Hipparchos and Newton and their compeers.

Comte recognized, though vaguely, the truth that while the human race in the course of its philosophic evolution must outgrow theology, it can never outgrow religion. He justly maintained that, while the conception of a presiding quasi-human Will must eventually be discarded as an inadequate subjective symbol, there will nevertheless remain to the last the powerful sentiment of devotion which has hitherto attached itself to that anthropomorphic conception, but must finally attach itself to some other conception. Throughout future time, while science is supreme, no less than in that past time when mythology was supreme, there must be a religion, and this religion must have an object. So far the position taken by Comte appears to be defensible enough. But now when we come to consider the object of the religious sentiment in Comte's scheme, we must pronounce his position not only irreconcilable with sound philosophy, but hopelessly retrograde as compared even with the current anthropomorphism. Seeing only the negative side of the theorem of relativity, and thus failing explicitly to recognize the existence of that Absolute Power of which the web of phenomena is but the visible garment, he was obliged to search for his Deity in the realm of the finite and the knowable. Working under these conditions, the result at which he finally arrived appears to have been legitimately evolved from the conception of the aims and scope of philosophy which he had framed in early life, at the very outset of his speculations. The thinker who from the beginning consistently occupied the anthropocentric point of view, who regarded philosophy, not as a unified theory of the Cosmos, but as a unified theory of Man, who depreciated the development theory and the study of sidereal astronomy as interfering with his anthropocentric notions, and to whom the starry heavens declared no glory save that of finite men, arrived ultimately at the deification of Humanity. Comte "refers the obligations of duty, as well as all sentiments of devotion, to a concrete object, at once ideal and real; the Human Race, conceived as a continuous whole, including the past, the present, and the future." "It may not be consonant to usage," observes Mr. Mill, "to call this a religion; but the term, so applied, has a meaning, and one which is not adequately expressed by any other word. Candid persons of all creeds may be willing to admit, that if a person has an ideal object, his attachment and sense of duty towards which are able to control and discipline all his other sentiments and propensities, and prescribe to him a rule of life, that person has a religion. . . . Many indeed may be unable to believe that this object is capable of gathering around it feelings sufficiently strong: but this is exactly the point on which a doubt can hardly remain in an intelligent reader of Comte; and we join with him in contemning, as equally irrational and mean, the conception of human nature as incapable of giving its love and devoting its existence to any object which cannot afford in exchange an eternity of personal enjoyment."[1] With the general tenour of this passage I heartily agree. I have no sympathy with those critics who maintain that the idea of Humanity is an unworthy idea, incapable of calling forth to a high degree our sentiments of devotion and reverence. No doubt, as the Comtists tell us, the majestic grandeur of which that idea is susceptible can be realized only after long and profound contemplation. And we may perhaps admit, with Mr. Mill, that "ascending into the unknown recesses of the past, embracing the manifold present, and descending into the indefinite and unforeseeable future, forming a collective Existence without assignable beginning or end, it appeals to that feeling of the Infinite which is deeply rooted in human nature." We may still further admit that all morality may be summed up in the disinterested service of the human race,—such being, as already shown (Part II. chap. xxii.), the fundamental principle of the ethical philosophy which is based on the Doctrine of Evolution. And it is, moreover, easy to sympathize with the feeling which led Comte formally to consecrate the memories of the illustrious dead, whose labours have made us what we are; that "communion of saints, unseen yet not unreal," as Carlyle nobly expresses it, "whose heroic sufferings rise up melodiously together unto Heaven, out of all times and out of all lands, as a sacred *Miserere;* their heroic actions also, as a boundless everlasting Psalm of triumph." This intense feeling of the community of the human race, this "enthusiasm of Humanity," as the author of "Ecce Homo" calls it, forms a very considerable part of Christianity when stripped of its mythology, and is one of the characteristics which chiefly

[1] Mill, *Auguste Comte and Positivism*, p. 122.

serve to difference the world-religion of Jesus and Paul from the ethnic religions of antiquity.

Nevertheless, after freely acknowledging all these points of excellence in the Comtean conception, it must still be maintained that Comte's assignment of Humanity as the direct object of religious worship was a retrograde step, when viewed in contrast, not only with the cosmic conception of Deity already clearly foreshadowed by Goethe, but even with the anthropomorphic conception as held by contemporary liberal theologians. A fatal criticism—omitted, and apparently overlooked by Mr. Mill, in his account of the Comtean religion—remains to be made upon it. I do not refer to the difficulty of ascribing godhood to a product of evolution, neither is it necessary to insist upon the marvellous shading-off of collective apehood into Deity which must puzzle the Comtist who stops to confront his theory with the conclusions now virtually established concerning man's origin; though beneath the cavil and sarcasm which cannot be kept from showing itself upon the surface of such objections, there lies just scientific ground of complaint against the Comtean hypothesis. The criticism to which I refer is one the force of which must be acknowledged even by those who have not yet learned to estimate the resistless weight of the evidence by which the development theory is supported. However grand Humanity may be as an object of contemplation, it is still finite, concrete, and knowable. It has had a beginning; in all probability it is destined to have an end. We can no longer, since the Copernican revolution, regard it as the chief and central phenomenon of the universe. We know it but as a local assemblage of concrete phenomena. manifested on the surface of a planet that is itself a lesser member of a single group among innumerable groups of worlds. It is no less significant than amusing that toward the last Comte would fain have banished from astronomy not only the study of the stars, but even the study of those planets in our own system which do not considerably perturb the motions of the earth. He wished to exclude from science everything which does not conspicuously affect human interests, and everything which by its magnitude dwarfs the conception of Humanity. Far sounder would his views have been had he now and then permitted his thoughts to range to the uttermost imaginable limits of the sidereal universe, and brought himself duly to realize how by the comparison Humanity quite loses its apparent infinitude. Or had he more carefully analyzed the process of human thinking itself, the study of which he stigmatized as "metaphysical" and profitless, he might perhaps have seen that the world of phenomena speaks to us, everywhere and at all times, if we only choose to listen, of an Infinite and Unknowable Reality, whereas the conception of Humanity is but the conception of a Finite and Knowable Phenomenon. Here we touch the bottom of his error. This great Being, says the Comtist, this collective Humanity, is our supreme Being,—"the only one we can know, *therefore* the only one we can worship." On the other hand, the Cosmist asserts, what we know is not what we worship; what we know is matter of science; it is only when science fails, and intelligence is baffled, and the Infinite confronts us, that we cease to analyze and begin to worship. What men have worshipped, from the earliest times, has been not the Known, but the Unknown. Even the primeval savage, who worshipped plants and animals, worshipped them only in so far as their modes of action were mysterious to him,—only in so far as they constituted a part of the weird uninterpreted world by which he was surrounded. As soon as he had generalized the dynamic phenomena presented by the plant or the animal, that is, as soon as it became an object of knowledge, it ceased to be an object of worship. As soon as the grander phenomena of sunrise and sunset, storm and eclipse, had been partially generalized, they were no longer directly worshipped, but unseen agents were imagined as controlling the phenomena by their arbitrary volitions, and these agents, as being mysterious, were worshipped. So when polytheism began to give place to monotheism, the process was still the same. The visible and tangible world was regarded as the aggregate of things which might be understood; but above and beneath all this was the mysterious aspect of things—the Dynamis, the Demiurgus, the Cause of all, the Ruler of all—and this mighty Something was worshipped. Though theology has all along wrestled with the insoluble problems presented by this supreme Mystery, and, by insisting on divers tangible propositions concerning it, has implicitly asserted that it can be at least partially known; the fact remains that only by being unknown has it continued to be the object of the religious sentiment. Could the theologian have carried his point and constructed a "science of Deity;" could the divine nature have been all expressed in definite formulas, as we express the genesis of vegetation or the revolutions of the planets, worship would have disappeared altogether. Worship is ever the dark side of the shield, of which knowledge is the bright side. It is because science can never explain the universe, it is because the enlarging periphery of knowledge does but reveal from day to day a greater number of points at which we meet the unknowable lying beyond, that religion can never become obsolete. Though we have come to recognize the most refined symbols by which men have sought to render Deity intelligible as inadequate and misleading symbols; though we sacrifice the symbol of personality, because personality implies limitation, and to speak of an infinite personality is to cheat oneself with a phrase that is empty of meaning; yet our recognition of Deity is only the more emphatic. Thus "the object of religious sentiment will ever continue to be that which it has ever been." The God of the scientific philosopher is still, and must ever be, the God of the Christian, though freed from the illegitimate formulas by the aid of which theology has sought to render Deity comprehensible. What is this wondrous Dynamis which manifests itself to our consciousness in harmonious activity throughout the length and breadth and depth of the universe, which guides the stars for countless ages in paths that never err, and which animates the molecules of the dew-drop that gleams for a brief hour on the shaven lawn, — whose workings are so resistless that we have naught to do but reverently obey them, yet so infallible that we can place our unshaken trust in them, yesterday, to-day, and for ever? When, summing up all activity in one most comprehensive epithet, we call it Force, we are but using a scientific symbol, expressing an affection of our consciousness, which is yet powerless to express the ineffable Reality. To us, therefore, as to the Israelite of old, the very name of Jehovah is that which is not to be spoken. Push our scientific research as far as we may, pursuing generalization until all phenomena, past, present, and future, are embraced within a single formula;—we shall never fathom this ultimate mystery, we shall be no nearer the comprehension of this omnipresent Energy. Here science must ever reverently pause, acknowledging the presence of the mystery of mysteries. Here religion must ever hold sway, reminding us that from birth until death we are dependent on a Power to whose eternal decrees we must submit, to whose dispensations we must resign ourselves, and upon whose constancy we may implicitly rely.

Thus we begin to realize, more vividly than theology could have taught us to realize, the utter absurdity of atheism. Thus is exhibited the prodigious silliness of Lalande, who informed mankind that he had swept the heavens with his telescope and found no God there,—as if God were an optical phenomenon! Thus, too, we see the poverty of that anthropomorphism which represents the infinite Deity as acting through calculation and contrivance, just as finite intelligence acts under the limitations imposed by its environment. And thus, finally, we perceive the hopeless error of the Positivist, who would give us a finite knowable, like Humanity, for an object of religious contemplation. The reasoning which demonstrates the relativity of knowledge, demonstrates also the failure of all such attempts to bind up religion in scientific formulas.

The anthropomorphic theist, habitually thinking of God as surrounded and limited by an environment or "objective datum," will urge that the doctrine here expounded is neither more nor less than Pantheism, or the identification of God with the totality of existence. So plausible does this objection appear, at first sight, that those who urge it cannot fairly be accused either of dulness of apprehension or of a desire to misrepresent. Nevertheless it needs but to look sharply into the matter, to see that the doctrine here expounded is utterly opposed to Pantheism. Though the word "pantheism" has been almost as undiscriminatingly bandied about among theological disputants as the word "atheism," it has still a well-defined metaphysical meaning which renders it inapplicable to a religious doctrine based upon the relativity of knowledge. In the pantheistic hypothesis the distinction between absolute and phenomenal existence is ignored, and the world of phenomena is practically identified with Deity. Of this method of treating the problem the final outcome is to be seen in the metaphysics of Hegel, in which the process of evolution, vaguely apprehended, is described absolutely, as a process of change in the Deity, and in which God, as identified with the totality of phenomenal existence, is regarded as continually progressing from a state of comparative imperfection to a state of comparative perfection. Or, in other words—to reduce the case to the shape in which it was presented in the first chapter of this work—the Universe, as identified with God, is regarded as self-evolved. Such a hypothesis, equally with that of the anthropomorphic theist, implicitly limits Deity with an "objective datum," and renders it finite; for, as Mr. Mansel has observed in another connection, "how can the Infinite become that which it was not from the first?" Obviously for the change an ulterior Cause is needed; and thus the pantheistic hypothesis resolves itself into the affirmation of a limited Knowable conditioned by an unlimited Unknowable,—but it is the former, and not the latter, which it deifies.

Hence to the query suggested at the beginning of this chapter, whether the Deity can be identified with the Cosmos, we must return a very different answer from that returned by the Pantheist. The "open secret," in so far as secret, is God,—in so far as open, is the World; but in thus regarding the ever-changing universe of phenomena as the multiform revelation of an Omnipresent Power, we can in nowise identify the Power with its manifestations. To do so would reduce the entire argument to nonsense. From first to last it has been implied that, while the universe is the manifestation of Deity, yet is Deity something more than the universe.

The doctrine which we have here expounded is, therefore, neither more nor less than Theism, in its most consistent and unqualified form. It is quite true that the word "theism," as ordinarily employed, connotes the ascription of an anthropomorphic personality to the Deity. But in this connotation there has been nothing like fixedness or uniformity. On the other hand the term has become less and less anthropomorphic in its connotations, from age to age, and in the sense in which it is here employed the deanthropomorphizing process is but carried one step farther. There was a time when theism seemed to require that God should be invested with a quasi-human body, just as it now seems to require that God should be invested with quasi-human intelligence and volition. But for us to concede the justice of the latter restriction would be as unphilosophical as it would have been for the early monotheists to concede the justice of the former. Just as the early Christians persisted in calling themselves theists while asserting that God dwells in a temple not made with hands, so may the modern philosopher persist in calling himself a theist while rejecting the arguments by which Voltaire and Paley have sought to limit and localize the Deity. Following out the parallel, we might characterize the doctrine here expounded as the "higher theism," in contrast with the "lower theism" taught in the current doctrine. Or in conformity with the nomenclature which has already done us such good service, we may still better characterize it as Cosmic Theism, in contrast with the Anthropomorphic Theism of those theologians who limit the Deity by an "objective datum."

This happy expression of Mr. Martineau's lays bare the anthropomorphic hypothesis to the very core, and when thoroughly considered, lets us into the secret of that superficial appearance of antagonism between Science and Religion which has disturbed so many theologians and misled so many scientific inquirers. Though as an act of lip-homage anthropomorphism asserts the infinitude and omnipotence of God, yet in reality it limits and localizes Him. Though it overtly acknowledges that "in Him we live and move and have our being," yet it tacitly belies this acknowledgment by the implication, which runs through all its reasonings, that God is a person localized in some unknown part of space, and that the universe is a "datum objective to God" in somewhat the same sense that a steam-engine is an "objective datum" to the engineer who works it. I do not say that such a conception would be avowed by any theologian: as thus overtly stated, it would no doubt be generally met with an emphatic disclaimer. Nevertheless this conception, whether avowed or disclaimed, lies at the bottom of all the arguments which theologians urge either against the theory of evolution or against any other theory which extends what is called "the domain of natural law." Take away this conception, and not only do their specific arguments lose all significance, but their entire position becomes meaningless: there ceases to be any reason for their opposing instead of welcoming the new theory. For if "extending the domain of natural law" be equivalent to "extending our knowledge of Divine action," what objection can the theologian logically make to this? Manifestly his hostile attitude is wholly prescribed by his belief, whether tacit or avowed, that the sphere of natural law and the sphere of Divine action are two different spheres, so that whatever is added to the former is taken from the latter. It is assumed that the universe is a sort of lifeless machine, which under ordinary circumstances works along without immediate Divine superintendence, in accordance with what are called natural laws, very much as the steam-engine works when once set going, in accordance with the harmoniously cooperating properties of its material structure. Only by occasional interposition, it is assumed, does God manifest his existence,—by originating organic life, or creating new species out of dust or out of nothing, or by causing prodigies to be performed within historic times for the edification of gaping multitudes. So deep-seated is this assumption—so vitally implicated is it with all the habits of thought which theology nurtures—that we sometimes hear it explicitly maintained that when natural law can be shown to be co-extensive with the whole of nature, then our belief in God will *ipso facto* be extinguished.

Such a position is no doubt as irreligious as it is unscientific; but it is not difficult to see how it has come to be so commonly maintained. Not only is it often apparently justified by the unphilosophical language of scientific men—especially of those shallow writers known as "materialists"—who speak of "natural law" as if it were something different from "Divine action;" but it is also the logical offspring of that primitive fetishism from which all our theology is descended. For as physical generalization began to diminish the sphere of action of the innumerable quasi-human agencies by which fetishism sought to account for natural phenomena, there could hardly fail to arise a belief in some sort of opposition between invariable law and quasi-human agency. On the one hand you have a set of facts that occur in fixed sequences, and so are not the result of anthropomorphic volition; on the other hand you have a set of facts that seem to occur according to no determinable order, and so are the result of anthropomorphic volition. The fetishistic thinker could not, of course, formulate the case in this abstract and generalized way; but there can be no doubt that a crudely felt antithesis of the kind here indicated must have been nearly coeval with the beginnings of physical generalization. Now the gradual summing up and blending together of all the primeval quasi-human agencies into one grand quasi-human Agency, could not at once do away with this antithesis. On the contrary, the antithesis would naturally remain as the generalized opposition between the realm of "invariable law" and the realm of "Divine originality." It would be superfluous to recount the various metaphysical shapes which this conception has assumed, in some of which Nature has even been personified as an intelligent and volitional agency, distinct from God, and working through law while God works through miracle. The result has been that, as scientific generalization has steadily extended the region of "natural law," the region which theology has assigned to "Divine action" has steadily diminished, until theological arguments have become insensibly pervaded by the curious assumption that the greater part of the universe is godless. For it is naïvely asked, if plants and animals have been naturally originated, if the world as a whole has been evolved and not created, and if human actions conform to law, what is there left for God to do?[1] If not formally repudiated, is he not thrust back into the past eternity, as an unknowable source of things, which is postulated for form's sake, but might as well, for all practical purposes, be omitted?

The reply is that the difficulty is one which theology has created for itself. It is not science, but theology, which has thrust back Divine action to some nameless point in the past eternity and left nothing for God to do in the present world. For the whole difficulty lies in the assumption of the material universe as a "datum objective to God," and in the consequent distinction between "Divine action" and "natural law,"—a distinction for which science is in nowise responsible. The tendency of modern scientific inquiry, whether working in the region of psychology or in that of transcendental physics, is to abolish this distinction, and to regard "natural law" as merely a synonym of "Divine action." And since Berkeley's time the conception of the material universe as a "datum objective to God" is one which can hardly be maintained on scientific grounds. It is scientific inquiry, working quite independently of theology, which has led us to the conclusion that all the dynamic phenomena of Nature constitute but the multiform revelation of an Omnipresent Power that is not identifiable with Nature. And in this conclusion there is no room left for the difficulty which baffles contemporary theology. The scientific inquirer may retort upon the theologian:—Once really adopt the conception of an ever-present God, without whom not a sparrow falls to the ground, and it becomes self-

[1] "Illos omnes Deum aut saltem Dei providentiam tollere putant, qui res et miracula per causas naturales explicant aut intelligere student." Spinoza, *Tractatus Theologico-Politicus*, vi. *Opera.* iii. 86. "Οὐ γὰρ ἠνείχοντο τοὺς φυσικοὺς καὶ μετεωρολέσχας τότε καλουμένους, ὡς εἰς αἰτίας ἀλόγους καὶ δυνάμεις ἀπρονοήτους καὶ κατηναγκασμένα πάθη διατρίβοντας τὸ θεῖον." Plutarch, *Nikias*, cap. 23. The complaint, it will be seen, is the same in modern that it was in ancient times. Compare Plutarch, *Perikles*, cap. 6; Cicero, *Tusc. Disp.* i. 13, *Opera*, ed. Nobbe, tom. viii. p. 299.

evident that the law of gravitation is but an expression of a particular mode of Divine action. And what is thus true of one law is true of all laws. The Anthropomorphist is naturally alarmed by the continual detection of new uniformities, and the discovery of order where before there seemed to be disorder; because his conception of Divine action has been historically derived from the superficial contrast between the seemingly irregular action of will and the more-obviously regular action of less complex phenomena. The Cosmist, on the other hand, in whose mind Divine action is identified with orderly action, and to whom a really irregular phenomenon would seem like the manifestation of some order-hating Ahriman, foresees in every possible extension of knowledge a fresh confirmation of his faith in God, and thus recognizes no antagonism between our duty as inquirers and our duty as worshippers. He will admit no such inherent and incurable viciousness in the constitution of things as is postulated by the anthropomorphic hypothesis. To him no part of the world is godless. He does not rest content with the conception of "an absentee God, sitting idle, ever since the first Sabbath, at the outside of his universe, and 'seeing it go;'" for he has learned, with Carlyle, "that this fair universe, were it in the meanest province thereof, is in very deed the star-domed City of God; that through every star, through every grass-blade, and most through every living soul, the glory of a present God still beams."[1]

From the anthropomorphic point of view it will quite naturally be urged in objection, that this apparently-desirable result is reached through the degradation of Deity from an "intelligent personality" into a "blind force," and is therefore in reality an undesirable and perhaps even quasi-atheistic result. To the theologian the stripping-off the anthropomorphic vestments with which men have sought to render the Infinite representable in imagination, always means the

[1] *Sartor Resartus*, bk. ii. chap. vii.; bk. iii. chap. viii.

leaving of nothing but "blind force" as a residuum. Trained upon the subjective method, and habitually applying to all propositions the test of metaphysical congruity only, he naturally regards the possibilities of human thought as fairly representative of the possibilities of existence. Accordingly since human intelligence is the highest mode of Being which we know—being in the nature of things the highest mode, since it is the mode in which we ourselves exist, and which we must therefore necessarily employ as a norm by which to estimate all other modes—the theologian infers that any higher mode of Being is not only inconceivable but impossible. And so, when a vast extension of our knowledge of nature shows (or seems to show) that the workings of quasi-human intelligence form but an inadequate and misleading symbol of the workings of Divine Power, it naturally seems to the theologian that we are giving up an "intelligent personality" for a "blind force."

Here, however, as before, the difficulty is one which theology has created for itself. It is not science, but theology, which conjures up a host of phantom terrors by the gratuitous use of the question-begging epithet "blind force." The use of this, and of the kindred epithet "brute matter," implies that matter and force are real existences,—independent "data objective to" consciousness. Such a view, however, as already shown, cannot be maintained. To the scientific inquirer, the terms "matter" and "force" are mere symbols which stand *tant bien que mal* for certain generalized modes of Divine manifestation: they are no more real existences than the $x$ and $y$ of the algebraist are real existences. The question as to identifying Deity with Force is, therefore, simply ruled out. The question which really presents itself is quite different. Theologically phrased, the question is whether the creature is to be taken as a measure of the Creator. Scientifically phrased, the question is whether the highest form of Being as yet suggested to one petty race of creatures by its ephemeral experience of what is going on in one tiny corner of the universe, is necessarily to be taken as the equivalent of that absolutely highest form of Being in which all the possibilities of existence are alike comprehended. It is the same question which confronted us in our opening chapter, and which returned to confront us in sundry other chapters of our Prolegomena. Already we have more than once answered it, in a general way, by showing that "the possibilities of thought are not coextensive with the possibilities of things." We have now to give it a more special answer, by inquiring into the possibility of a mode of existence not limited by the conditions which limit conscious existence within the narrow domain of our terrestrial experience. In other words, we have to inquire into the relations between Matter and Spirit; and the inquiry, besides throwing light on questions which must have arisen in the course of our exposition of the evolution of life and intelligence, will also furnish us with the means for emphasizing the theistic conclusions obtained in the present chapter.

## CHAPTER IV.

### MATTER AND SPIRIT.

It is the usual lot of scientific writers who maintain theories which have not yet become popular with the theological world, to be accused of holding opinions which they not only do not hold, but against which they have perhaps, on every fitting occasion, publicly and emphatically protested. Partly, no doubt, such misrepresentations arise from that carelessness (to call it by no worse name) which too often characterizes the statements of persons who have come to believe that the interests of sacred truth have been committed to them for safe keeping. Whether the truth in question derives its sacredness from time-hallowed tradition or what are called the "higher instincts of our nature," whether its self-appointed guardians are conservative theologians or radical iconoclasts, extreme devotion to its interests is liable to be accompanied by a lofty disregard for that accuracy of statement which to the scientific inquirer seems so indispensable. It appears to be tacitly assumed that the interests of Truth in the abstract can be rightly subserved only by the sacrifice of divers humble concrete truths. Abundant evidence of this is to be found in the tracts and speeches of "teetotalers," "labour reformers," "friends of the People," and other sentimentalists

As regards theologians, a great deal is to be said in behalf of their intolerance of opinions which they honestly believe to be fraught with spiritual and moral evil. But this zeal in the cause of Truth too often betrays them into misrepresentations which suggest that the maxim *Nulla fides cum hæreticis* has not yet been completely expunged from their moral code. Especially in the use of unpopular question-begging epithets they are by no means sufficiently scrupulous. Such epithets as "materialism" and "atheism," being extremely unpopular, have long been made to do heavy duty in lieu of argument. In this sort of barbaric warfare the term "materialism" is especially convenient, by reason of a treacherous ambiguity in its connotations. Certain abstract theorems of metaphysics are correctly described as constituting materialism; and the persons who assert them are correctly called materialists. On the other hand, those persons are popularly called materialists who allow their actions to be guided by the desires of the moment, without reference to any such rule of right living as is termed a "high ideal of life." Persons who worship nothing but worldly success, who care for nothing but wealth, or fashionable display, or personal celebrity, or sensual gratification, are thus loosely called materialists. The term can therefore easily be made to serve as a poisoned weapon, and there are theologians who do not scruple to employ it as such against the upholders of philosophic opinions which they do not like but are unable to refute. A most flagrant instance was recently afforded by a lecturer on Positivism, who, after insinuating that pretty much the whole body of contemporary scientific philosophers are Positivists, and that Positivists are but very little better than materialists, proceeded to inform his audience that "materialists" are men who lead licentious lives.

It would be hard to find words strong enough to characterize the villany of such misrepresentations as this could we fairly suppose them to be deliberately intended. They would imply extreme moral turpitude, were it not that they are so obviously the product of extreme slovenliness of thinking joined with culpable carelessness of assertion. The chain of ill-conceived arguments upon which they depend is something like this:—Every attempt to interpret the succession of mental phenomena by means of theorems originally devised to interpret the movements of matter, involves the assertion of materialism; the assertion of materialism involves the denial of personal immortality; the denial of personal immortality deprives morality of its principal sanction, and prevents us from having any higher ideal of life than the gratification of egoistic desires; *ergo*, we are justified in insinuating that philosophers who interpret mental manifestations by a reference to material structure are likely to be men of loose morals. Such is the tacit argument which underlies this kind of theological misrepresentation; and in pity for the mental confusion which it implies, we may perhaps condone or overlook the bigotry which assists in disguising its flimsiness. In truth, a more striking example of the audacity of the subjective method could not well be found. Not one of the premises from which so startling a conclusion is drawn has been verified; and it would not be difficult to show that each one involves a *non sequitur*. It might be shown that the denial of personal immortality does not deprive morality of its principal sanction, or prevent us from having any higher ideal of life than the gratification of egoistic desires. And it might be forcibly argued that the denial of personal immortality has by no means been proved to be an inevitable corollary from the assertion of materialism, though it may freely be admitted to be a probable corollary. But with these two unverified inferences we are not now especially concerned. What concerns us is the initial *non sequitur*,—that every attempt to interpret mental manifestations by a reference to material structure involves the assertion of materialism. This is the *non sequitur* which lies at the very bottom of the theological misrepresentation, and its utter fallaciousness needs to be thoroughly exposed.

It would be grossly unjust to throw all the blame of this particular *non sequitur* upon the theologians, who have enough logical delinquencies of their own to answer for, without being required to carry the burden of their adversaries' errors into the bargain. The illegitimate inference is one which scientific writers, and philosophers of a certain school, have been quite as ready to make as theologians: indeed, I believe it was the former who first suggested it to the latter. At all events, without going into historical minutiæ concerning the origin of materialism, but confining our attention to its more recent scientific phases, we may observe that it was not a theologian, but an eminent man of science, who first suggested that the results of modern objective psychology might be represented in the formula, *Ohne Phosphor kein Gedanke.* This formula has been caught up as a watchword by a school of atheistic writers, some of whom, as Moleschott and Vogt, rank very high as scientific specialists, but none of whom seem to be worthy of mention for psychological capacity or for acquaintance with the best thoughts of modern philosophy. The most conspicuous representative of this school is Dr. Büchner,—a writer who deserves praise for his power of lucid exposition, but whose pages are too often deformed with brutalities of expression for which no atonement is made in the shape of original or valuable thought. Although this writer has no scientific reputation whatever, and although his school has no more claim to rank with the great schools of philosophy in our time than it had when the now-forgotten Lamettrie represented it in the days of Hume and Kant, yet through loudness of asseveration it has succeeded in doing much to mislead and perplex the public mind with reference to the philosophic results of recent scientific inquiry. Because Dr. Büchner and his followers point to certain discoveries in nervous physiology or in transcendental physics as evidence of the materiality of mind, it has come to be currently supposed that those scientific inquirers who accept the discoveries accept also the materialistic inference. And because the ablest scientific inquirers, being more occupied in hunting for truths than in looking about for ugly consequences, have seldom said anything on either side of the question, their silence has been interpreted as equivalent to assent, both by the materialists and by the theologians. Energetic protests, however, have been made against this erroneous interpretation, by Prof. Tyndall on the part of molecular physics, and by Prof. Huxley on the part of physiology; while Mr. Spencer has most conclusively demonstrated that, from the scientific point of view, the hypothesis of the materialists is not only as untenable to-day as it has ever been, but must always remain inferior in philosophic value to the opposing spiritualistic hypothesis. Let us look at some of the arguments which necessitate this conclusion.

"No thought without phosphorus!" This remark of Moleschott's has been called a "trenchant" remark. To me it seems a very barren piece of truism. I have no doubt that a century hence, the fact that such a remark should have been regarded either as a valuable novelty or as an alarming heresy, will be cited in evidence of the intellectual dulness of our time. If the aphorism is not restricted to the conditions under which thinking occurs within the limits of our experience, it is merely an audacious assertion, not worthy of serious refutation. If it is thus restricted, it becomes a mere platitude. Within the limits of our experience no one supposes that thinking is done without a body. No philosopher of any school whatever, theological or scientific, maintains that, during the period of human life there is such a thing as consciousness without brain. None will assert, that, under terrestrial conditions, we have any experience of psychical manifestation apart from physical structure. When, therefore, some speculative physiologist singles out one of the most important chemical ingredients of brain-substance, and tells us that there is no thinking done without that chemical ingredient, we have no good ground either for rejoicing over increased wisdom, or for alarm at possible conclusions. The conclusions to be drawn, whatever they may be, remain just the same as before. Vision is essentially a psychical process; yet no one pretends that vision can be accomplished without an eye. If I were to proclaim on the house-tops, "No vision without retinal rods," would not the common-sense of mankind either rebuke my audacity in pretending that I had got possession of a new and wonderful truth, or derisively inquire my reasons for making so much outcry over such a manifest platitude?

The case remains entirely unaltered when we come to such a minute comparison of psychical manifestation and brain-action as was indicated in our chapter on the Evolution of Mind. Whatever theory be held with regard to a future life, he who admits that during the present life mental action in the gross is correlated with brain-action in the gross, can in no wise complain of an attempt to trace out the detailed correlations between mental action in the little and brain-action in the little. If the brain is the organ of Mind, and if the daily manifestations of Mind, in all their complexity, are conditioned by the possession of such a complex organ, then the simple ultimate elements of which the complex mental manifestations are made up, must be severally conditioned by the simple ultimate elements, structural and functional, which make up the complex organ and its molecular activities. In proceeding to trace out these simple ultimate correlations, we are merely analyzing two complicated groups of phenomena into their elements, in order that we may arrive at a better practical understanding of them; and at the end of our inquiry we no more stand committed to any conclusion regarding the real nature of either group than we did at the beginning. When we admit that a blow on the head is likely to make a man insensible, we are just as much or just as little materialists as when we suggest the hypothesis that cerebral inflammation, by obstructing certain particular transit-lines, may prevent certain particular associations of ideas and thus obliterate certain specific memories. Repeating Mr. Spencer's words, we may say that "the general relation between mental manifestations and material structure traced out [in this work], has implications identical with, and no wider than, those which familiar experiences thrust upon us." In objective psychology, as in other departments of inquiry, science is but an extension of common knowledge. "That drowsiness impedes thinking, that wine excites or stupefies according to amount and circumstances, that great loss of blood produces temporary unconsciousness,—are facts admitted by everyone, be his theory of things what it may. That you cannot get out of the undeveloped child thoughts and feelings like those you get out of the developed man; that the idiot, with brain permanently arrested in its growth, remains permanently incapable of any but the simplest mental actions; are propositions not denied by the most intemperate reviler of physiological psychology. But one who recognizes such facts and propositions is just as much chargeable with materialism as one who puts together facts and propositions like those which constitute the exposition [of psychical phenomena contained in this work]. Whoever grants that from the rudimentary consciousness implied by the vacant stare of the infant, up to the quickly apprehensive, far-seeing, and variously-feeling consciousness of the adult, the transition is through slow steps of mental progress that accompany slow steps of bodily progress, tacitly asserts the same relation of Mind and Matter which is asserted by one who traces out the evolution of the nervous system and the accompanying evolution of intelligence, from the lowest to the highest forms of life."[1]

It appears, therefore, that, so far as objective psychology is concerned, but little support has as yet been obtained for the materialistic hypothesis. The most that psychology, working with the aid of physiology, has thus far achieved, has been to show that, within the limits of our experience, there is an *invariable concomitance* between psychical phenomena and the phenomena of nervous action; and this, as we have seen, is but the elaborate analytic statement of a plain truth, which is asserted alike by philosophers of every school and by the common-sense of every human being,—namely, that from birth until death there is no manifestation of Mind except in association with Body. But beyond this it is quite clear that objective psychology can never go. The most that psychology, working with the aid of physiology, can ever achieve, will be to show the invariable concomitance between nervous and psychical phenomena, within the limits of our experience. The most it can ever do will be to illustrate, with more and more minute detail, that same proposition in asserting which it has been from the outset upheld by the universal consent of mankind. To enlarge the scope of that proposition, to add to it new ulterior implications, must for ever remain beyond its power. Or if this is still not perfectly clear, the kindred considerations now to be drawn from the study of transcendental physics will make it clear.

It has been not uncommonly taken for granted, both by materialists and by theologians, that molecular physics, in establishing a quantitative correlation between the various modes of motion manifested throughout organic and inorganic nature, has supplied a basis whereon to found some theory of the materiality of Mind. Here, as before, the theologians have accepted the materialistic inference and aimed their assaults at the irrefragable scientific theorem,

[1] *Principles of Psychology*, vol. i. p. 617.

instead of admitting the scientific theorem and showing that, when rightly understood, it does not afford a premise for the materialistic inference. Mr. Spencer pithily remarks that the one class show by their fears, quite as much as the others show by their hopes, that they believe in the theoretical possibility of resolving mental phenomena into motions of matter; whereas those who really comprehend the import of modern discoveries in molecular physics are more thoroughly convinced than ever that any such reduction is utterly beyond the bounds of possibility. A brief consideration will suffice to show us that one of the great results of the discovery of the correlation of forces is the final destruction of the central argument by which materialism has sought to maintain its position. Henceforth the spiritualistic hypothesis may, perhaps, be still regarded as on trial, in so far as it needs much further explanation and limitation; but the materialistic hypothesis is doomed irretrievably.

For let us note well what is implied in the assertion that sun-derived radiance is metamorphosed, first into the static energy of vegetable tissue, and afterwards into the dynamic energy which maintains the multiform activity of the animal organism; and that through the liberation of a part of such dynamic energy, in the form of discharges between interconnected ganglia, there are rendered possible the phenomena of conscious activity.[1] Let us endeavour to mark out precisely what is meant by this assertion. In its present form it is a concrete statement, based upon the abstract truths that, within the limits of our experience, any given species of motion whatever has acquired its distinctive attributes through transformation from some other species, and will again lose these distinctive attributes through a subsequent transformation. For example, the heat which now raises the temperature of a pound of water just one degree of Fahrenheit, has acquired its present form of existence

[1] See above, vol. i. pp. 411, 416.

through the transformation of as much molar motion as is implied in the fall of 772 pounds of matter through one foot of space; and it will lose its present form of existence as fast as it is retransformed into molar motion of expansion, or into other modes of molecular motion, according to superinduced circumstances. So when food is taken into the organism and assimilated with the tissues, the quantity of molecular motion involved in the secretion of bile by the liver, or in the raising of the arm by an act of will, or in the knitting of a new plexus of associated ideas by the opening of new communications between brain-cells, may equally be said to have acquired its present specific forms through transformation from the potential motion latent in the prepared food. So we may say, very roughly, that there is a metamorphosis of molar motion into heat and actinism; of heat and actinism into the potential motion latent in the nutriment ultimately derived from sun-nourished vegetable tissues; of this potential motion into undulations among the molecules of nerve; of these undulations back into molar motions of the muscles which move limbs, or into molecular motions of secreting glands, and so on, in a never-ending circuit. The circuit is thus very roughly described, but such is essentially its character. But now let us note that throughout this wondrous circuit, from molar motion to molecular nerve-motion, and back again to molar motion, there is no question of Mind whatever. The metamorphosis is always from one species of material motion into some other species of material motion, but never from a species of material motion into an idea or a feeling. The dynamic circuit is absolutely complete without taking psychical manifestations into the account at all. Now obviously the most that molecular physics can ever accomplish will be to point out, in more and more minute detail, the characteristics of the various metamorphoses which occur within the limits of this circuit. The ideal goal of physical inquiry would be to furnish algebraic equations for every curve described by every particle of matter during the entire series of transformations, from the arrested molar motions of the gravitating particles of the sun, down to the endlessly-complex molecular motions which take place within the cerebral tissue of a mathematician engaged in solving partial differential equations. However stupendous such an achievement may seem to us who are as yet in the callow infancy of scientific inquiry, there is nevertheless no radical absurdity involved in conceiving it as theoretically possible. But now let us suppose all this actually achieved. Let us suppose physical inquiry to have reached its uttermost conceivable limit, having reduced the whole problem of motion, in all its myriad manifestations, in both inorganic and organic nature, to a purely algebraic problem, for the solution of which the requisite algebraic devices are at hand; and let us consider what we have thus achieved. Have we made the first step toward the resolution of psychical phenomena into modes of motion? Obviously we have not. The closed circuit of motion, motion, motion, remains just what it was before. No conceivable advance in physical discovery can get us out of this closed circuit, and into this circuit psychical phenomena do not enter. Psychical phenomena stand *outside* this circuit, *parallel* with that brief segment of it which is made up of molecular motions in nerve-tissue. However strict the parallelism may be, within the limits of our experience, between the phenomena of mind and this segment of the circuit of motions, the task of transcending or abolishing the radical antithesis between the phenomena of mind and the phenomena of motions of matter, must always remain an impracticable task. For in order to transcend or abolish this radical antithesis, we must be prepared to show how a given quantity of molecular motion in nerve-tissue can become transformed into a definable amount of ideation or feeling. But this, it is quite safe to say, can never be done. Free as we were, a moment ago, to admit the boundless possibilities of scientific inquiry in one direction, we may here at once mark the bounds beyond which, in another direction, scientific inquiry cannot advance.

For in the last resort it is subjective psychology which must render the decisive verdict as to the possibility of identifying feeling with motion; and to obtain this decisive verdict there is but one legitimate way. By a physical analysis we must ascertain what is the primordial element in motion, and by a psychological analysis we must ascertain what is the primordial element in feeling; it must then be left for consciousness to decide whether these two primordial elements are or are not in such wise like each other that the one may be substituted for the other indifferently; and from this verdict there can, in the nature of the case, be no appeal. Now it would be very rash to suppose that we have as yet arrived at a knowledge of the primordial unit, either of motion or of feeling: still we have made an approximation sufficient for the purposes of the present argument. Our analysis has progressed so far as to enable us to foresee the verdict, and to rest assured that further analysis will reiterate and not reverse it. In the chapter on the Composition of Mind, we saw that "the physical action which accompanies psychical changes is an undulatory displacement of molecules, resulting in myriads of little waves or pulses of movement." We saw also that, "as a cognizable state of consciousness is attended by the transmission of a number of little waves from one nerve-cell to another, so the ultimate psychical elements of each conscious state must correspond to the passage of these little waves taken one by one." And we were "led to infer, as the ultimate unit of which Mind is composed, a simple *psychical shock*, answering to that simple *physical pulsation* which is the ultimate unit of nervous action."[1] Here, then, are our approximately-primordial

[1] See above, p. 131.

elements,—on the one hand a psychical shock as the basis of all consciousness, on the other hand a physical pulsation as the basis of all that molecular motion of which nervous action is a species. It is now for consciousness to decide, upon direct inspection, whether a psychical shock is so much like a physical pulsation that in a given series of propositions the one term might be substituted for the other. "Can we, then, think of the subjective and objective activities as the same? Can the oscillation of a molecule be represented in consciousness side by side with a [psychical] shock, and the two be recognized as one? No effort enables us to assimilate them. That a unit of feeling has nothing in common with a unit of motion, becomes more than ever manifest when we bring the two into juxtaposition. And the immediate verdict of consciousness thus given, might be analytically justified were this a fit place for the needful analysis. *For it might be shown that the conception of an oscillating molecule is built out of many units of feeling; and that to identify it with a [psychical] shock would be to identify a whole congeries of units with a single unit.*"[1]

Thus we were fully justified in stating that through no imaginable future advance in molecular physics can the materialists ever be enabled to realize their desideratum of translating mental phenomena in terms of matter and motion. We were right in hinting that one grand result of the

[1] Spencer, *Principles of Psychology*, vol. i. p. 158. I have taken the liberty to alter Mr. Spencer's metaphorical phrase "nervous shock" into the more literally accurate phrase "psychical shock." The term "nervous shock," though partially justified by the colloquial use of the word "nervous" in description of psychical states (as when we speak of feeling nervous or flighty), is nevertheless a bad term in an argument like the present, where the strictest accuracy is above all things desirable. For besides this psychological use of it, the term "nervous shock" is used in physiology in a sense strictly synonymous with one kind of "physical pulsation." So that, to those who pay more attention to an author's slips of expression than to his manifest meaning, the term may seem to contain the materialistic implications which it is the express purpose of Mr. Spencer's argument to avoid. Any such misapprehension is impossible if we substitute the term "psychical shock."—(Mr. Spencer authorizes me to add that he thoroughly approves of this emendation.)

enormous progress achieved during the past forty years in the analysis of both physical and psychical phenomena, has been the final and irretrievable overthrow of the materialistic hypothesis. Henceforth we may regard materialism as ruled out, and relegated to that limbo of crudities to which we some time since consigned the hypothesis of special creations. The latest results of scientific inquiry, whether in the region of objective psychology or in that of molecular physics, leave the gulf between Mind and Matter quite as wide as it was judged to be in the time of Descartes. It still remains as true as then, that between that of which the differential attribute is Thought and that of which the differential attribute is Extension, there can be nothing like identity or similarity. Although we have come to see that between the manifestations of the two there is such an unfailing parallelism that the one group of phenomena can be correctly described by formulas originally invented for describing the other group, yet all that has been established is this parallelism. When it comes to the task of making the parallels meet, we are no better off than Malebranche with his Occasional Causes, or Leibnitz with his Pre-established Harmony: nay, we are no better off than the ancient Gnostics, with their "æons" and their "Demiurge." Rich as are the harvests which science has obtained from these two fields, the fence which divides them has never been broken down; and until the insuperable distinction between Subject and Object, between the Conscious and the Unconscious, can be transcended, it can never be broken down.

But while the materialistic hypothesis is thus irretrievably doomed, it is otherwise with the opposing spiritualistic hypothesis. It is true that we cannot directly translate Matter in terms of Spirit, any more than we can translate Spirit in terms of Matter. But we have seen that the term "matter" does not stand for any real existence, but only for one of the modes in which an Inscrutable Existence reveals itself to us.

within the limits of our terrestrial experience. It must always be borne in mind that we go with Berkeley to the full extent of asserting that the term "matter" means, not the occult reality, but the group of phenomena which are known as resistance, extension, colour, etc.[1] If now we proceed to the outermost verge of admissible speculation, and inquire for a moment what may perhaps be the nature of that Inscrutable Existence of which the universe of phenomena is the multiform manifestation, we shall find that its intimate essence may conceivably be identifiable with the intimate essence of what we know as Mind. In order to show how this can be, I shall cite from Mr. Spencer a somewhat lengthy passage, to which the attention of critics has hitherto been too little directed.

"Mind, as known to the possessor of it, is a circumscribed aggregate of activities; and the cohesion of these activities, one with another, throughout the aggregate, compels the postulation of a something of which they are the activities. But the same experiences which make him aware of this coherent aggregate of mental activities, simultaneously make him aware of activities that are not included in it—outlying activities which become known by their effects on this aggregate, but which are experimentally proved to be not coherent with it, and to be coherent with one another.[2] As, by the definition of them, these external activities cannot be brought within the aggregate of activities distinguished as those of Mind, they must for ever remain to him nothing more than the unknown correlatives of their effects on this aggregate; and can be thought of only in terms furnished by this aggregate. Hence, if he regards his conceptions of these activities lying beyond Mind, as constituting knowledge of them, he is deluding himself: he is but representing these activities in terms of Mind, and can never do other-

[1] See above, vol. i. p. 88.
[2] See, in this connection, *First Principles*, pp. 143—156.

wise. Eventually he is obliged to admit that his ideas of Matter and Motion, merely symbolic of unknowable realities, are complex states of consciousness built out of units of feeling. But if, after admitting this, he persists in asking whether units of feeling are of the same nature as the units of force distinguished as external, or whether the units of force distinguished as external are of the same nature as units of feeling; then the reply, still substantially the same, is that we may go farther towards conceiving units of external force to be identical with units of feeling, than we can towards conceiving units of feeling to be identical with units of external force. Clearly, if units of external force are regarded as absolutely unknown and unknowable, then to translate units of feeling into them is to translate the known into the unknown, which is absurd. And if they are what they are supposed to be by those who identify them with their symbols, then the difficulty of translating units of feeling into them is insurmountable: if Force as it objectively exists is absolutely alien in nature from that which exists subjectively as Feeling, then the transformation of Force into Feeling is unthinkable. Either way, therefore, it is impossible to interpret inner existence in terms of outer existence. But if, on the other hand, units of Force as they exist objectively, are essentially the same in nature with those manifested subjectively as units of Feeling; then a conceivable hypothesis remains open. Every element of that aggregate of activities constituting a consciousness, is known as belonging to consciousness only by its cohesion with the rest. Beyond the limits of this coherent aggregate of activities, exist activities quite independent of it, and which cannot be brought into it. We may imagine, then, that by their exclusion from the circumscribed activities constituting consciousness, these outer activities, though of the same intrinsic nature, become antithetically opposed in aspect. Being disconnected from consciousness, or cut off by its limits, they are thereby rendered foreign to it. Not being incorporated with its activities, or linked with these as they are with one another, consciousness cannot, as it were, run through them; and so they come to be figured as unconscious—are symbolized as having the nature called material as opposed to that called spiritual. While, however, it thus seems an imaginable possibility that units of external Force may be identical in nature with units of the force known as Feeling, yet we cannot by so representing them get any nearer to a comprehension of external Force. For . . . supposing all forms of Mind to be composed of homogeneous units of feeling variously aggregated, the resolution of them into such units leaves us as unable as before to think of the substance of Mind as it exists in such units; and thus, even could we really figure to ourselves all units of external Force as being essentially like units of the force known as Feeling, and as so constituting a universal sentiency, we should be as far as ever from forming a conception of that which is universally sentient."[1]

I do not know where we could find anything more admirable than this lucid statement, in which the most subtle conclusion now within the ken of the scientific speculator is reached without disregard of the canons prescribed by the doctrine of relativity. From this masterly statement it appears that while the Inscrutable Power manifested in the world of phenomena cannot possibly be regarded as quasi-material in its nature, it may nevertheless be possibly regarded as quasi-psychical. Were we compelled to choose between these two alternatives, the latter would be the one which we must perforce adopt. For besides the general reason here indicated for such preference, there would in such case be presented the more special reason, that upon no imaginable hypothesis of evolution (if the foregoing analysis be correct) can units of Mind be regarded as pro-

[1] Spencer, *Principles of Psychology*, vol. i. pp. 159--161.

duced by the collocations of units of Matter. Were we constrained to such a treatment of the subject, we should be forced to admit that the actual existence of psychical energy, as a phenomenon essentially distinct from physical energy, implies, as its antecedent source, something quasi-psychical in the constitution of things.

A third alternative, however, remains open. Since we know nothing even of Mind, save as qualitatively differentiated from Matter, under the persistent conditions by which conscious activity is limited, it is open to us to maintain that the Unknown Reality which is manifested under both aspects cannot legitimately be formulated in terms of either aspect. The unconditioned Source of the phenomena which we distinguish as psychical, and of the phenomena which we distinguish as material, may well be neither quasi-psychical nor quasi-material. Whichever set of terms we use, we are using symbols the values of which are determined by our experiences of conditioned existence, and which must therefore be totally inadequate to express the characteristics of unconditioned existence. Nevertheless, in so far as the exigencies of finite thinking require us to symbolize the Infinite Power manifested in the world of phenomena, we are clearly bound to symbolize it as quasi-psychical, rather than as quasi-material. Provided we bear in mind the symbolic character of our words, we may say that "God is Spirit," though we may not say, in the materialistic sense, that "God is Force." Such an utterance is, indeed, anthropomorphic. But we are now finding powerful confirmation of the argument elaborated in our Prolegomena, that a Positive mode of philosophizing is impracticable, and that we can never get entirely rid of all traces of anthropomorphism.[1] As formerly shown, "there is anthropomorphism even in speaking of the unknown Cause as a *Power* manifested in phenomena;" and if this expression is liable to

[1] See above, vol. i. p. 183.

be honestly misinterpreted as implying the identification of Deity with so-called "blind force," and as thus conveying a *lower* conception than that upon which theology insists, then we need not shrink from the scarcely-greater anthropomorphism involved in speaking of the unknown Cause as a *Spirit* manifested in phenomena. Such a choice of symbols will at least serve to show that we no more identify Deity with "blind force" than we identify Mind with "brute matter," or a psychical shock with a physical pulsation, and that, in our innermost intent, we are striving to convey a *higher* conception than that upon which theology insists.

But in thus consenting to adopt a term about which quasi-psychical connotations have clustered, we do not implicitly consent to the clothing of Deity with definable psychical attributes. The moment we use the words "intelligence" and "volition," we are using words which have distinct meanings, as descriptive of certain circumscribed modes of psychical activity in man and some other animals. Except as descriptive of these circumscribed modes of psychical activity, they have no meanings whatever: and to seek to apply them to the unlimited activity (whether quasi-psychical or not) of a Being that is not circumscribed by an "objective datum" of any sort, is simply to call into existence a number of illegitimate propositions which, if dealt with as legitimate, would entangle us once more in the net-work of absurdities from which we were set free by the chapter on Anthropomorphic Theism.

Thus we are gradually finding ourselves obliged to regard the suggestion with which we ended the chapter just mentioned as something more than a mere random suggestion. Whether it be true or not that, within the bounds of the phenomenal universe the highest type of existence is that which we know as Humanity, the conclusion is in every way forced upon us that, quite independently of limiting conditions in space or time, there is a form of Being which can neither be assimilated to Humanity nor to any lower type of existence. We have no alternative, therefore, but to regard it as higher than Humanity, even "as the heavens are higher than the earth;" and, except for the intellectual arrogance which the arguments of theologians show lurking beneath their expressions of humility, there is no reason why this admission should not be made unreservedly, without the anthropomorphic qualifications by which its effect is commonly nullified. The time is surely coming when the slowness of men in accepting such a conclusion will be marvelled at, and when the very inadequacy of human language to express Divinity will be regarded as a reason for deeper faith and more solemn adoration.

## CHAPTER V.

### RELIGION AS ADJUSTMENT.

FROM this abstract exposition of Cosmic Theism as a religious doctrine, let us now proceed to consider some of the practical relations of Cosmic Theism to human life, with especial reference to conduct, which, as Matthew Arnold well says, makes up in importance at least seven-eighths of life. As every system of religion has comprised, on the one hand, a theory of the world, and on the other hand, a code enjoining certain kinds of human conduct, and as we have thus far expounded Cosmism as a theory of the world, what is now to be said of the relations of Cosmism to human conduct? Or, in other words, does the enlargement of our conceptions of Divine action, in conformity with the requirements of contemporary knowledge, involve any radical alteration of the fundamental principles of action in which Religion, viewed practically, consists?

The position is often taken, by those who dissent from current ecclesiastical creeds, that there is no reason in the nature of things why the long-established association between religion and ethics should be continued,—and to these the following inquiry will perhaps seem uncalled for. It is urged, with justice, that conduct is not necessarily dependent on creed that equal uprightness may coexist with belief in doctrines diametrically opposite, that, in point of fact, the atheist usually leads quite as pure and holy a life as the Christian ; and moreover, that it is possible to construct, out of scientific materials solely, an ethical code even more complete than any of those now generally accepted and practised. It would be useless to deny the force of these arguments. Not only is it true that science can furnish the inquirer with adequate principles of right action, but it is also true that, even without any very elaborate or thoroughly understood ethical code, the heterodox inquirer is, on the average, quite as likely to live rightly as the orthodox believer, since our characters depend far more upon our feelings which are inherited than upon the doctrines which are taught us. But, while admitting all this, it must still be claimed that the time-honoured association of religion with morality is not arbitrary but founded in the nature of things, and that it will accordingly continue in the future. The arguments just stated present but one side of the case. For while it is quite true that character is not a product of belief, it is no less true that action is influenced by belief. While observation shows that theological scepticism does not exert a deteriorating influence upon character, it cannot be doubted that ethical scepticism, could it become dominant, would confuse and obscure the incentives which prompt us to actions in harmony with the environment, and deter us from mal-adjustments. Practically the momentum of inherited impulse and bequeathed ethical tradition is so powerful that the cases in which theological scepticism has entailed permanently-effective ethical scepticism have been the exception rather than the rule. But what now concerns us is the inquiry whether in the nature of things a substitution of scientific for theological symbols involves an alteration of ethical values in the grand equation between duty and action. We shall find that no such change is involved in the substitution. Though we may, and do, throw overboard the whole of the semi-barbaric mythology in which Christianity has hitherto been symbolized, we shall find, nevertheless, that we have kept firmly in our possession the ethical kernel for which Christianity is chiefly valued even by those who retain the whole of this mythology.

If we inquire into the position which every theological creed has occupied with reference to the ethical code by which it has been supplemented, we shall find that in every case it has served to supply a powerful *sanction* to the principles of right action contained in the ethical code. That "thy days may be long in the land which Jehovah thy God giveth thee," or that "thy Father which seeth in secret may reward thee openly," *therefore* must thou do these things written in the law. Along with the moral code, embodying the principles of right action recognized by the community, there has ever been declared some theory of the relations of man to the unknowable Power manifested in the Cosmos, which has furnished incentives to the actions regarded as right and deterrents from the actions regarded as wrong. It is because religion has ever furnished this weighty sanction to morality that creeds and conduct have always been associated in men's minds; and it is because of this that narrow-minded theologians, unable or unwilling to admit that there can be any other adequate sanctions than those supplied by their own creed, so persistently argue upon the assumption that those who do not accept their creed must of necessity be morally perverse. We need not for the moment inquire into the moral value of the sanctions established by the various historic religions: whether they appeal to the purest and highest of human feelings or not, the essential point which now concerns us is the existence of such sanctions as an indispensable part of every religious system.

What, now, are the ethical sanctions recognized by science and by that religious doctrine which I have here proposed to designate as Cosmic Theism? In what sense does a scientific philosophy hold to the distinction between sin on the one hand, and crime or tort on the other? Our questions may readily be answered if, bearing in mind the theoretic attitude of Cosmism toward Anthropomorphism, we note the anthropomorphic theory of sin and the anthropomorphic sanctions for righteousness. On the anthropomorphic hypothesis, sin is an offence against a personal Deity, consisting in the disobedient transgression of some one of his revealed edicts, and calling for punishment either in the present or in a future life, unless reparation be made by repentance or sacrifice. Now the theory of the Cosmist is in substance quite identical with this,[1] though expressed by means of very different verbal symbols. From the scientific point of view, sin is a wilful violation of a law of nature, or—to speak in terms of the theory of evolution—it is a course of thought or action, wilfully pursued, which tends to throw the individual out of balance with his environment, and thus to detract from his physical or moral completeness of life. The seeking after righteousness is characteristic of the modern follower of science quite as much as it was characteristic of the mediæval saint; save that while the latter symbolized his yearning as a desire to become like his highest concrete conception of human excellence ideally embodied in Christ, the former no longer employs any such anthropomorphic symbol, but formulates his feeling in scientific phrase as the persistent desire to live rightly, or in entire conformity to the requirements of nature,—as Goethe expresses it,—

"Im Ganzen, Guten, Wahren, resolut zu leben."

The feeling is identical in the two cases, though the

[1] Saving only the last clause. For, as we shall presently see, science knows of no such thing as reparation for sin. Repentance cannot ward off punishment. And herein the Cosmic hypothesis is as far superior to the Anthropomorphic hypothesis from the ethical, as it is from the philosophical, point of view.

difference in the technical expression of it is as great as the difference between the theology of the "Imitation" and the science of "First Principles." Now when a law of nature has been violated (to use the current phrase), the religion of the scientific inquirer tells him that a sin has been committed; and he is smitten with a sense of self-reproach no whit less keen than that experienced by his mediæval predecessor. The distinction between the scientific and the religious view of the breach of law is thus apparent. When an act has been committed which must entail more or less misery either upon the individual himself or upon others, science merely recognizes that there has been a breach of law; but religion further declares that sin has been done, and there ensues a painful state of consciousness which, as we must carefully note, is not due to selfish dread of suffering to be encountered (since similar suffering in a righteous cause would be met with a feeling of self-approval), but is made up chiefly of self-condemnation for the inexcusable infraction of nature's ordinance. Regarded as a product of psychical evolution, this sense of sin, peculiar to the most highly developed organisms, is the analogue of the sense of pain shared in some degree by all organisms endowed with consciousness. The sense of sin, like the sense of pain, is normally the deterrent from actions which tend to diminish the completeness of the correspondence in which life consists. But while the sense of pain is common to those creatures whose incentives to action are purely selfish, the sense of sin can be possessed only by those creatures whose intelligence is sufficiently complex to enable them to recognize the relationship in which they stand to the omnipresent Power, and whose highest incentives to action are therefore quite impersonal. To feel the sting of self-reproach because of wrong-doing, without any selfish reference to the misery which the wrong-doing must inevitably entail, is the high prerogative of that creature whose future career of evolution, as we have seen, must mainly consist in spiritual improvement,—and in it we may recognize the sure token of the glorious fulness of life to which Humanity must eventually attain.

Such is the crude outline of the theory of sin, and of the ethical sanctions furnished by religion, into which Cosmism metamorphoses the anthropomorphic theory. Far from rejecting as a mythologic fiction the doctrine that sin is a violation of God's decrees, entailing inevitable punishment, science recognizes therein the anthropomorphic version of the truth that every failure in the system of adjustments in which life consists is followed inevitably by pain, in some one of its lower or higher forms. And thus, by bringing the whole subject into the philosophic domain wherein the Law of Evolution holds sway, we begin to understand, so far as it is possible to understand, the philosophy of evil, pain, and wrong, which to the anthropomorphic theist, as we have seen, must ever remain a distressing and insoluble enigma. Let us briefly trace the process by which men have slowly arrived at the perception of the beneficence of pain, that we may the more clearly see how the process has been determined by the deanthropomorphization of the agencies by which pain is wrought.

In treating of the philosophy of fetishism (Part I. chap. vii.) it was shown that by primeval men, unused to scientific generalization, the forces of nature must have been likened to human volition, because there was nothing else with which to compare them. Man felt within himself a source of power, and did not yet surmise that power could have any other source; and consequently he identified, without any qualification, the forces displayed outside of himself with the force of will as directly revealed in his consciousness. In this necessity of thought originated not only the personifications of ancient mythology, but also the primitive religious worship; a religion of sacrifice, of sorcery, and of terror, as different from modern religion as mythology is different from modern philosophy. Of primitive religion the most prominent, as well as the most abiding, phase is devil-worship. Mr. Hunter's remarks concerning the Santals will apply equally well to barbarians all over the world, as also to the primeval men from whose crude notions modern orthodoxy has inherited its terrorism. "Of a supreme and beneficent God the Santal has no conception . . . He cannot understand how a Being can be more powerful than himself without wishing to harm him. Discourses upon the attributes of the Deity excite no emotion among the more isolated sections of the race, except a disposition to run away and hide themselves in the jungle; and the only reply made to a missionary at the end of an eloquent description of the omnipotence of God, was, 'And what if that Strong One should eat me?' But although the Santal has no God from whose benignity he may expect favour, there exist a multitude of demons and evil spirits, whose spite he endeavours by supplications to avert. So far from being without a religion, his rites are infinitely more numerous than those of the Hindu."[1] The genesis of this primitive devil-worship finds its explanation in the fact that the uncontrollable agencies of nature—the storm and the earthquake, the wind and the wave—though supposed to resemble man in so far as they were intelligent and volitional agents, could not be wholly like him. Their ways were not as his ways. They were not to be counted upon. They could not be prepared for, defended against, or reasoned with. They might bring harm; and frequently they did bring harm. Accordingly they were regarded with fear and trembling. It is not easy for us to realize the extent to which in early times the unknown was identified with the hurtful.[2] It is not possible for us

[1] *Annals of Rural Bengal*, p. 181.

[2] As Humboldt says, in allusion to the long-enduring effects of this primitive inference :—"Es liegt tief in der trüben Natur des Menschen, in eine

adequately to represent in imagination the overpowering emotions of mingled doubt and dread which must have seized the primitive thinker when brought face to face with this omnipresent, but to him utterly incoherent, universe. Where certainty is for us, for him was uncertainty. The same resistless forces which to us bring expected benefits were for him productive mainly of unlooked-for calamities. We, holding in our grasp the Aladdin's lamp of physical knowledge, may find them obedient slaves: to him, who had not unearthed the talisman, they proclaimed themselves inexorable masters. Hunger and disease, exposure to heat and cold, to the attacks of savage beasts and of unseen enemies, were stern realities of daily experience. There were neither houses for shelter and defence, nor cities for the common protection, nor arts to insure exemption from physical discomfort. Language had not yet found need for words to denote some of the most necessary implements and some of the most ordinary processes of life. Nature was unmanageable as well as unknown,—a stumbling-block as well as a riddle.

Thus the unclassed phenomenon came to be a source of terror; for experience had taught that it was quite as likely to bring disaster as good fortune. Thus the volitional agencies by which fetishism sought to account for surrounding phenomena came to be regarded as capricious and malevolent agencies, whose wrath must be averted by prayer or sorcery, and whose favour must be bought by sacrifice. Thus arose the conception of God as a consuming fire. Thus it was that in Egypt deprecating prayers were addressed to the crocodile, and in Syria to the serpent; that Hindu mothers threw their children into the Ganges, while Carthaginians burned their new-born infants in front of the brazen image of Moloch.

ernsterfüllten Ansicht der Dinge, dass das Unerwartete, Ausserordentliche nur Furcht, nicht Freude oder Hoffnung erregt." *Kosmos* tom. i. p. 119.

This sense of a Satanic presence in nature, whether embodied in the form of a malevolent devil or in that of a ferocious deity, ever ready to burst forth with fire and consume his creatures, has been of long continuance. It lies at the bottom of mediæval witchcraft, and it shows itself in the modern "revival-meetings" in which the religious theories of uneducated people still betray their close kinship with those of the savage. From the educated portion of the community, however, it has entirely disappeared; and its disappearance is manifestly due to that part of their education which has consisted in the scientific generalization of natural agencies, and in the consequent deanthropomorphization of their conceptions of force. We have seen that, with the progress of generalization, the conception of volition is gradually excluded from all those groups of phenomena in the production of which the human will is not implicated, and is replaced by the conception of a uniform force, whose actions may be foreseen or modified, and whose effects, if harmful, may be avoided. Our ability to predict the simpler phenomena of nature has deprived them of the terrors due primitively to our anthropomorphic explanations of them. Armies retreating from destruction—like that of Nikias—have never been checked in their course by eclipses which had been foreseen; and comets have been beheld with equanimity since they have been known to move in conic sections. But coincident with the progress of our ability to predict these simpler phenomena, has been the progress of our ability to modify those which are more complicated. The advancement of science is also the advancement of art. Penetrating inquisitively into the secrets of Nature, we employ our information in extorting from her her treasures. Fire is not the only bad master that we have contrived to make a very good servant. We transform heat into motion, and improve our means for travelling. We change electricity into motion, and facilitate the transfer of intelligence. The agencies which produce small-pox we compel to defeat themselves. And thus, in many ways, we extract profit and gratification from that which is ugly and noxious; as the refuse of gas-works and the drainings of stables, when dealt with by the chemist, yield rich dyes and delicate perfumes.

Thus, as science advances, Nature is better understood. As art progresses, she inflicts less pain and bestows more pleasure. Once hated as an enemy, she is at last revered as a benefactor. Gradually it comes to be perceived that all pain arises from disregard of her wisely-framed ordinances; and that, by conformity to those ordinances, pain may ultimately be avoided. Where the ancient man saw nothing but capricious volition, the modern man beholds force acting by invariable methods. The former knew not that the pain under which he was writhing resulted from a violation of Nature's edicts, and he sought to prevent its recurrence by sacrifice and supplication. The latter knows that Nature's commandments are not to be broken. He knows that to their infringement there is attached an inevitable penalty,—that misery will follow disobedience, the first time, the second time, every time; and he therefore learns to obey. Matter does not put off its resistance to save from broken bones; the stomach does not stop digesting, that poison may be innocuous; the law which couples imprudent exposure with bronchitis and pneumonia will not cease to operate, though thousands die; nerve-tissue will not renounce its properties, to prevent indulgence in evil thoughts and yielding to sinful inclinations from depraving the imagination and weakening the will. To be delivered from evil, we must avoid the mal-adjustments of which evil is the consequence and the symptom. Hence, while to the aboriginal man malevolence was the only conceivable source of suffering, he reverent follower of science perceives the truth of the paradox that the infliction of pain is subservient to a beneficent end. "Pervading all nature, he sees at work a stern discipline, which is a little cruel, that it may be very kind." That perpetual warfare going on throughout the animal world, whereby those no longer fit to live are spared the miseries of protracted existence, is found to be also the indispensable condition of the origination of higher forms of life. The disappearance of savage tribes before the spread of civilized races, while often accompanied by unjustifiable aggression on the part of the stronger, is perceived to involve the increase of the sum-total of happiness. Thus, with Michelet, we come to regard pain as in some sort the artist of the world, which fashions us with the fine edge of a pitiless chisel, cutting away the ill-adjusted and leaving the nobler type to inherit the earth.[1]

But note that such a solution of the mystery of pain is attainable only by the complete elimination of anthropomorphism from the problem. Introduce a quasi-human will behind the series of phenomena, and we are at once confronted anew with all the difficulties mentioned in the chapter on Anthropomorphic Theism. The fact stands inexorably before us, that a Supreme Will, enlightened by perfect intelligence and possessed of infinite power, might differently have fashioned the universe, though in ways inconceivable by us, so that the suffering and the waste of

[1] "La douleur est en quelque sorte l'artiste du monde, qui nous fait, nous façonne, nous sculpte à la fine pointe d'un impitoyable ciseau. Elle retranche la vie débordante. Et ce qui reste, plus exquis et plus fort, enrichi de sa perte même, en tire le don d'une vie supérieure." Michelet, *L'Oiseau*, p. 106. Compare the sublime passage concerning man, wherein Tennyson says:—

"If so he type this work of Time

"Within himself from more to more;
*And, crowned with attributes of woe*
*Like glories*, move his course, and show
That life is not as idle ore;

"But iron dug from central gloom,
And heated hot with burning fears,
And dipped in baths of hissing tears,
And battered with the shocks of doom,

"*To shape and use.*"

life which characterize nature's process of evolution might have been avoided. It may be said that such a supposition is sheer nonsense,—since we must accept, as a pre-requisite for all speculation on the subject, the properties of matter and motion as we find them, necessitating as they do the process of evolution as we observe it. But to say this is to concede all that is here maintained, and implicitly to admit that, instead of postulating a quasi-human Will as the source of phenomena, we must rest content with the recognition of an Inscrutable Power, of which the properties of matter and motion, necessitating the process of evolution, with pain and wrong as its concomitants, are the phenomenal manifestations.

With the entire elimination of anthropomorphism, the conception of malevolence as the source of suffering completely vanishes, and the mind assumes an attitude of reverent resignation with reference to the workings of Divine power. Even such a catastrophe as the Lisbon earthquake, which so sorely puzzled the aged Voltaire and the youthful Goethe, lost its worst horrors when geology, discarding mythological explanations, referred it to the action of those same subterranean energies which are ever maintaining the earth in a habitable condition. The scientific inquirer must needs recognize the fact that physical forces will work their normal effects, though the result be the sending of rain alike upon the just and upon the unjust. The expansive energy of steam will slay not only the wicked engineer who has neglected his boiler, but also the innocent children peacefully playing on the deck overhead.

> "Streams will not curb their pride,
> The just man not to entomb,
> Nor lightnings go aside
> To leave his virtues room."

But the flood and the earthquake, like the wickedness of men, in so far as the arrangements of society are not yet adequate for curbing it, must be accepted with resignation as part and parcel of the events which the constitution of our universe necessitates. Such evils, which right living will not guard against, furnish no excuse for ceasing to shun the committal of wilful wrongs which detract, to a far greater extent, from the fulness of life of ourselves and our fellow-creatures. The sanction by which the religion of the scientific inquirer enforces its ethical code, is the certainty that mal-adjustment will be followed, always by the suffering or degradation of the wrong-doer himself, and usually by the suffering of others who are innocent. And while in this respect there is no essential difference between the Cosmic and the Anthropomorphic theories, on their ethical sides, there is another respect in which the sanction recognized by the former is far more powerful, and must in time become far more effective, than the sanction recognized by the latter. For the current anthropomorphism, in this as in other points betraying its kinship to primeval fetishism, asserts that by repentance and prayer the evil effects of sin may be avoided. The anthropomorphic theist sees in his Deity a being so nearly like himself as to be willing to interfere with the ordinary course of things and dissociate the act of wrong-doing from its legitimate penalty. As the father puts forth his arm and saves his falling child from the natural consequences of a false step, so it is supposed that God will, in certain cases, turn aside the blow which nature has in store for human misdeeds. Science knows of no such interference with the law that pain is consequent upon mal-adjustment. The deed once done will work its full effects, save in so far as checked by counter-actions. He who has swallowed arsenic will be saved, not by prayer, but by an emetic. He who has yielded to temptation may indeed, by the repentant feeling of which prayer is the expression, secure himself from future yielding; but the tendency toward loss of self-control, initiated by the first surrender cannot be rendered non-existent by any *ex post facto* act of contrition, though its operation may be counteracted. And if the misdeed, as usually happens, has involved others than the agent, its evil consequences must endure and ramify, until they at last disappear through some natural process of equilibration. No amount of repentance for lying can deprive lies of their tendency to weaken the mutual confidence of men and thus to dissolve society. The lie once told must work its effects, as surely as the stone dropped into water must give forth its arrested motion in rippling circles. No penance or priestly absolution can do away with the persistence of force.

Obedience to the so-called "laws of nature," which are the decrees of God, is therefore the fundamental principle of religion viewed practically. And, as was hinted at the close of the twenty-second chapter of Part II., religion, as thus interpreted, has a wider meaning than morality. For, as we saw, in the chapter referred to, that a philosophy of hedonism has for its subject-matter the principles of action conducive to the right living of the individual so far as his own happiness is concerned, and that a philosophy of morality has for its subject-matter the principles of action conducive to the right living of the individual so far as the well-being of the community is concerned; so a philosophy of religion has for its subject-matter the relations of the individual to the Inscrutable Power manifested in the universe, and the principles of action conducive to his right living considered as a part and parcel of the universe. To live in conformity to Nature's decrees, is to live morally, in the common acceptation of that term, and something more beside. For there are many actions which, as immediately concerning none but the individual, are technically neither moral nor immoral, but which nevertheless are right or wrong. Over-eating, for example, which can hardly be termed immoral, and which the current hedonism mildly characterizes as imprudent, may from a religious point of view be regarded as wrong or sinful. I cite this homely illustration because it leads directly to the pith and centre of the truth which I am seeking to explain. Hedonism, of which the highest principle of action is personal selfishness, regards the individual as having a right to do what he likes with his own body. Religion declares that he has no such right, but on the other hand has duties toward himself which he is as much bound to discharge as if they directly concerned other people. Religion, therefore, extends the rules of right and wrong primarily derived from the relations of the individual to the community, until they cover even the self-regarding actions of the individual. And what is this but establishing rules of action concerning the individual in his relations to what we call Nature or the Universe? Finally, as the organized moral sense takes cognizance of actions injurious to the community, visiting them with the stings of self-reproach without any direct or conscious tracing out of their probable injurious consequences; so the religious sense takes cognizance of all actions whatsoever which come within the class of mal-adjustments, whether they directly concern the community or not, and the feeling of self-condemnation arises irrespective of any direct estimate of probable consequences. For the religious sense is primarily based upon the aspiration—the noblest which any creature can entertain—after complete fulness of life; and any thought or act, any sin of omission or of commission, inconsistent with such aspiration, awakens the painful consciousness of shortcoming, without any reference to those lower considerations of pleasure and pain of which alone hedonism takes cognizance.

Such, in brief outline, is the theory of religion which seems to me most thoroughly consonant with our present knowledge. Scanty justice can be done, in one short chapter, to so great a subject. But a detailed exposition would not be in keeping with the purpose of the present work. It is not my aim to propound a complete theory of religion, or to prepare the way for the inauguration of any new religious system—for I should regard any undertaking of this kind as *ab initio* self-convicted of absurdity—but simply to show that it is in the power of Science, without proving recreant to its own methods, to maintain every one of the fundamental truths which give to Religion its permanent value. Starting from the knowledge of nature which we now possess, and without making appeal to venerated traditions based upon the scantier knowledge possessed by relatively barbarous ages, I have sought to show that the truths already discerned and asserted in these traditions—the fundamental truths to which alone the traditions owe their permanent hold upon men's minds—are in nowise shaken, but rather confirmed and reiterated by our present knowledge. For my purpose, this has been sufficiently shown in the present chapter and its two predecessors. For not only have we seen that scientific inquiry, proceeding from its own resources and borrowing no hints from theology, leads to the conclusion that the universe is the manifestation of a Divine Power that is in no wise identifiable with the universe, or interpretable in terms of "blind force" or of any other phenomenal manifestation ; but we have also seen that the ethical relations in which man stands with reference to this Divine Power are substantially the same, whether described in terms of modern science or in terms of ancient mythology. And in so far as there is any difference between the scientific and the mythologic view of the sanctions by which these ethical relations are maintained, we have seen that the sanctions recognized by the former are even more powerful than those recognized by the latter. While, lastly, as regards the basis of these ethical relations, the superiority of the scientific view is most conspicuously manifest. Far from its being true, as Mr. Mivart seems to fear, that the

Doctrine of Evolution leaves morality without a theoretical basis, it supplies for it a theoretical basis incomparably deeper and stronger than has ever been supplied for it by any anthropomorphic theory of things. For not only does the Doctrine show that the principles of action which the religious instincts of men have agreed in pronouncing sacred, are involved in the very nature of life itself, regarded as a continuous adjustment; but it shows that the obligation to conform to these principles, instead of deriving its authority from the arbitrary command of a mythologic quasi-human Ruler, derives it from the innermost necessities of that process of evolution which is the perpetual revelation of Divine Power. He to whom the theory of evolution, in all its details, has become as familiar as the saws and maxims of the old mythology are to him who still accepts it, will recognize that to be untrue to the highest attainable ethical code is to be untrue to philosophy, untrue to science, untrue to himself. Thus in the grand equation between duty and action, the substitution of scientific for theological symbols involves no alteration of ethical values. And thus in casting aside the mythologic formulas in which religious obligation was formerly symbolized, we do but recognize the obligation as more binding than ever.

In criticism of the religious theory thus briefly expounded, it will doubtless be urged that such religion is too abstract, too coldly scientific, to have any general influence upon action, and can therefore be of no practical value. The conception of sin as a phase of mal-adjustment will be pronounced incapable of awakening the needful feelings unless there be joined to it the anthropomorphic symbol of an offended God. And it will moreover be asserted with vehemence, that in place of a Father whom men can love and venerate, we are giving them a mere philosophical formula, calling for no warmer feeling than calm intellectual assent.

Granting that our doctrine is philosophically the reverse of atheism, it will be urged that here extremes meet, and that an infinite and therefore unknowable God is practically equivalent to no God at all.

In reply to the latter objection it is hardly necessary again to remind the objector that upon similar grounds, and with equal plausibility, the early Christians were called atheists by their pagan adversaries. The reproach of atheism has been well defined, by Mr. R. W. Mackay, to be the reproach which the adherents of a lower creed endeavour to cast upon those of a higher one. The less anthropomorphic the symbol by which Deity is represented, the less readily imaginable it is as something which can be seen, or heard, or prayed to, the less existent does it appear. And as we proceed to take away, one by one, the attributes which limit Deity, and enable it to be classified, we seem, no doubt, to be gradually destroying it altogether. Nevertheless, to him who has thus far intelligently followed this exposition, it will not be necessary to demonstrate that the symbolization of Deity indicated by the profoundest scientific analysis of to-day is as practically real as the symbolization which has resulted from the attempts of antiquity to perform such an analysis, and is in every way more satisfactory alike to head and heart. To him the most refined anthropomorphism to be met with in current theological treatises will no doubt seem as unsatisfactory as the anthropomorphism of orthodox "revivalists" must seem to Mr. Hutton or Mr. Martineau.

Indeed there are few philosophical terms which have more thoroughly brought out the inveterate tendency of men to mistake the counters of thought for its hard money than this term "Unknowable." Alike from Idealists and Positivists, from theologians of every school and from penny-a-liners of no school, we hear long arguments based upon the vague connotations which the word "Unknowable" calls up, without any reference to the precise sense in which the symbol is used in Mr. Spencer's philosophy,—nay, without even a suspicion that the symbol may have a precise value in some measure purified from such connotations. At this stage of our exposition, it is enough to suggest the fallaciousness of such argumentation, without characterizing it in detail. It is enough to remind the reader that Deity is unknowable just in so far as it is not manifested to consciousness through the phenomenal world,—knowable just in so far as it is thus manifested; unknowable in so far as infinite and absolute,—knowable in the order of its phenomenal manifestations; knowable, in a symbolic way, as the Power which is disclosed in every throb of the mighty rhythmic life of the universe; knowable as the eternal Source of a Moral Law which is implicated with each action of our lives, and in obedience to which lies our only guaranty of the happiness which is incorruptible, and which neither inevitable misfortune nor unmerited obloquy can take away. Thus, though we may not by searching find out God, though we may not compass infinitude or attain to absolute knowledge, we may at least know all that it concerns us to know, as intelligent and responsible beings.[1] They who seek to know more than this, to transcend the conditions under which alone is knowledge possible, are, in Goethe's profound language, as wise as little children who, when they have looked into a mirror, turn it around to see what is behind it.

To the other objection above hinted at it may be replied that undoubtedly the conception of sin here developed is too abstract to awaken the needful feelings in any save those who have obtained, either through their own inquiries or by the aid of instruction from others, a firm grasp of some philosophic theory of the universe like the one crudely sketched in the present work. For the larger part of the world to-day the anthropomorphic doctrine of sin is unquestionably the better one,—and it is the doctrine held by

[1] See above, vol. i. pp. 95, 96.

the larger part of the world. If it were possible for men to come by the thousand, as on a second day of Pentecost, and embrace the views here expounded, or others like them, without having slowly and surely grown to them, there would be great risk of their going away with a frail and unserviceable religious theory. But as it is absolutely certain that such views will never become prevalent until the scientific philosophy upon which they are based has become generally understood and accepted, and as by that time they will necessarily have come to appear quite substantial and practical there appears to be but little weight in the objection referred to.

Indeed, as the next chapter will plainly show, nothing can be farther from the intentions of the scientific thinker than the demand that contemporary society shall give up any of the religious doctrines with which it is able to rest contented, in exchange for doctrines which to all minds save those sufficiently instructed in science are likely to seem shadowy and over-subtle. Far from proposing to institute a new religion which, like Islam, is to overrun the world and wrench all men suddenly from their idols, our aim is simply to point out some of the more important modifications which current religious doctrines seem destined to undergo in becoming accepted and assimilated by thinkers whose theories of things are based wholly upon irrefragable scientific truths. That the Doctrine of Evolution, which is now the possession of a few disciplined minds, will eventually become the common property of the whole civilized portion of the human race, is, to say the least, very highly probable. In view of this probability, it seems to me a worthy end for our philosophic inquiry, if we can ascertain that, in spite of the total change in the symbols by which religious faith finds its expression, nevertheless the religious attitude of mankind will remain, in all essential respects, unchanged. I shall endeavour to show, therefore, in the following chapter, that with reference to the fundamental truths of Christianity, and likewise with reference to the time-honoured institutions which are woven into the fabric of modern society, our Cosmic Philosophy is eminently conservative,—owning no fellowship either with the radical Infidelity of the eighteenth century or with the world-mending schemes of Positivism.

## CHAPTER VI.

### THE CRITICAL ATTITUDE OF PHILOSOPHY.

OUR outline-sketch of the Cosmic Philosophy based on the Doctrine of Evolution would remain seriously defective without some account of its critical bearing with reference to past and present religious beliefs and social institutions. Since the reception of a number of definite opinions concerning man in his relations to the universe and to his fellow-creatures must leave their possessor in a certain characteristic attitude,—aggressive or sympathetic, iconoclastic or conservative,—toward the multitude of opposite or conflicting opinions by which he is surrounded, it becomes desirable for us to ascertain whether the critical temper of our Cosmic Philosophy tends toward the subversion or the conservation of that complex aggregate of beliefs and ordinances which make up the social order amid which we live Our object will be best attained, and our results will be most clearly presented, if we begin by considering some of the philosophic contrasts between the statical and dynamical habits of thinking, to which attention was called in an earlier chapter.

A statical view of things, as I have above defined it, is one which is adjusted solely or chiefly to relations existing in the immediate environment of the thinker. Certain groups of physical phenomena, certain psychical prejudices, certain social customs, having existed with tolerable uniformity over a limited portion of the earth's surface, it is assumed either that the given phenomena have always existed, or at least that they enter by divine pre-arrangement into the eternal order of things in such a way that any thorough-going alteration of them must involve universal anarchy and ruin. The fundamental doctrine of the philosophy which is determined by this statical habit of interpreting phenomena, is the Doctrine of Creation. The world is supposed to have been suddenly brought into existence at some assignable epoch, since which time it has remained substantially unaltered. Existing races of sentient creatures are held to have been created by a miraculous fiat in accordance with sundry organic types which, as representing unchangeable ideas in the Divine Mind, can never be altered by physical circumstances. The social institutions also, amid which the particular statical theory originates, are either referred back to the foundation of the world, as is the case in early and barbaric mythologies; or else, as is the case with modern uneducated Christians, they are supposed to have been introduced by miracle at a definite era of history. In similar wise the existing order of things is legitimately to endure until abruptly terminated by the direct intervention of an extra-cosmic Power endowed with the anthropomorphic attributes of cherishing intentions and of acting out its good pleasure. Facts of palæontology, such as the extinction of myriads of ancient animal and vegetal species, are explained as the result of innumerable catastrophes determined by this same extra-cosmic Deity; and strange geologic phenomena are interpreted by the myth of a universal deluge which left them once for all just as we see them. Likewise the social institutions and the religious beliefs now existing by express divine sanction, must remain essentially unaltered under penalty of divine wrath as manifested in the infliction upon society of the evils of atheism and anarchy. Hence, as the Doctrine of Creation is itself held to be one of these divinely-sanctioned religious beliefs, the scientific tendency to supersede this doctrine by the conception of God as manifested not in spasmodic acts of miracle, but in the gradual and orderly evolution of things, is stigmatized as an atheistical tendency, and the upholders of the new view are naturally enough accredited with a desire to subvert the foundations of religion and of good conduct. Hence it is that even such scientific writers as Mr. Mivart—unable to escape the evidence in favour of Evolution which is supplied by their own studies, yet somewhat desperately clinging to the philosophic views which are founded upon the Doctrine of Creation—are now and then guilty of remarks much better befitting ignorant priests than men who have lived in direct contact with modern scientific thought. That dominance of the statical habit of thinking, which leads Mr. Mivart to prefer the irregular action of "sudden jumps" to the slow but regular operation of natural selection, leads him also to assert that the Doctrine of Evolution, as consistently held by Prof. Huxley, tends toward the intellectual and moral degradation of mankind and toward the genesis of "horrors worse than those of the Parisian Commune!"[1]

Before proceeding to show how assertions of this sort are, from the evolutionist's point of view, as reckless and absurd as, from Mr. Mivart's point of view, they are justifiable and logical, let us note that the statical habit of thinking is by no means monopolized by the orthodox, or by those whose philosophic theories consist mainly of elements inherited from primeval mythology. The progress of scientific discovery since the time of Galileo and Bacon has but gradually, and as its newest result, established the Doctrine of Evolution; yet it has, from the very outset, assumed a hostile

[1] *Contemporary Review*, January 1872, p. 196.

attitude toward the body of mythical conceptions of which the current Christian theologies have been largely made up. The consequence of this has been the rise of a purely negative iconoclastic style of criticism, both in religion and in politics, which, in spite of its deadly hostility to the prevailing orthodoxy, has nevertheless been equally characterized by theories and aims which are the products of the old statical habits of thought. While orthodoxy and its companion legitimism have regarded the existing religious and social order, not as a product of evolution, but as a divinely-appointed and therefore eternally sacred order of things; on the other hand iconoclasm, whether manifested in religion or in politics, has regarded the existing order of things, not as a product of evolution, but as the work of artful priests and legislators of antiquity, which may accordingly be destroyed as summarily as it was created. Even while justly inveighing, therefore, against patent absurdities or flagrant wrongs in the established order of things, the iconoclast proceeds from a point of view as untenable as that occupied by his orthodox antagonist. Rejecting the mythical conception of the established order as in any especial sense divinely-appointed, he nevertheless borrows from the old mythology its notion of cataclysms, and vainly imagines that beliefs and institutions which suit the intellectual and moral needs of half the world can be incontinently eradicated or overthrown by direct assaults from without. Reasoning, then, upon this inadequate basis, and being as incapable of appreciating sympathetically the beliefs of a bygone age as his orthodox opponent is incapable of emancipating himself from such beliefs, the controversy between the two becomes naturally barren of profit though fruitful in recrimination; and each regards the other with a dislike or a distrust which, though justifiable enough when considered from the points of view respectively occupied by the antagonists, nevertheless seems barbaric or childish to those who have reached a higher stand-point.

This higher stand-point is furnished by what I have called the dynamical habit of looking at things as continually changing in a definite and irreversible order of sequence. That this habit should not have been acquired, save by two or three isolated minds, until the present century, is not to be wondered at, since for the full acquirement of it there is needed a familiarity with scientific conceptions of genesis which could not have been gained at any earlier date. But as soon as the tendency to contemplate all phenomena as the products of preceding phenomena has become fairly established, a marked change is noticeable in the current style of criticism. The comparative method is found to be as applicable to religious beliefs and social or political institutions as it is to placental mammals or to pluperfect tenses. And so the habit of regarding the existing order of things as on the one hand ordained of God or on the other hand maliciously contrived by the Devil gradually fades away, and is replaced by the habit of regarding it as evolved from some preceding order of things, and as in turn destined normally to evolve some future order. Hence the evolutionist perceives that it is not by mere controversial argument that mankind can be led to exchange the mythological for the scientific point of view. He regards the process as one, not of sudden conversion, but of slow growth, which can be accomplished only by the gradual acquirement of new habits of thought,—habits that are formed day by day and year by year, in the course of a long contact, whether immediate or not, with the results of scientific inquiry. Thus the evolutionist owns no fellowship with Jacobins and Infidels, for he has learned that engrained habits of thought and favourite theories of the world, being the products of circumstances, must be to a certain extent adapted to the circumstances amid which they exist; and he knows that they cannot be destroyed, and ought not to be destroyed, save as they are gradually supplanted by habits of thought that are relatively more accurate and by theories of the world that are relatively more complete.

In view of these considerations we may the better comprehend the significance—upon which I formerly (Part I. chap. vii.) insisted—of the change in the attitude of philosophy of which Comte's celebrated doctrine of the "Three Stages" was partly the cause and partly the symptom. In spite of his hostility to the Doctrine of Evolution, in most of the forms in which he came into contact with it as technically stated, Comte was nevertheless thoroughly inspired by the comparative method, so far as the study of history was concerned. As far as was possible with his slender scientific resources, he looked at human affairs with the eye of an evolutionist. When he announced it as a law that every human conception must pass through three stages—the theological, the metaphysical, and the positive—though his statement was a crude one, it nevertheless clearly showed that a time had come when opinions were no longer to be tried by their conformity to some absolute standard, whether of orthodoxy or of radicalism, but were henceforth to be estimated in their relations to the circumstances which had given rise to them.

Those who have most carefully studied the iconoclastic philosophy of Voltaire and the *Encyclopédistes* of the eighteenth century, will best appreciate the character and extent of the revolution in the attitude of philosophy which was effected by this new method of criticism. In the opinion of those metaphysical thinkers, everything old was wrong, and anything new was likely to be right. They classified men, not relatively, as ancients, mediævals and moderns, but absolutely as fools and philosophers; the philosophers being all who subscribed to the doctrines of the *Encyclopédie*, the fools being all those who believed in miracles or in a personal God

So utterly destitute were they of that historic sense which enables the critic to enter into the spirit of the epoch which he is criticizing, that they could not interpret the mythology of antiquity and the theologic dogmas of the mediæval Church otherwise than as a set of ingenious devices contrived by priests and rulers for the ensnaring and subjugation of mankind. Perhaps nothing can better illustrate the barrenness of their point of view than their undiscriminating admiration for the emperor Julian, whose memory they exalted because of his attempt to stop the progress of Christianity; this being the very reason for which that monarch is now justly regarded as one of the most blindly retrograde statesmen that ever lived. Such was their criticism—a mere bald negation and disavowal of all that had preceded them. And such being their criticism, such also was their political philosophy—an unqualified protest, primarily against feudalism, monopoly and divine right, but ultimately, as carried out by Rousseau, against all constraint whatever of man by man, and therefore against the very constitution of society. The immortal pamphlet in which this greatest of sophists sought to demonstrate that all civilization, all science, and all speculative culture is but an error and a failure, and that the only remedy lies in a return to primitive barbarism,—was the legitimate outcome and *reductio ad absurdum* of a philosophy which began by forcibly severing itself from all historic sympathy with the time-hallowed traditions of our race.

Such a philosophy may end, as it has ended, in anarchy of thought, but not in rational conviction. It cannot organize a new framework of opinions, nor can it even thoroughly accomplish the task of destroying the old framework. It may indeed, as it has done here and there, knock the venerable edifice into unshapely ruin, but it cannot sweep away the cumbersome débris, and leave the ground clear for the erection of a new and more permanent structure. It discredits altogether too profoundly the earnest work of that average human intelligence of past times, from which all our individual intelligences, with all their real or fancied enlightenment, are both by instruction and by inheritance derived. To refute the mediæval conception of the world, without accounting for its long predominance, was to leave it but half refuted. And accordingly, when this negative philosophy was brought to a practical test by the Revolution of 1789, its inefficiency, both for construction of the new, and for thorough destruction of the old, was made painfully manifest. It soon became evident that more than one brick of the mediæval edifice had been left standing, to serve as an obstruction. In France—then the centre of the European intellectual movement—there set in a powerful reaction. Against the revolutionary school of negative philosophers and anarchical statesmen, there asserted itself a retrograde school, which saw no escape save in a return to the mediæval conception of the world and a renewal of adherence to mediæval principles of action. This retrograde movement was represented in politics by Napoleon, the latter half of whose career was characterized by the conscious effort to imitate the achievements of Charles the Great; in literature by Chateaubriand; in psychology by Laromiguière and Maine de Biran; and in general philosophy by Joseph de Maistre. The last-named writer, who, for reasons easily explicable, has been too little studied, and whose true position in the history of thought Comte was the first to perceive and point out, will perhaps be remembered by future generations as the last heroic champion of a lost cause. Like Don Diego Garcia, whom Cervantes has immortalized, this unterrified knight took it upon himself to defend single-handed the fastnesses of mediæval theology against the whole invading army of modern scientific conceptions. With that uncompromising fanaticism which characterizes men who abandon critical reflection in order to constitute themselves the advocates of a cause, De Maistre undertook to annihilate physical science and the group of philosophic notions to which its discoveries had given rise. According to him, Kant was an ignorant charlatan, Bacon an atheist in hypocritical disguise, and the so-called Baconian philosophy "a spiritless materialism," uncertain and unsteady in its expression, frivolous in tone, and full of fallacies in every assertion. In place of this "spiritless materialism" he would give us the full-blown Catholicism of the days of Hildebrand, every subsequent variation from which has, in his opinion, been due, not to disinterested seeking after higher truth, but to a madness of neologism, a diseased craving after new and strange devices.

In these interesting opinions—interesting because they come, not from a peevish and ignorant priest, but from a man of wide culture, worldly wisdom, and undoubted intellectual power—may be seen the violence of the reaction against that negative philosophy which, in its effort to break entirely with the past, had assisted in bringing about the speculative atheism and practical anarchy of 1793. We have now to note that, from the statical point of view which he occupied, De Maistre was perfectly right in regarding modern scientific thought as an enemy to society which must be put down at whatever cost. For as modern science had not yet reached that conception of gradual change which underlies the Doctrine of Evolution, while it had become distinctly conscious of its hostility to the current mythologies, it assumed the attitude of Atheism with reference to Christian theology and of Jacobinism with reference to the institutions of Christian society. Now it is perfectly true that the practical outcome of these kindred forms of iconoclasm, could they be allowed to have their way unhindered, would be the dissolution of society and the return to primeval barbarism. For since it is impossible for a given state of civilization to be made to order, even by the greatest political genius, or to be produced in any way save by evolution from an antecedent state, it follows that the dissolution of the social relations existing at any epoch would simply leave the work of civilization to be (at least, to a great extent) done over again. An instructive historical example of such a dissolution of social relations, partially effected, and of the consequent partial return toward barbarism, is to be found in the history of Romanized Europe from the fourth to the tenth centuries of the Christian era. And as this partial dissolution cannot be referred solely to the barbaric attacks from without—which during at least seven centuries had been steadily kept up without impairing the integrity of the Empire—it must be referred to causes operative within; to the demoralization consequent upon general scepticism as to the validity of the principles of action by which men had formerly been guided. Now the violent breaking up of the feudal and mediæval Christian system, which occurred during the last century, was attended by some of the same dangerous symptoms as those which marked the dissolution of ancient polytheism and ancient notions of civic patriotism; though in the modern case the succession of phenomena was more rapid, and there were no assaults from outside barbarism to complicate matters. We have lately remarked upon the curious phenomenon of a free-thinker, like Rousseau, openly advocating a return to barbarism, upon the ground—which admirably illustrates his statical view of things—that social relations were due to a primitive contract, from which the contracting parties might at any time withdraw. It is also worth noting that, under the practical application of Rousseau's doctrines by his apparently well-meaning but narrow-minded and fanatical disciple, Robespierre, the rejection of Christianity was followed by an act of adoration toward a courtesan which would have been more in keeping with early polytheistic ages, and the overthrow of feudal tyranny was followed by a mode of settling political questions such as is normally practised only among societies of primitive type. It is significant also, to the evolutionist, that this partial dissolution of social relations should have been followed by that disgraceful epoch in which principles of international equity worthy only of Attila or Genghis Khan were embodied in the barbarous ethical code of the First Empire.

A still more complete illustration of the tendency of pure iconoclasm toward social dissolution is to be found in certain radical theories concerning labour, property, and marriage, which have been current during the present century among people untrained in science and unfamiliar with the lessons of history, and which played their part in shaping the policy of the Parisian Commune of 1871. For the purposes of our inquiry it is not necessary for me to offer a matured judgment concerning this unfortunate historical transaction in all its actual complexity, even were I competent to do so. It is enough for us to remember that among those political leaders who sought to inaugurate the reign of the Commune, a considerable number professed to hold the doctrines commonly known as communistic, and that the social relations which they were intent upon establishing are precisely those which Sir Henry Maine has shown to have existed among primeval men, and which exist to-day among the lowest races. This desire to return to the community of property and of wives characteristic of primitive savagery, to regulate human concerns by *status* and not by contract, to crush out capital and with it the possibility of any industrial integration, to abolish the incentives which make man sow to-day that he may reap in the future, to destroy social differentiation by constraining all persons alike to manual labour, to strangle intellectual progress by permitting scientific inquiry only to such as might succeed in convincing a committee of ignorant workmen that their discoveries were likely to be practically useful, to smother all individualism under a social tyranny more absolute than the Hindu despotism of caste; this desire, it is obvious, is simply the abnormal desire to undo every one of the things in the doing of which we have seen that social evolution consists. It is, in short, the theory of Rousseau unflinchingly carried into details, though, in deference to the watchwords of the present age, it is couched in expressions which imply a sympathy with human progress.

For such abnormal phenomena as those of the Terror and the Commune, there is no doubt a deeper cause than the prevalence of anarchical social and religious theories. Such phenomena are strictly analogous to those of disease, indicating that sundry social functions are out of balance, and that the social organism is violently striving to regain equilibrium even at the risk of premature dissolution. Scientifically considered, the Commune was a case of retrograde metamórphosis, quite analogous to cancer in the individual organism; and it was due to a minor failure of adjustment incident upon a rapid change in the social environment. Increased wealth and a heightened standard of comfortable living, entailing prolonged labour and more intense brain-work, leave the least industrious and intelligent members of the community in misery little removed from starvation. And while under the unchecked operation of natural selection these unadapted members of the community would soon perish, as the lunatic and the drunkard would perish, we nevertheless save them artificially, as we artificially protect the drunkard and the lunatic; and we do so rightly, because the repression of our humanitarian feelings would entail far greater damage to society than the survival of these incapables. But in surviving they constitute a growth of a lower order of vitality, like a cancer implanted in nobler tissues, and their effort is to abolish a civilization of which their own misery is, for the time being, the inevitable result, and to reinstate that primitive order of things in which the strong fist and the strong passions were not yet at the mercy of the keen intelligence and the large capacity for toil. Here, as in the case of the abnormal individual desires treated in the concluding chapter of Part II., we find a number of unadjusted cravings which natural selection can but imperfectly deal with, and which it must be left for some process of direct adaptation slowly to adjust. An analogous though not entirely similar explanation will apply to the case of Robespierre and the Terror.

But while such pathological phenomena can by no means be explained as solely due to certain anarchical theories social and religious, it still remains true that between the abnormal social phenomena and the anarchical theories there is a very close kinship; such that the theory finds itself practically incarnated in the social event, while it is through the anarchical theory that the abnormal social event finds itself redeemed from the odium attaching to sheer criminal malevolence, and entitled to that slight modicum of credit which we are wont to accord to sincerity when allied with destructive fanaticism. It is as true that the iconoclastic theory naturally lends itself to the purposes of the Jacobin or the Communist, as it is that the Jacobin or the Communist naturally justifies to himself his purposes by an appeal to the iconoclastic theory. Hence it is undeniable that when modern scientific thought, not yet having reached a dynamical view of things, allied itself to the spirit of mere negative protest against existing beliefs and institutions, it might well have seemed to a thinker like De Maistre to be irreconcilably hostile to all the habits and aspirations which give to civilized life its value.

Now the dynamical view of things, however crudely announced by Comte in his theory of the "Three Stages," differed widely from the statical view of De Maistre; for it proclaimed that we must found our general conception of the world and our plans for social amelioration upon a synthesis of special scientific truths, established by the use of the objective method, and not upon a congeries of theological dogmas, established originally by the use of the subjective method, and afterwards certified only by a perennial appeal to some authority assumed as infallible. It differed equally from the statical view represented by the iconoclasm of the eighteenth century; for it said, we cannot ignore the past, or treat it with contumely: the men who originated mythological explanations of natural phenomena were neither knaves nor the dupes of knaves, but genuine philosophers who made the best use of such implements of research as lay before them: men's conceptions of the world have been progressively stripped of their anthropomorphic vestments, and the scientific mode of thought, which, manifesting itself here and there in fragmentary generalizations, has all along been determining the progress, must ultimately, organized in a series of grand, all-embracing generalizations, reign supreme: the history of human thought is thus a development, and each creed or system, no matter how absurd it may at first appear, is a phase of that development; so that to construct a philosophy or a polity *de novo*, out of abstract principles, without reference to the concrete facts of past history, is simply to build a castle in the air.

Thus would Comte have answered on the one hand the Jacobins and on the other hand the Ultramontanes, with both of whom he has, by a strange but not inexplicable fate, been charged with owning fellowship. Thus we arrive at the philosophic explanation of the unparalleled range of his historic sympathies, of the generous recognition which he was ever ready to accord to the crude but needful and serviceable beliefs and institutions of earlier ages, and to their representative men of whatever creed. And thus, too, we are enabled to appreciate one of Comte's principal reasons for calling his system of philosophy "Positive." In sharp contrast with the *negative* philosophy of the atheists and Jacobins, its purpose was not to overthrow old beliefs by an assault from without, but to construct, upon the basis of the positive truths already furnished by science, a new system of beliefs, which should account for the old ones and supplant them by sheer force of its superior catholicity. For five centuries, said Comte, science has been arrayed in apparent hostility to religion, and philosophy has been chiefly employed in disintegrating Christian theology and feudalism: the time has now come for this negative work to be regarded only as incidental to the positive work of integrating scientific truths into a body of philosophic doctrine, upon which may ultimately rest a new theory of religion and a reorganized social polity.

As thus described, the critical attitude assumed by Positivism may appear to be identical with that which is the result of a thorough adherence to the Doctrine of Evolution. There is, however, a profound difference between the position of the evolutionist and that of the positivist, which it is well worth our while to characterize at some length, even at the risk of an apparent digression. Our subject is so very complex, by reason of the wide range of its practical applications, that we shall be greatly helped—as we have already on many occasions been helped—by contrasting our own view with that Comtean view which superficially resembles it. When we have noticed the two great errors—both of them due to imperfect apprehension of the nature of evolution, which left Comte, in spite of himself, in an attitude of hostility both to the current Christian theology and to the existing framework of society, we shall have virtually illustrated, with satisfactory clearness, our own conservative point of view.

In the chapter on Anthropomorphism and Cosmism the first of the two fatal errors of Positivism was elaborately described and criticized. It was shown that, although by his theory of the three stages Comte announced his philosophy as a continuous development from older theological philosophies, and although he declared himself determined not to break with the past, yet nevertheless his explicit ignoring of Deity constituted in itself a breach with the past which no amount of continuity in other respects could remedy or atone for. We saw that, in spite of their numberless superficial differences, all historic religions have been at one in the affirmation of a Supreme Power upon which man is dependent; and we saw that with respect to this affirmation our Cosmic Philosophy is as much at one with Christianity as Christianity is at one with older religious philosophies. On the other hand it is self-evident that there can be no continuity of development between a system of thought which affirms this truth and a system of thought which either denies it, like Atheism, or ignores it, like Positivism. In this respect it cannot be questioned that Comte broke with the past as completely as if he had been a dogmatic atheist. Hence is to be explained his utterly unphilosophical attempt to found a new religion. In his earlier scheme no place is left for religion at all; but when, by an afterthought, he recognized the existence in mankind of a religious sentiment which demands satisfaction, his ignoring of Deity led him to the construction of an artificial religious scheme from which the essential element of religion was entirely omitted. Had he recognized this essential element, he would have seen that the time for instituting new religions has long since passed by, and that religious progress in future is possible only through the gradual evolution of Christianity itself into higher and higher forms.

The second fatal error in Positivism is the opinion that society can be reorganized by philosophy. To demonstrate anew the fallaciousness of this opinion, which underlies the whole Comtean effort to reconstruct human society after a utopian model, would be but to repeat the arguments which have formed the woof of our chapters on sociology. If there is any convincing power in the multitude of mutually harmonious proofs which were there accumulated, we must be already convinced that men are civilized, not by a mere change in their formulas of belief, but only by a change in their type of character which can be effected only through a considerable lapse of time. This is the reason why civilizations cannot be made, but must grow. We differ from the ancient Angles and Saxons, not so much because we know more than they knew, as because we have undergone fifteen centuries more of social discipline which has perceptibly modified our character, and with it our moral ideals. If Comte had ever firmly grasped the theorem "that society is to be reorganized only by the accumulated effects of habit upon character," he would have held himself aloof from projects which could have no meaning save on the hypothesis that society can be reorganized by philosophy. He would have seen that though the fruit of the tree of knowledge may make us like gods, knowing good and evil, it is only the tree of life which can renovate our souls and fit us for Paradise.

But now, since society grows, but is not made; since men cannot be *taught* a higher state of civilization, but can only be *bred* into it; it follows that the whole Comtean attempt to construct an ideal Polity, including a new religion and new social institutions, was—save as a warning for future thinkers—just so much labour thrown away. After all his profound and elaborate survey of human history, Comte strangely forgot that the sum-total of beliefs and institutions in the twentieth century will be the legitimate offspring of the sum-total of beliefs and institutions in the nineteenth, but can in no case be the offspring of an individual intellect, even were that intellect ten times more powerful than Comte's. No individual will has ever succeeded in remodelling society in conformity to a prescribed ideal. Perhaps no single man, if we except the Founder of Christianity, has ever made his individual character and genius count for so much in the subsequent direction of human events as Julius Cæsar. But Cæsar never reconstructed society, and, though not instructed in the Doctrine of Evolution, would have felt such a task to be simply an impossibility. The secret of Cæsar's greatness, and of his success, lay in the wondrous common-sense with which he perceived the true significance of contemporary events, and in the unflinching perseverance with which he wrought out the political system for which society was already yearning, and which the circumstances of the times rendered indispensable to the maintenance of civilization. This has been the secret of the success of all statesmen of the highest order; of Charles the Great and Hildebrand, as well as of William the Silent, Edward I. of England, Henry IV. of France, and Richelieu. By a sagacious instinct these great men felt, though they could not scientifically explain, the direction in which human affairs were naturally tending; and it was because they shaped their efforts with a view to assist, and not to check or warp, the resistless tendencies of society, that they succeeded in stamping their individualities so powerfully upon history. It is from the lack of this sagacity that the ablest retrograde statesmen have either failed utterly, or at best succeeded only in working wanton mischief. Julian, and Philip II. of Spain, occupied positions which enabled them to wield enormous power, and the former was a man of signal ability and undoubtedly good intentions. Yet Julian wholly failed to see that Platonic Paganism, however well adapted it may have been to the sporadic, municipal civilization of antiquity, was no longer adapted to the intellectual and moral needs of men living under the Roman Empire. Hence his insensate attempt to destroy the only religious organization capable of holding society together during the perilous times that were coming; an attempt which his early death fortunately frustrated before it had been persisted in long enough to work much social disturbance. Philip II., a man of mediocre ability and hopelessly vulgar egoism, might yet have done a good work, could he ever have been brought to understand the way in which the world was moving, and would move in spite of him. Yet he thought to establish in Romanized Europe an Oriental patriarchal despotism, and he thought by mere brute force to bring over half the civilized world to a religious system which it had for ever discarded. And thus, though he wielded a power such as no man for centuries had wielded before him, he achieved absolutely nothing. At the end of his evil career, he was farther from each of his cherished aims than at the beginning. The physical power of Spain was exhausted in the vain effort to stem the course of events, and all the credit the son of Charles V. ever earned was that of being one of the most mischievous among the enemies of the human race.

Now, our practical object in studying human progress scientifically is to be able to arrive at certain definite general principles of statesmanship. In every branch of speculative or practical activity, men begin by reasoning from particulars to particulars, accomplishing their results by a kind of sagacious instinct which hits upon the means requisite for attaining a given end. But after a while, as science progresses, they establish general principles of action, and work with a distinct consciousness of the adaptation of the means employed to the end proposed. From being instinctive and irregular, their proceedings become ratiocinative and systematic; witness the whole history of industrial art. And, as that history shows, the more intelligent and coherent the course of proceeding, the less is the time and effort wasted in vain experiment. It is just the same in politics. We need to understand the conditions essential to progress, and the direction which progress is taking, that we may avoid the mischief entailed by stupid and ignorant legislation, and secure the benefits arising from legislation that is scientifically conceived and put into operation with a distinct consciousness of the ends to be secured. We need sociology that we may not waste our energies and damage society in opposing the very reforms which a little science might tell us that the community requires and will have, sooner or later, in spite of us. I do not mean to say that a knowledge of the laws of history will alone suffice to make us statesmen. Science and art are two different things, and so are scientific genius and practical genius. But if a Themistokles or a Hildebrand were to arise among us, he would be all the more useful for working in conformity to scientific principles, instead of trusting solely to his native sagacity. It is when genius works with vision that it achieves its utmost. And when we cannot have genius, by all means let us have vision, so far as science can impart it to us. Daily we grow indignant over the hand-to-mouth policy of our legislators, which inflicts so much needless suffering, and makes it so much harder for all of us to earn our bread. But we must remember that such a policy is the natural outcome of a foolish neglect of the lessons which history has to teach, and which may be read by anyone who holds the scientific clue to them.

Such is our practical object, and our sole practical object, in studying sociology as a science. To attempt to construct an ideal polity, by adopting which society is to remodel itself, is to show that we have studied that science to little purpose. For if history can teach us anything, it can teach us that civilization is a slow growth, of which no one can foresee, save in its most general features, the final result; far less force that result prematurely merely by appeals to men's judgment.

How utterly Comte ignored all this—the plain teaching both of historic induction, and of deduction from the laws of organic life—can be appreciated only when we read the insane pages in which he attempts to predict the immediate future. He by no means intended that society should wait till a remote era for the entire realization of his project. In seven years the control of public education in France was to be given to Comte. In twelve years the Emperor Napoleon was to resign in favour of a Comtist triumvirate. In thirty-three years the religion of Humanity was to be definitely established. As Mr. Mill says, "a man may be deemed happy, but scarcely modest, who had such boundless confidence in his own powers of foresight, and expected to complete a triumph of his own ideas on the reconstitution of society within the possible limits of his life-time. If he could live (he said) to the age of Fontenelle, or of Hobbes, or even of Voltaire, he should see all this realized, or as good as realized."

But what we have here to note is not especially the personal conceit of the project, or the marks of insanity clearly indicated in these inordinate expectations; what we have to note is the mode of genesis of this wild scheme. Extravagant beyond all comparison as Comte's proposals for remodelling religion and society undoubtedly were, they can nevertheless be easily traced, in their general outlines, back to the two errors which I have above signalized as the fundamental errors of Positivism. The first error—the ignoring of Deity—necessitated a complete rupture with Christian forms of religion; and the second error—the belief that society can be reorganized by a change in formulas of belief—led naturally to the attempt to substitute a new religion for Christianity and a new kind of civilization for the existing civilization. Thus in spite of his keen historic appreciation of the excellence of Christianity, and in spite of his sympathetic critical attitude, was Comte logically forced into a position quite as untenable as that held by the atheists and Jacobins. And now let us observe how, even as with these iconoclasts, the social state which Comte expected to substitute within forty years for the existing social state, was in all essential respects a retrogradation toward a more primitive structure of society. The positivist utopia is not indeed a return to pristine savagery, like the utopia of Rousseau and his followers, but it is a reversion toward a spiritual despotism, such as was realized in ancient Egypt, and such as might perhaps have been realized in mediæval Europe, had not the policy of the Emperors opposed a salutary check to the policy of the Popes. In the chapter on the Evolution of Society, we found it to be the chief characteristic distinguishing social progress from the lower orders of organic evolution, that individuals, regarded as units of the community, are continually acquiring greater and greater freedom of action, consistently with the stability of the community. Now Comte's ideal state of society is a state in which the units of the community possess no more individual freedom than the cells which make up the tissues of a vertebrate animal. It is an absolute spiritual despotism,—or if not technically a despotism, we may at least say of it, as Mr. Grote says of Plato's imaginary commonwealth, that it is a state in which existence would be intolerable to anyone not shaped upon the Comtean model. Public opinion is to be controlled by a priestly class of philosophers, against whose authority all revolt would be as useless as the rebellion of a mediæval monarch against a papal interdict. As Mr. Spencer sums it up: the Comtist "ideal of society is one in which *government* is developed to the greatest extent, in which class-functions are far more under conscious public regulation than now, in which hierarchical organization with unquestioned authority shall guide everything—in which the individual life shall be subordinated in the greatest degree to the social life." Now this cannot be unless the development of society as it has hitherto proceeded is to be diametrically reversed. As our whole inquiry into the process of social evolution has taught us, "the form of society towards which we are progressing is one in which *government* will be reduced to the smallest amount possible and *freedom* increased to the greatest amount possible; one in which human nature will have become so moulded by social discipline into fitness for the social state, that it will need little external restraint, but will be self-restrained; one in which the citizen will tolerate no interference with his freedom, save that which maintains the equal freedom of others; one in which the spontaneous cooperation which has developed our industrial system, and is now developing it with increased rapidity, will produce agencies for the discharge of nearly all social functions, and will leave to the primary governmental agency nothing beyond the function of maintaining those conditions to free action, which make such spontaneous cooperation possible; one in which individual life will thus be pushed to the greatest extent consistent with social life; and in which social life will have no other end than to maintain the completest sphere for individual life."[1]

If the scrutiny of these contrasted theorems still leaves us in any doubt as to the retrograde character of Comte's ideal society, a single practical illustration will more than suffice to convince us. We have seen that certain Jacobins of the Commune announced their intention to permit scientific research only to such persons as might succeed in convincing an examining-committee of average citizens that their researches were likely to be of direct practical value. I need not say that, if such a rule could be enforced, the intellectual advancement of mankind would be instantly arrested. It is interesting to observe that Comte entertained an intention not wholly dissimilar to this. Disgusted with the insatiable curiosity which leads scientific thinkers to pry into the secrets of nature in all directions at once, often spending years upon subjects which to self-complacent ignorance or Philistinism seem entirely trivial, Comte enacted that "some one problem should always be selected, the solution of which would be more important than any

[1] Spencer, *Recent Discussions*, p. 123.

other to the interests of humanity, and upon this the entire intellectual resources of the theoretic mind should be concentrated, until it is either resolved, or has to be given up as insoluble; after which mankind should go on to another, to be pursued with similar exclusiveness."[1] It only remains to add that this all-important problem was to be prescribed by the High Priest of Humanity. When now, knowing as we do Comte's intense aversion to certain kinds of inquiry, we consider what would have been the result could such a system have gone into operation forty years ago; when we reflect that Bessel would never have been allowed to measure the parallax of a star, that the cell-doctrine in biology would have been hopelessly doomed, that Mr. Darwin's researches would have been prohibited as useless, that the correlation of forces would have still remained undiscovered, that psychology would have been ruled out once for all, that the new chemistry would not have come into existence, and that spectrum analysis would never have been heard of; when we reflect upon all this, we may well thank God for the constitution of things which makes it impossible that the well-being of the human race should ever be irrevocably staked upon the wisdom or folly of a single speculative thinker.

So far as our present purpose is concerned, it would be time worse than wasted to present in further detail Comte's purely whimsical and arbitrary proposals for the remodelling of society. As questions of philosophy they possess neither interest nor value: they are interesting solely as throwing light upon the morbid psychology of a powerful mind, fertile in suggestions, but hopelessly deficient in humour. Whoever wishes to learn their character can do so at the expense of wading through one of the most dismal books in all literature —the *Catéchisme Positiviste.* Enough has been said to establish the fact that in breaking with the past and seeking to

[1] Mill, *Auguste Comte and Positivism,* p. 164.

remodel religion and society artificially, Comte yielded to the inevitable necessity which compels the would-be reconstructor of society to remodel it ideally upon a lower type than that which actually exists. He would have given us a religion without God and a society without freedom of action.

If we now pause for a moment, and gather up the different threads of the argument, we shall assist the comprehension of our own position, presently to be stated. Let us, then, contemplate in a single view the conclusions deducible from the foregoing series of criticisms.

We have seen the old statical habit of thought, as represented in the Doctrine of Creation, manifesting itself in rigid orthodoxy, both in religion and in politics. We have observed the way in which modern scientific inquiry, detecting numberless absurdities or anomalies in the religious and political orthodoxy inherited from mediæval times, yet retaining and carrying into its criticisms the statical habit of thought, has assumed an iconoclastic attitude with reference to the existing order of things. We have traced this iconoclastic attitude in the modern history of Atheism and Jacobinism, and have noted how its tendency is in the direction of social dissolution. We have found that the only possible result of a sudden and violent alteration of the existing order of things must be a retrogradation toward some lower order of things, characteristic of some less advanced type of civilization. And of this fatal necessity we have seen the most instructive example in the career of the Positive Philosophy. Though it had partially compassed, in an empirical fashion, the notion of development; though it was fully alive to the barrenness of iconoclastic methods; though it began by regarding itself as the normal product of a long course of speculative evolution;—nevertheless when, by its ignoring of Deity, Positivism found itself arrayed in sheer opposition to established and time-honoured theories, the resulting retrogradation was hardly less marked than it had been in the case of atheistic Jacobinism. And when the notion (born of the statical habit of thought), that men's natural ways of thinking and acting can be suddenly changed by a change in philosophic formulas, was called to its aid, the result was that absurdest though most logically constructed of all utopias, the Positive Polity.

In view of these profoundly interesting and instructive conclusions, can we not, by sheer contrast, immediately discern what must be the critical attitude of any philosophy which is based upon the thorough and consistent recognition of the Doctrine of Evolution? We too, as well as the Positivists, have our ideal state of society,—a state well described in the passage above quoted from Mr. Spencer, in which the greatest possible fulness of life shall be ensured to each member of the community by the circumstance that in the long course of social equilibration the desires of each individual shall have become slowly moulded into harmony with the coexistent desires of neighbouring individuals. But as cataclysms and miracles and sudden creations have no place in our purely dynamical theory of things, we do not expect to see this ultimate state of society realized within half a century. We know full well that it can be realized only in the indefinitely remote future. Nay, since the conception of absolute finality is as inconsistent with the Doctrine of Evolution as is the conception of absolute beginning, we do not regard it as destined ever to be absolutely realized. That supreme epoch of social equilibrium in which every man shall love the Lord with all his heart and his neighbour even as himself, in which the beast shall have been worked out, and, in Tennyson's phrase, the ape and the tiger shall have been allowed to die within us, in which egoistic or anti-social impulses shall be self-restrained, and everyone shall spontaneously do that which tends towards the general happiness,—this supreme epoch is likely for ever to remain an ideal epoch which shall relatively be more and more distinctly realized without ever being realized absolutely, just as the hyperbola for ever approaches its asymptote without coming in contact with it. There will always be room left for that aspiration after a yet higher fulness of life, after a "closer walk with God," which, whether it be expressed by the symbols of science or by the symbols of mythology, is the indestructible essence of all religion. An absolutely perfect state of society would be, by a curious and instructive paradox, a state in which the religious sense would have no further function to subserve, because goodness would have become automatic and aspiration would be at an end.

But while our ideal state of society is one which can only be gradually, relatively, and approximatively realized, it has none the less a present existence as an ideal which we must ever strive to incarnate as far as possible in the concrete facts which make up the sum of our every-day life. There is a practical sense in which the evolutionist, no less than the radical sceptic or the orthodox believer, must recognize that he has a missionary function to fulfil. We do indeed aim, in conformity with surrounding conditions, at the realization of our social and ethical ideal,—seeking to do what within us lies to hasten the time when it may be proclaimed, with fresh significance, that the kingdom of heaven is at hand. But how shall we seek to effect our purpose? Shall we go forth to all the world and preach some "gospel of Evolution," in the hope that men, seeing the error of their ways, shall suddenly embrace the new faith and be henceforth spiritually healed? In two ways our philosophy has taught us the absurdity of such a proceeding. *First*, such doctrines are too subtle, too spiritual indeed, to be apprehended otherwise than by a slow process of growth, intellectual and moral. Accordingly, since men's theologies are narrowly implicated with their principles of action, the taking away of their theology by any other process than that of slowly supplanting it by a new system of conceptions equally adapted to furnish general principles of action, would be to leave men trivial-minded and irreligious, with no rational motive but self-interest, no clearly-conceived end save the pleasure of the moment. The evolutionist, therefore, believing that faith in some controlling ideal is essential to right living, and that even an unscientific faith is infinitely better than aimless scepticism, does not go about pointing out to the orthodox the inconsistencies which he discerns in their system of beliefs. And while assured that the deanthropomorphizing process will continue to go on as it has gone on since the dawn of history, under the slow but unceasing stimulus of scientific generalization, he at the same time rejoices that a violent destruction of anthropomorphic conceptions is impossible. Refraining, therefore, from barren theologic controversy, his aim is to carry scientific methods and scientific interpretations into all departments of inquiry, in accordance with the profound aphorism of Dr. Newman: "False ideas may be refuted by argument, but only by true ideas can they be expelled." Have we not seen that our beliefs are in a measure wrought into the very substance of our brains, so that the process of eradicating them *must* be a process of substitution which, as involving structural changes, must needs be gradual?

But *secondly*, the evolutionist must recognize that, even were it possible to effect a sudden conversion of mankind to a faith based upon scientific knowledge, such a conversion would not bring about the desired result of inaugurating a higher and better state of society. Not by a change of opinion, but by a change of heart, is the grand desideratum to be obtained. It is not by accepting all the theorems comprised in the Doctrine of Evolution, or in any other doctrine whatever, that men are to obey the dictates of selfishness less and the dictates of sympathy more. Yet *this* is the transfer of allegiance upon which, as we have elsewhere shown, the amelioration of society and the relief of man's estate depend.

And these considerations as to the critical attitude of the evolutionist with reference to theology will equally apply to his critical attitude with reference to politics, concerning which I need, therefore, add but few explanatory words. Since it is the plain teaching of history that the group of institutions making up the framework of society at any given period cannot be violently altered without entailing a partial disintegration of society; since any custom or observance can be safely discontinued only when the community has grown to the perception of its uselessness or absurdity; and, above all, since the integrity of society depends in an ultimate analysis, not upon its institutions (which may be as liberal in Mexico as in Massachusetts), but upon the integrity of its individual members; it follows that the evolutionist will look askance at the panaceas of radical world-menders, refusing to believe that the millennium can be coaxed or cheated into existence until men have learned, one and all, each for himself, to live rightly. The only utopian ideal which he can consistently cherish, is that of contributing his individual share of effort to the improvement of mankind by leading an upright life, and applying the principles of common-sense and of the highest ethics within his ken to whatever political and social questions may directly concern him as member of a progressive community.

When, therefore, we are asked how we shall seek to incarnate in fact our ethical and social ideal, the reply is: we must seek to realize this ideal, in so far as our frail half-developed natures will allow, by leading pure and upright lives, repressing the selfish impulses which are our legacy from the brute, obeying the dictates of sympathy whereby we are chiefly distinguished as human, and conforming as well as we may to the highest ethical code within our ken.

As the coral reef is built by millions of tiny polyps, each giving up his little life to the process, until a stately island arises in mid-ocean, so the ideal society of the future, with its exemption from the ills which we now suffer, will be the result of myriads of individual efforts towards greater completeness of life. Every temptation that is resisted, every sympathetic impulse that is discreetly yielded to, every noble aspiration that is encouraged, every sinful thought that is repressed, every bitter word that is withheld, adds its little item to the impetus of the great movement which is bearing Humanity onwards toward a richer life and a higher character. Out of individual rectitude comes the rectitude and happiness of the community; so that the ultimate salvation of mankind is to be wrought out solely by obedience to that religious instinct which, as shown in the preceding chapter, urges the individual, irrespective of utilitarian considerations, to live in conformity to nature's requirements. "Nearer, my God, to thee," is the prayer, dictated by the religious faith of past ages, to which the deepest scientific analysis of the future may add new meanings, but of which it can never impair the primary significance.

Thus with regard to its practical bearings upon human conduct, the religious attitude of our scientific philosophy seems to be absolutely identical with the religious attitude of Christianity. We arrive at a deeper reason than has hitherto been disclosed for the difference between our position with reference to Christianity, and that which has been assumed by Radicalism and by Positivism. It is not merely that we refuse to attack Christianity because we recognize its necessary adaptation to a certain stage of culture, not yet passed by the average minds of the community; it is that we still regard Christianity as, in the deepest sense, our own religion. Or, if a somewhat different form of statement be preferred, we regard it as a faith which, precisely in the act of realizing more and more fully its own ideal, becomes more and more fully identified with the faith which we are conscious of cherishing. Instead of the intolerant hostility of the Infidel, or the indifferent neutrality of the Positivist, we offer cordial aid and sympathy. I cannot better illustrate the twofold source of this sympathy than by citing the words of a lady who is fairly entitled to rank as one of the most original and suggestive thinkers of our time. Speaking of the lower of the two lines of thought which determine the critical attitude of the evolutionist, Miss Hennell says:— "When we see the various modes of error in belief, no longer in the light of heresies that we have the right to punish, or even to despise, but only as the incomplete condition that must of necessity belong to that which has to ripen out of the lower state into the higher; and when we bethink ourselves that it is the matter of our own most cherished aspiration that our own condition, as presently occupied, has to appear in the very same light to the station to be attained hereafter; charity towards the imperfection is so inevitable that indeed it no longer requires to be insisted on as if it required inculcation. Our sphere of religious sympathy has been so much enlarged beyond its former bounds, that the original matter of duty has become matter of simple unquestioning feeling." Now this admirably illustrates what I have called the lower of the two lines of thought which determine our position: it explains our refusal to attack Christianity. The following deeply-meditated passage illustrates the higher line of thought, and shows why we identify our position with that which is held by Christianity. "Very slight ground of self-gratulation should I have found," says Miss Hennell, "in even the most palpable superiority of present faith that might have been gained, if the acquisition had really been made, as at first it appeared to me to be made, and as it must still appear to orthodox believers to be made, at the expense of the absolute subversal and denial of the faith that had gone before it. If I could not now perceive that what was once true to me, and true to the world, was true for ever, in relation to what had to come after it, I do not deny to myself that I should inevitably fall away to cease believing at all henceforth both in myself and in the world. Yes: if I could not see in relation to Christianity, just as truly as was seen by the master-spirits of that religion in relation to Judaism, that neither of this later form of realization 'can one jot or tittle pass away, until all be fulfilled' in the newly-arriving doctrines of General Religion,—never, I am convinced, could the latter take any real hold upon me: never, in fact, could it *be* a religion to me."[1]

To those who still adhere to the sharp distinctions characteristic of the statical view of things, who carry into their estimate of religious opinions the conception of fixity of species, it may seem absurd or sophistical in us to assimilate with Christianity a system of thought which has entirely thrown off the mythologic symbols wherein Christianity has hitherto been clothed and whereby it is customarily recognized as possessing an individuality of its own. To such it naturally seems that the giving up of the symbol is the giving up of the reality, and that the critical attitude of him who has given up the symbol must be an attitude of radical hostility. But now, as the crowning result of the whole argument, we are enabled to show how the dynamical view of things disposes of this paradox. He who brings to his estimate of religious opinions a Darwinian habit of mind, must understand that a sudden and radical alteration of Christianity into something else is as impossible as the sudden and radical change of one type of organism into another. He will see that, while form after form has perished, the Life remains, incarnated in newer and higher forms. That which is fundamental in Christianity is not the mythologic superstratum, but the underlying spiritua-

[1] Miss Hennell, *Present Religion*, pp. 50, 51.

principle. The mythologic symbols have changed from age to age. The constant element has been, on its intellectual side the recognition of Deity, and on its emotional side the yearning for closer union with Deity, or for a more complete spiritual life. And the three foregoing chapters have conclusively proved that this constant element, in both its aspects, remains unchanged in that religion whose symbols are shaped by science.

In using the phrase "Cosmic Theism," therefore, to denote the religious phase of the philosophy based upon the Doctrine of Evolution, I do not use it as descriptive of a new form of religion before which Christianity is gradually to disappear. I use it as descriptive of that less-anthropomorphic phase of religious theory into which the present more-anthropomorphic phase is likely to be slowly metamorphosed. The conflict, as it presents itself to my mind, is not between Christianity and any other embodiment of religion or irreligion. The conflict is between science and mythology, between Cosmism and Anthropomorphism. The result is, not the destruction of religion, but the substitution of a relatively adequate for a relatively inadequate set of symbols. In the scientific philosopher there may be as much of the real essence of Christianity as there was in the cloistered monk who preceded him; but he thinks in the language of a man and not in the language of a child.

The critical attitude of our philosophy with reference to the beliefs and the institutions amid which we live, has now been quite thoroughly defined both by what it is and by what it is not. We may now, I think, safely affirm that when Mr. Mivart accuses the Doctrine of Evolution of tending toward the intellectual and moral degradation of mankind and toward the genesis of atrocities worse than those of the Parisian Commune, he clearly shows that he has not thoroughly comprehended the implications of the doctrine. The conception of evolution, which he adopts after a loose and inconsistent fashion in so far as his own special studies have constrained him to adopt it, remains nevertheless in his mind a barren conception. He quite fails to grasp the dynamical view of things, and therefore naturally regards the overthrow of Roman Catholic theology as equivalent to the inauguration of atheism and of anarchy. We have seen, on the other hand, that all the iconoclastic attacks which have been directed either against Christianity or against the existing order of society have been theoretically based upon fallacies which are incompatible with the Doctrine of Evolution. It has been shown that, upon our general theory of life, we can look, for the realization of our highest social ideal, only to the perfecting of individual character under the conditions at any time existing. And for the perfecting of individual character we must rely upon that increasing sense of divine omnipresence and that increasing aspiration after completeness of spiritual life, which, taken together, constitute the permanent element in Christianity. When we add that our ethical code, deduced theoretically from the conception of Life set forth at such length in the second part of this work, is at bottom identical with the ethical code sanctioned by the highest Christianity, it at last becomes apparent how truly conservative, in the best sense of the word, is the critical attitude of our philosophy.

The iconoclast, who has the welfare of mankind nearest his heart, will indeed probably blame us as too conservative, —as lacking in robust and wholesome aggressiveness. And he will perhaps find fault with us for respecting prejudices which he thinks ought to be shocked. Our reply must be. that it is not by wounding prejudices that the cause of truth is most efficiently served. Men do not give up their false or inadequate beliefs by hearing them scoffed at or harshly criticized: they give them up only when they have been taught truths with which the false or inadequate beliefs are incompatible. The object of the scientific philosopher therefore, will be to organize science and extend the boundaries of knowledge.

If he obtains a fresh morsel of truth, he will proclaim it to the world without dread of consequences, and let it bide its time until society comes, of its own free-will and intelligence, to accept it. But while feeling it unnecessary, and often unadvisable, to urge his views upon others, no craven fear of obloquy will prevail upon him to conceal them when it is desirable that they should be stated. He will state them without mental reservation, and, above all, without fear of any possible harm that can come from the unhampered quest of truth. There is nothing more reprehensible than the secret dread of ugly consequences with which so many writers approach all questions of vital importance. They shrink from lifting the veil which envelopes the Isis-statue of Truth, lest instead of a beaming countenance they may perchance encounter a ghastly death's head. But philosophy should harbour neither fears nor repugnances, nor qualms of conscience. It is not for us, creatures of a day that we are, and seeing but a little way into a limited portion of nature, to say dictatorially, before patient examination, that we will not have this or that doctrine as part of our philosophic creed. We must feel our way as best we can, gather with unremitting toil what facts lie within our reach, and gratefully accept such conclusions as can honestly and by due process of inference and verification be obtained for our guidance. We are not the autocrats, but the servants and interpreters of Nature; and we must interpret her as she is,—not as we would like her to be. That harmony which we hope eventually to see established between our knowledge and our aspirations is not to be realized by the timidity which shrinks from logically following out either of two apparently conflicting lines of thought—as in the question of matter and spirit—but by the fearlessness which pushes each to its inevitable conclusion. Only when this is recognized will the long and mistaken warfare between Science and Religion be exchanged for an intelligent and enduring alliance. Only then will the two knights of the fable finally throw down their weapons, on discovering that the causes for which they have so long been waging battle are in reality one and the same eternal cause,—the cause of truth, of goodness, and of beauty; "the glory of God, and the relief of man's estate"

# INDEX.

# INDEX.


ABSOLUTE, the, i. 9, 14 ; ii. 412.
Absolute Existence, what is meant by it, i. 87—91.
Absolute truth, no criterion of, i. 11, 70.
Abstract and concrete sciences distinguished by Comte, i. 189, 214.
Abstract sciences cannot furnish a primordial principle on which to build a philosophy, i. 268.
Abstract-concrete sciences, i. 215, 218, 269.
Abstractness not the same as generality, i. 214.
Actinism as a mode of motion, i. 292.
Adam, William, ii. 193, 386.
Adaptation, direct, ii. 56.
Adjustment, ii. 64.
Adoption, legal fiction of, ii. 216.
Agassiz, Louis, i. 449 ; ii. 382.
Agreement, method of, i. 241.
Alcohol retards waste, i. 334.
Alexander's campaigns, their civilizing influence, ii. 215.
Altruism and egoism, ii. 202, 207.
Amphioxus and ascidian, i. 450.
Analytical truths cannot make up a body of philosophy, i. 314.
Ancestors, worship of, ii. 349.
Ancient societies simulating societies of modern type, ii. 248.
Animals, how classified, i. 448 ; dependent on solar radiation, i. 410.
Anstie on Stimulants and Narcotics, i. 197.
Antelopes as illustrating use and disuse, ii. 17.
Anthropomorphism contrasted with Cosmism, i. 182 ; can never be wholly got rid of, i. 183 ; ii. 449.
Anticipation of future contingencies, ii. 92, 247, 303.
Antipodes, how far inconceivable by the ancients, i. 64.
Antiquity of man, immense significance of, ii. 320.
Apes, brain of, ii. 133.
Arabian conquests, their civilizing influence, ii. 215.
Archæus, theory of, i. 197, 419.
Archebiosis, i. 243, 425 ; difficulty of the question, i. 427.
Archimedes, i. 201, 209, 253.
Argyll, Duke of, i. 20 ; ii. 264, 317.
Aristæus and his bees, i. 418.
Aristotle, i. 126, 224.
Arnold, Matthew, ii. 452, 463.
Articulata, origin of the type, i. 345.
Aryan languages, i. 443.
Aryan race, i. 448.
Ascidian and amphioxus, i. 450.
Association of ideas, ii. 139, 147.
Asteroids, origin of, i. 369 ; their planes of revolution not yet accounted for, i. 372.
Astrogeny, i. 220.
Astronomy, a deductive science, i. 113 ; when constituted as a science, i. 197, 199, 201 ; scope of, i. 202, 220 ; a concrete science, i. 214 ; observation in, i. 243.
Atheism, i. 7 ; ludicrously treated by Comte, i. 262.
Athens, its importance in history, ii. 262.
Atoms, constitution of, i. 4.
Attitude of philosophy, i. 259 ; ii. 473.
Attraction and repulsion, i. 5, 290.
Australians have no words for justice, etc., ii. 289.
Automatic nervous action, ii. 156.
Autonomism, ii. 205.
Axioms, i. 63.

Bacon, F., his services in founding modern philosophy, i. 112; his condemnation of the subjective method, i. 114; his rejection of the Copernican astronomy, i. 232.
Bagehot, W., ii. 259, 267, 280, 340.
Bain, A., on liberty of choice, ii. 179.
Barbaric languages, absence of general terms in, ii. 308.
Barratt, A., on final causes, ii. 397, 402.
Bastian, H. C., i. 129, 425.
Bathybius, i. 426.
Beale on Cancers, i. 343.
Belief, double sense of the word, i. 61.
Berkeley, i. 74, 117.
Bernard, Claude, i. 244.
Berzelius, overthrow of his dualistic theory, i. 225.
Bessel measures parallax of 61 Cygni, i. 249.
Bichat, i. 199.
Biogeny, i. 221.
Biology, i. 37, 41, 113; when constituted as a science, i. 199; a concrete science, i. 213; scope of, i. 221; difficulty of experimentation in, i. 243; pre-eminently the science of classification, i. 244.
Birds, carinate and struthious, ii. 51.
Blainville's attempts at linear classification, i. 449.
"Blind force" and "intelligent personality," ii. 429.
Borda's pendulum experiment, i. 237.
Botany as related to biology, i. 212.
Boyle and Mariotte, their law of pressures and densities, i. 206.
Bradley's discovery of aberration, i. 204.
Brain increases in heterogeneity with mental labour, ii. 140.
Brain-action, new theory of, ii. 141.
Brewster's optical discoveries, i. 206.
Bridges, J. H., i. 252, 259; ii. 248.
Broussais, ii. 74.
Brown, Thomas, i. 53.
Bruno, Giordano, ii. 375.
Buckle, H. T., his lack of the historic sense, i. 165; on Mohammedan civilization, ii. 200; his philosophy of history, ii. 229.
Büchner, L., i. 123; ii. 435.
Butterflies and their colours, ii. 25; in Celebes and Java, ii. 56.

Cancers, i. 198, 343.
Carbon, its function as a constituent of organic matter, i. 331.
Carinate birds, ii. 51.
Cartesian test of truth, i. 99, 108; doctrine of causal resemblance, ii. 386
Cats and humble-bees, i. 308.
Cats' whiskers, ii. 90.
Causation, universality of, i. 53; source of our belief in, i. 146; Hamilton's theory of, i. 148; Hume's theory of, i. 127, 155; hypothesis of *occulta vis*, i. 154; does not imply constraint, i. 183; volitional theory of, i. 158; ii. 39[illegible]; Ferrier's view of, ii. 183.
Cause, efficient and phenomenal, i. 154.
Causes and effects, resemblance of, ii. 386
Cavendish's torsion-balance experiment, i. 205.
Celibacy of clergy, ii. 222.
Cell-doctrine repudiated by Comte, i. 247, 251.
Cephalic ganglia, their increasing importance, ii. 87.
Cerebral differences between civilized man and savage, ii. 316.
Cerebrum and cerebellum, size of in different animals, ii. 133; functions of, ii. 137.
Châlons, battle of, ii. 262.
Chambers, G., his obituary notice of the nebular hypothesis, i. 386.
Chance and law, ii. 171.
Chemical heterogeneity of the earth's surface, how brought about, i. 431.
Chemism, cohesion, and gravity, i. 291.
Chemistry, i. 34; its relations to mineralogy, i. 189, 212; wherein different from physics, i. 192, 203; when constituted as a science, i. 199; revolutionized by Dumas, Laurent, etc., i. 225.
Chinese, their small foresight, ii. 305; primitive structure of their society, ii. 248.
Christianity, genesis of, ii. 169, 206, 218; its political effects, ii. 278.
Christians formerly called atheists, ii. 469.
Cicada and rattlesnake, ii. 29.
Circulatory system, stages of its evolution, ii. 145.
Citizenship in Greece and Rome, ii. 221.
Civic communities, ii. 117.
Civilization a process of adaptation, ii. 202, 212.
Clan-societies, their characteristics, ii. 204.
Classification as dependent on hereditary kinship, i. 448.
Classifying and reasoning, ii. 106.
Climates, interdependence of, i. 404.
Clover and humble-bees, i. 308.
Codfish, their rate of increase, ii. 11.

Coexistence and non-coexistence, ii. 118.
Coextension and non-coextension, ii. 118.
Cognition involves recognition, i. 12; ii. 120; discrimination, i. 14; how it arises, ii. 121.
Coherence as resulting from integration, i. 337.
Cohesion, gravity, and chemism, i. 291.
Cointension and non-cointension, ii. 118.
Colours of plants and animals, ii. 20.
Comets and nebulæ, i. 389.
Comets "forming their own future," ii. 180.
Commune of Paris, ii. 483.
Community and environment, ii. 197; its growth in size and complexity, ii. 204; more than an organism, ii. 226.
Comparative method as connected with dynamical habits of thought, ii. 477.
Comparison, i. 241.
Compressibility of matter, i. 3.
Comte, Auguste, his weakness as a psychologist, i. 82, 163, 249; ii. 73; compared with Plato, i. 103, 139; abandons the objective method, i. 131; empire of dead over living, i. 135; ii. 199; his habit of abstaining from reading, i. 137; his Subjective Synthesis, i. 140; question as to his insanity, i. 141; not the founder of scientific philosophy, i. 162; his keen historic sense, i. 165; compared with Cuvier, i. 166; his "Law of the Three Stages," i. 168; ii. 238, 245, 468; his inconsistent statements, i. 170; compared with Copernicus, i. 185; his classification of the sciences, i. 189—215; his wrong arrangement of the parts of sociology, i. 194; his rejection of psychology, i. 194; ii. 73: his erroneous view of chemistry, i. 225; his small esteem for syllogistic logic, i. 235; his contributions to the logic of induction, and his conception of Philosophy as an Organon, i. 240; merged Philosophy in Logic, i. 246; repudiated cell-doctrine, i. 247; condemned all inquiries into the origin of man, i. 248; denied the possibility of a science of stellar astronomy, i. 248; wherein different from St. Simon and Fourier, i. 260; identified philosophy with sociology, i. 260; how he reached the Religion of Humanity, i. 261; his ludicrous treatment of atheism, i. 262; his remark about the meaning of "Physics," i. 279; his acceptance of phrenology, ii. 74; his claim to be regarded as the founder of sociology, ii. 232, 253; his law of social progress, ii. 240; his remark that the heavens declare the glory of Hipparchos and Newton, ii. 415; his Religion of Humanity, ii. 417; his advance towards a dynamical view of things, ii. 486; his belief that society can be reorganized by philosophy, ii. 488; his extravagant expectations, ii. 493; his intention of restricting scientific research, ii. 496.
Concealment, its uses in the animal world, ii. 21.
Concomitant variations, i. 237, 244.
Concrete relations interpreted sooner than abstract relations, i. 210.
Concrete sciences, how distinguished by Comte, i. 189; cannot furnish a primordial theorem upon which to found a philosophy, i. 268.
Condillac, i. 118.
Condorcet, i. 253; ii. 253.
Connature and non-connature, ii. 118.
Conscience, beginnings of, ii. 348.
Consciousness, how far known, i. 16; its direct warrant for the existence of its states, i. 64; dependent on cerebral changes, i. 413; ii. 149; involves an orderly succession of changes, ii. 119, how evolved from automatic mental action, ii. 154; does not assert that volitions are uncaused, ii. 182.
Conspicuous phenomena generalized sooner than those that are inconspicuous, i. 209.
Contingent Truths defined by Mr. Lewes i. 58.
Continuity between inorganic and organic phenomena, i. 435; among psychical phenomena, ii. 132.
Contract and *status*, ii. 221.
Convolutions in the brain, structure of, ii. 135.
Cooling of the solar system, i. 357.
Cooperation as masking the effects of natural selection, ii. 258.
Copernican revolution and final causes, i. 261.
Corporate responsibility in ancient communities, ii. 268.
Corpuscular theory of light, i. 130.
Correlation of forces, i. 40, 290; affords no support for materialism, ii. 440.
Correlation of growth, ii. 16.
Correspondence extending in time and space, i. 35; ii. 89, 299; in speciality, ii. 93; in complexity, i. 36; ii. 94, 309; in definiteness, ii. 307; in generality, i. 36; ii. 308; in integration, i 37.

Corti, fibres of, ii. 61.
Cosmism, i. 39, 44, 95, 182, 263, 276; ii. 425, 505.
Coulomb's discovery of the laws of electric equilibrium, i. 203.
Cousin, V., his notions of method, i. 118.
Creation, doctrine of, opposed to the doctrine of evolution, ii. 377, 474.
Crusades, their civilizing influence, ii. 215.
Crystallization, i. 242.
Custom, despotic yoke of, in early times, ii. 265.
Cuvier, i. 166, 244; his classification, i. 449.
Cyclical recurrence, strictly speaking, requires infinite time, i. 313.

DAMMARAS, their inability to count, ii. 288.
Darwin, Charles, i. 308, 462; his discovery of natural selection, ii. 4; his hypothesis of pangenesis, ii. 45; does not allege ubiquitous progress, ii. 257; his suggestion as to the origin of gregariousness, ii. 341; his theory of the beginnings of conscience, ii. 348.
"Darwinism" rejected by Comtists, i. 248.
Day, lengthening of, i. 393.
Deanthropomorphization, i. 176; not a fundamental but a derivative fact, ii. 246.
Death from old age, ii. 71.
Deity, how far unknowable, ii. 413, 470; how far to be regarded as quasi-psychical, ii. 446—451.
Demokritos, his guess that all the senses are modifications of touch, ii. 90.
Demonstration, what it consists in, i. 62.
Derivation hypothesis, i. 442.
Descartes, his test of truth, i. 99; his conception of philosophy less sound than Bacon's, i. 115; his hypothesis of vortices, i. 127; his view of final causes, ii. 384.
Design, argument from, ii. 381.
Desire, how it passes into volition, ii. 177.
Devil-worship, ii. 458.
Didelphia, ii. 50.
Difference and No-difference, i. 89.
Differentiation defined, i. 336
Dilemma of matter and motion, how practically resolved, i. 271, 273.
Dinosaurus and birds, ii. 51.
Distribution of organisms, i. 460.
Dogs, races of, ii. 9.
Dynamic paradox in the process of evolution, i. 331, 398; ii. 283.
Dynamical and statical habits of thought, ii. 371, 473.
Dysteleology, or imperfect adjustment, ii. 403.

EAR-PIANO, ii. 61.
Early society, dilemma of, ii. 270.
Earth, its primitive heat, i. 357; why it has attained so great structural heterogeneity, i. 398; changes of its surface, ii. 13; its age cannot be estimated with our present resources, ii. 48.
Echoes, fetishistic interpretation of, i. 197.
Effort, sense of, i. 156.
Ego-altruistic feelings, ii. 352.
Egoism and altruism, ii. 201, 207.
Electricity a mode of motion, i. 292.
Elevation and subsidence, ii. 39.
Embryologic illustrations of the law of evolution, i. 338; evidence in favour of derivation, i. 454.
Embryos of dog, man, and bird, i. 454.
Emerson, R. W., on the colours of animals, ii. 23.
Emotion, rise of, ii. 155.
Emotional states, order of their grouping, ii. 117.
Emotions and centrally-initiated sensations, ii. 116.
Empiricism, i. 62.
*Encyclopédistes*, their anarchical doctrines, ii. 478.
Environment, social, ii. 197; heterogeneity of, ii. 213.
Epicurean doctrine of pleasures, ii. 329.
Equality and likeness, ii. 103.
Equilibration, ii. 64.
Equinoxes, precession of, i. 303.
Error equivalent to wrong classifying, i. 32.
Ether, i. 6.
Ethical sanctions recognized by science, ii. 455.
Etymologies of Aryan words, i. 446.
European civilization in early times, ii. 271; not autochthonous, ii. 275; causes of its progressiveness, ii. 277.
Evolution, law of, its universality, i. 274; primary and secondary redistributions, i. 329; conditions essential to, i. 329; why manifested chiefly in organic bodies, i. 331; illustrated in function as well as in structure, i. 349; passage from lower to higher orders of, ii. 292; discovery of, an extension of corre-

spondence in time, ii. 370; also a vast integration of correspondences, ii. 373.
Experience, how far it can tell us of the future, i. 49, 53.
Experience-philosophy inadequately stated by the English school from Hobbes to Mill, i. 287; ii. 160.
Experiential origin of necessary truths, i. 56.
Eyes of vertebrates and mollusks, ii. 53, 59.

FALLING bodies, law of, i. 108.
Family-groups, importance of their first establishment, ii. 295.
Fatalism, ii. 185.
Feeling, sensation and emotion, ii. 117.
Ferrier, Prof., i. 75, 79; ii. 173, 283.
Fetishism, origin of, i. 157; defined, i. 168; psychological interpretation of, i. 179; how outgrown, i. 180.
Feudal institutions, wherein different from institutions of primitive races, ii. 222.
Fevers, i. 198.
Fichte, J. G., i. 48, 52, 76.
"Fictions," legal, their civilizing function, ii. 279; scientific and legal, i. 273.
Final causes, logical aspect of the doctrine, ii. 383.
First Cause, i. 7.
Fishes, brain of, ii. 133.
Flowers and insects, ii. 28.
Fly-catcher, ii. 149.
Force, persistence of, i. 40, 283; ii. 414.
Forces, correlation of, i. 40, 290; affords no support for materialism, ii. 440.
Foresight, ii. 92, 247, 303.
Fossilization a rare occurrence, ii. 38.
Fourier, J., his law of conduction, i. 206.
France as illustrating national aggregation, ii. 217.
Frankland on the effects of the moon's cooling, i. 382.
Free-will, the popular argument for, ii. 173; not really a difficult problem, ii. 174; tricks of language upon which the absurd paradox is founded, ii. 188.
Freeman, E. A., ii. 217, 235.
Frequent phenomena generalized sooner than those that are infrequent, i. 210.
Fresnel, i. 130.
Froude, J. A., on the science of history, ii. 166.

GALILEO, i. 34, 107, 109, 201, 204; his law that the relative motions of parts are not altered by the motion of the whole, i. 295.

Galton, F., ii. 288.
Galvanism, i. 206.
Gaudry's discoveries of "transitional forms" near Athens, ii. 41.
*Gemeinde*, ii. 216.
General terms, lack of, in barbarous languages, ii. 308.
Generation, spontaneous,—the question really at issue, i. 426.
Genesis, sciences of, i. 222.
*Gens* and γένος, ii. 216.
Geogeny, scope of, i. 220.
Geologic rhythms, enormous complexity of, i. 304.
Germ-theory, i. 420.
German language never purged of its realistic implications, i. 123.
Glacial epoch, date of, i. 304; ii. 295.
God, how far unknowable, i. 15; ii. 412, 470.
Goethe's discoveries in morphology, i. 113; his anecdote about the founding of St. Petersburg, i. 121; his interest in the controversy between Cuvier and Geoffroy Saint-Hilaire, ii. 3; his views concerning the quasi-humanity of God, ii. 409.
Gravity, cohesion, and chemism, i. 291.
Greek philosophy, i. 23, 43.
Gregariousness, origin of, ii. 341.
Grimm, J., his demonstration of the fetishistic origin of myths, i. 177.
Grove, W. R., i. 40, 203, 293.
Gustatory sensations, how compounded, ii. 128.

HABIT, dynamical explanation of, ii. 144.
Haeckel, E., i. 450; ii. 26, 397.
Hall, Sir James, produces artificial marble, i. 242.
Hamilton, Sir W., i. 78; his theory of causation, i. 148; his theory of the inverse variation of perception and sensation, ii. 114; his theory of pleasure and pain, ii. 327.
Hannibal, why powerless against Rome, ii. 262.
Harmonic tones, ii. 125.
Hartley, i. 117.
Harvey's discovery of the circulation of the blood, i. 113.
Hegel, i. 24, 43, 48, 52, 67, 77, 92, 99, 104; his theory of the identity of contradictories, i. 119; why he is so hard to understand, i. 120; his contempt for verification, i. 121; his preference for the Ptolemaic astronomy, i. 122; de-

nies the kinship between philosophy and common-sense, i. 124.
Heineccius, his definition of *status*, ii. 221.
Heliconias, ii. 26.
Hellenic political system, cause of its premature overthrow, ii. 218.
Helvetius, i. 118.
Hennell, Sara, ii. 503.
Herakleitos, his belief that the universe is in a ceaseless flux, i. 312.
Heredity as an element in the organization of experiences, ii. 149.
Heresy, its social value, ii. 272.
Herschel, Sir W., his theory of the constitution of nebulæ, i. 386.
Heterogeneity defined, i. 336.
Heterogeneity of society as checking warfare, ii. 251.
Hipparchos, i. 199.
Hipparion and its kindred, i. 452.
Hippokrates, i. 224.
Hobbes, i. 117, 121, 211; his conception of society as a Leviathan, ii. 226.
Holbach, i. 118.
Homesickness, ii. 328.
Homogeneity defined, i. 336.
Homogeneous, instability of, i. 353.
Horse, pedigree of, ii. 242.
Huggins, W., determines the proper motion of Sirius, i. 207; demonstrates the gaseous condition of irresolvable nebulæ, i. 386.
Humanity, religion of, ii. 417.
Humble-bees and red clover, i. 308.
Hume, i. 47, 86, 118, 127, 155.
Hunter, W. W., on religion of Santals, ii. 458.
Hutton, R. H., his misinterpretation of Mr. Spencer, ii. 339.
Huxley, T. H., i. 129, 164, 166, 175, 185, 227, 232, 247, 262; his classification of animals, i. 450; his remark about final causes, ii. 384.
Huyghens, his theory of light, i. 130.
Hybrids, infertility of, ii. 44.
Hydra, its ability to distinguish light from darkness, ii. 90.
Hygienic fallacies, i. 150.
Hypothesis, its requisites, i. 137, 266.

ICHTHYOSAURIANS and whales, ii. 58.
Iconoclasm as illustrating statical habit of thought, ii. 476.
Ideal types of manhood in ancient and modern times, ii. 207.
Idealism, i. 45, 74—90.
Ideas and sensations, ii. 111.
Ideational centres, ii. 137.
Identity of contradictories, how far true, i. 119.
*Ignes fatui*, fetishistic interpretation of, i. 197.
Ignorance consists in failure to classify, i. 31.
Immobile civilizations, explanation of, ii. 276.
Inconceivable, ambiguity of the word, i. 61; difference between inconceivable and incredible, i. 62.
Inconceivability-test, what is meant by it, i. 69; ii. 162.
Increase of plants and animals, high rate of, ii. 11.
Individuals, their influence in history, ii. 237.
Individuation, ii. 95, 223.
Induction, its weakness illustrated by Newton's discoveries, i. 266.
Infancy, origin of, ii. 159, 342; how the prolongation of it gave rise to society, ii. 344, 360, 369.
Infants, crying of, i. 104.
Infinite, the, i. 7, 13.
Inflexibility of mind in lower races, ii. 313.
Innate ideas, i. 46, 101, 115; ii. 161.
Inorganic physics, how divided by Comte, i. 192.
Insects, origin of, i. 345; their relations with flowers, ii. 28.
Instability of the homogeneous, i. 353.
Instinct, inheritance of, ii. 150; how distinguished from reflex action, ii. 152; how it merges into reason, ii. 154.
Integration defined, i. 336; degree of, an important test in classification, i. 347.
Intuitional knowledge, ii. 161.
Isolation, its effects upon social development, ii. 276.
Isomeric transformations in nerve-fibres, ii. 136.

JACOBINISM, origin of, ii. 476; tendency toward social dissolution, ii. 482.
Jaws, diminution of, ii. 320.
Jesuit missionaries in Paraguay, ii. 304.
Joule's discovery of the mechanical equivalent of heat, i. 34, 203.
Julian, ii. 490.
Jupiter, his physical condition, i. 377.
Juristic writers of the seventeenth century, ii. 280.

KANT, i. 24; asserted the relativity of knowledge, i. 48; his inconsistency, i. 52, 118; reconciliation of his philo

sophy with that of Locke and Hume, ii. 160, 326, 356; his remark about the moral sense, ii. 324.
Kepler, i. 107; his belief that the planetary motions were controlled by archangels, i. 110, 197.
Kirchhoff's discovery of spectrum-analysis, i. 207.
Knowing is classifying, i. 11, 27; ii. 106, 297.
Kowalewsky's discovery of the relationship between the ascidians and the amphioxus, i. 450.

Lagrange's principle of virtual velocities, i. 36, 40.
Lalande's inability to discover God with a telescope, ii. 422.
Lamarck's attempts at linear classification, i. 449; his theory of adaptive changes, ii. 6.
Languages, classification of, i. 443.
Lankester, E. R., ii. 95.
Laplace's discovery of the heat disengaged by sound, i. 206; his remark about Newton, i. 326; about final causes, ii. 383.
Lavoisier, i. 34, 199.
Law, universality of, i. 288.
Law and Lawgiver, ii. 392.
"Legal" stage of progress, ii. 240.
Leibnitz, i. 24, 46; his theory of Preestablished Harmony, i. 129, 158.
Lessing, i. 166.
Lewes, G. H., i. 18, 48, 50, 52, 58, 68, 125, 128, 141, 257, 456; ii. 75, 241, 415.
Liegnitz, battle of, ii. 263.
Life, genesis of, i. 430; definition of, ii. 67; identical with ability to maintain life, ii. 95.
Light, its relation to other modes of motion, i. 19, 292.
Likeness and equality, ii. 103; and unlikeness, ii. 119.
Lion, antelope, and buffalo, ii. 18.
Littré, E., his defence of Comte's originality, i. 228, 231; rejects Mr. Spencer's doctrine of the Unknowable, i. 82, 169, 262; his suggestion as to Comte's insanity, i. 141; on Free-will, ii. 179; on the function of Tradition in sociology, ii. 234.
Locality, sense of, ii. 300.
Locke, i. 46, 78; strength and weakness of his position, ii. 161.
Logic, its relations to mathematics, i. 215, 219; why omitted from Comte's list of sciences, i. 234.
Lombard, J., his experiments on heat evolved by the cerebrum, i. 415.
Lowe, Robert, his opinion of the battle of Marathon, ii. 260.
Loyalty, its function in early times, ii 266.
Lucretius and spontaneous generation, i. 418.
Lyell, Sir C., on increasing heterogeneity of environment, ii. 213.

Machinery, ancient and modern, ii. 207.
Magendie, i. 244.
Magnetism a mode of motion, i. 292.
Maine, Sir H., on the early constitution of society, ii. 209, 220; on conservatism in India, ii. 280.
Maistre, J. de, his retrograde doctrines, ii. 480.
*Mala prohibita* and *mala in se*, ii. 282, 357.
Malebranche, i. 24, 158.
Mammals, embryology of, i. 340; cross-relations among, ii. 50.
Mammoths in Siberia, i. 321.
Man, how affected by natural selection, ii. 258; genesis of, summary of the argument, ii. 358; all-important contrast, ii. 294; why he differs so much from the apes in intelligence and so little in structure, ii. 319; why he can never be supplanted by a higher race, ii. 321.
Manichæism, ii. 405.
Mansel, H. L., i. 9, 14, 25.
Marathon, battle of, ii. 261.
Marriage in primitive times, ii. 345.
Mars, his physical condition, i. 383.
Marsupials and placental mammals, ii. 50, 52.
Martineau, J., his theory of a "datum objective to God," ii. 405, 425.
Materialism utterly indefensible, ii. 79; ambiguous sense of the term, ii. 433; rejected by objective psychology, ii. 437; and by molecular physics, ii. 439.
Mathematics, i. 193, 200, 215, 219.
Matter, composition of, i. 3; how far known, i. 16; how cognized, i. 282; indestructibility of, i. 65, 280; primary qualities of, i. 78; action of matter on matter unthinkable, i. 5, 155; action of mind on matter, or of matter on mind unthinkable, i. 158; ii, 445.
Maudsley on the will, ii. 175.
Means of investigation more numerous

in the more complex sciences, i. 210, 243.
Mediæval philosophy, i. 24.
Meldrum, C., on the relation between sun-spots and rainfall, i. 406.
Memory, changes in, ii. 148; rise of, ii. 155.
Mental phenomena not identifiable with material phenomena, i. 352, 412.
Metamorphosis of energy, its wondrous significance, i. 416.
Metaphysics defined and criticized, i. 26, 95, 105, 126, 143, 176.
Meteorologic differentiations of earth's surface, i. 403.
Meteorology, i. 34, 190, 220.
Meteors, i. 11, 391.
Method of constructing a theory of the universe, i. 265.
Mice and humble-bees, i. 308.
Michelet, J., on the function of pain, ii. 462.
Military activity diminished with progress of civilization, ii. 247.
Military life as nourishing the altruistic feelings, ii. 205.
Military strength segregated into the most highly civilized communities, ii. 259.
Mill, James, i. 117, 221; ii. 82.
Mill, J. S., attacks Mr. Spencer's test of truth, i. 61; unwittingly contravenes the experience-theory, i. 67; ii. 162; his criticism of Comte's rejection of the objective method, i. 135; of Hamilton's view of causation, i. 148; his own view of causation, i. 150—154; refutes the volitional theory, i. 159—161; his illustration of the method of concomitant variations, i. 238; his obligations to Comte, i. 240; his remarks on biology, i. 245; his definition of Philosophy, i. 246; his opinion that the law of causation is an induction *per enumerationem simplicem*, i. 286; his remark about uniformity of law, i. 289; his estimate of the nebular hypothesis, i. 364; his suggestion that strongly marked individuality tends to disappear in modern times, ii. 267; his criticism of the Cartesian doctrine of causal resemblance, ii. 387; his remark about God's goodness, ii. 407; his view of the Religion of Humanity, ii. 417.
Mind not like a blank sheet, i. 46; ii. 151; can never be resolved into motions of matter, ii. 442; law of its composition, ii. 119; unit of, ii. 131; quantity of, correlated with quantity of brain, ii. 133.
Mineralogy, i. 189, 220, 225.
Miracles, ii. 379.
Missionary enterprises, why so often futile, ii. 142.
Mivart, St. George, his theory that Nature makes jumps, ii. 33; his objections to the Darwinian theory, ii. 50, 286; misinterprets Mr. Spencer, ii. 339; his view of the practical consequences of the Doctrine of Evolution, ii. 475, 506.
Modern communities overworked, ii. 335.
Modification of phenomena implies a certain amount of prevision, ii. 170.
Moleschott on thought and phosphorus, ii. 435.
Monodelphia, ii. 50.
Monotheism, i. 168.
Moon, its physical condition, i. 378; a type of the penultimate condition of all the planets, i. 392; speculations as to life upon it, i. 400; process by which its distance is determined, ii. 99.
Moral aspects of primitive society, ii. 346.
Moral government of the world, ii. 407.
Morality and religion, their association not arbitrary, ii. 453; distinction between, ii. 465.
Morphological testimony in favour of derivation, i. 459.
Moths and lighted candles, ii. 332.
Motion, transmission of, i. 6; how far known, i. 16; continuity of, i. 280; how cognized, i. 282; modes of, i. 290; direction of, i. 293; ii. 142; first law of, i. 294; how far to be regarded as eternal, ii. 391.
Multiplication of effects, i. 354.
"Musical residua" in old violins, ii. 143.
Musical sounds, constitution of, ii. 123.
Mythology, its kinship with metaphysics, i. 105, 143, 178; ii. 349.
"Myths and Myth-makers," i. 106, 178, 196; ii. 349.

NARCOSIS does not vary uniformly according to dose, i. 238.
Nationalities, doctrine of, ii. 269.
Natural laws and divine action, ii. 425.
"Natural reason" in jurisprudence, ii. 281.
Natural selection, ii. 3; not limited to slight changes, ii. 19; logical character of the theory, ii. 46; wherein modified by social conditions, ii. 258, 334; point

at which its action changes, ii. 295; overthrows the argument from design, ii. 397.
Nebulæ, constitution of, i. 386; distribution of, i. 388; analogy with comets, i. 389.
Nebular hypothesis, i. 248, 356—397.
Necessary truths, i. 24, 47, 52—60.
Negative evidence, i. 56.
Neptune, discovery of, i. 35; ii. 106; his retrograde rotation, i. 356, 365; formation of, i. 362.
Nerve-tissue, establishment of transit-lines in, ii. 145.
Nervous arc, ii. 151.
Nervous systems, genesis of, 146.
Newman, J. H., quoted, ii. 500.
Newton's theory of matter, i. 4; theory of gravitation, i. 12, 111, 113; theory of light, i. 130; his remark about metaphysics, i. 177; his law of the velocity of sound, i. 205; his discoveries illustrate the helplessness of simple induction, i. 266; ii. 192; his hypothesis of gravitation inconceivable if metaphysically interpreted, i. 272; greatness of his achievements, i. 326.
Nitrogen as a constituent of organic matter, i. 333.
*Nuance*, sense of, i. 29.
Nutritive and relational systems of organs, ii. 86.

Objective and subjective elements in cognition, how far separable, i. 50.
Objective method defined, i. 109.
Observation, i. 241.
Occasional causes, i. 24, 158.
Occult substrata demolished by Berkeley and Hume, i. 88.
*Occulta vis* in causation, i. 154.
Olfactory sensations, how compounded, ii. 128.
*Omne vivum ex vivo*, i. 419.
Organic matter, direction of motion in, ii. 144.
Oriental type of civilization, how it has originated, ii. 268.
Origin, proximate and ultimate, i. 248, 250.
Ornithodelphia, ii. 50.
Ovum of mammals, i. 340.
Owen, Richard, on final causes, ii. 384.

Pain, beneficence of, ii. 457.
Pains and pleasures, ii. 327.
Pangenesis, ii. 45.
Pan-Hellenism, ii. 205.
Panspermatism, i. 420.
Pantheism, i. 7; ii. 423.
Paracelsus, i. 419.
Paraguay Indians and Jesuits, ii. 304.
Parental feeling correlated with duration of infancy, ii. 343.
Parkman, F., ii. 247.
Parmenides of Plato, i. 23.
Patois, their tendency to disappear, ii. 34.
*Patria Potestas*, ii. 220.
Patriotism, ii. 205.
*Pax Romana*, ii. 206.
Pedigree of a hypothesis as a test of its value, i. 438.
*Pen* and *feather*, i. 446.
Pendulum, rhythm of, i. 299; Borda's experiment with, i. 237.
Perception implies recognition, ii. 107; simple and complex, ii. 112; how different from sensation, ii. 113; rise of, ii. 156.
Persistence of Force, i. 40, 283.
Personality incompatible with infinity, ii. 408.
Phenomena, definition of, i. 20.
Philip II., ii. 494; why a fit subject for moral disapprobation, ii. 183.
Philosophy distinguished from science, i. 39—44.
Phosphorus and thought, ii. 436.
Phrenology, ii. 74, 135.
Physics, when constituted as a science, i. 199, 202; how divided, i. 203; the science of experiment, i. 243; ancient and modern meaning of the word, i. 279.
Physiological units, ii. 45.
Physiology, wherein different from psychology, ii. 76.
Planaria, its eye-spot, ii. 90.
Planes of revolution of asteroids not yet accounted for, i. 372.
Planetary motions, i. 12; ancient theory of, i. 107; supposed to be controlled by archangels, i. 110, 197; great complexity of, i. 295; rhythm of, 303; gradual retardation of, i. 394.
Planets, sizes of, i. 366; physical condition of, i. 376; their ultimate fate, i. 395.
Plants, their growth dependent on solar energy, i. 408.
Plateau's experiment in illustration of the nebular hypothesis, i. 363.
Plato, i. 23, 99, 102; his theory of reminiscence, i. 100; compared with Comte, i. 103, 139; on final causes, ii. 405.
Pleasures and pains, ii. 327; why noxious

actions are sometimes pleasurable, ii. 333.
Polarity, i. 290; physiological, ii. 57.
Political economy, a deductive science, i 113.
Polytheism, i. 168.
Positive Polity, utter failure of, ii. 489; its retrograde character, ii. 494.
Positivism, its relations with idealism, i. 74—83; an impracticable philosophy, i. 175; current disposition to identify all scientific philosophy with it, i. 255; five fundamental propositions of, i. 257; antagonistic to Cosmism, i. 93, 94, 145, 175, 184, 263.
*Post hoc ergo propter hoc*, i. 150.
Power, our notion of, whence derived, i. 156.
Prayer cannot ward off the effects of wrong-doing, ii. 464.
Precession, i. 303.
Prediction in science, i. 33.
Pre-established Harmony, i. 24, 129, 158.
Preformation, theory of, i. 456.
Prehension and intelligence, ii. 309.
Prevision, quantitative and qualitative, i. 33; in sociology, ii. 169.
Primitive men, their unprogressiveness, ii. 291.
Primitive religion, ii. 458.
Primitive state of high civilization, theory of, ii. 264.
Proctor, R., i. 374, 378, 380.
Progress, habitually misunderstood, ii. 193; not universal, ii. 195, 255; yet still the prime phenomenon to be investigated, ii. 196; factors of, ii. 197; its fundamental characteristic, ii. 201; its root in the exercise of the conjugal and parental feelings, ii. 203; determined by increasing heterogeneity of environment, ii. 213; why more rapid in modern than in ancient times, ii. 214; law of, ii. 223; Comte's theory of, ii. 240; moral and intellectual elements in, ii. 241; why some people do not advance, ii. 256—283; inconspicuous in lower races of men, ii. 289.
Proklos, his divine light, i. 23, 125.
Protective spirit, ii. 231.
Protists, Haeckel's Kingdom of, i. 450.
Providence, mediæval notion of, ii. 381.
Psychical phenomena can never be resolved into motions of matter, ii. 442.
Psychical states built up out of subpsychical states, ii. 123; cohere less strongly as they increase in complexity, ii. 153.
Psychogeny, i. 221.
Psychology, rejected by Comte, i. 194; twofold division of, i. 221; wherein different from biology, ii. 76; problem of, ii. 78; its claims to rank as a primary science, ii. 80; its dependence on biology, ii. 82.
Pterodactyl and birds, ii. 51—53.
Punic wars compared with the war of secession, ii. 249.
Pyrrhonism, i. 23.

RAINBOWS, why explained before comets, i. 210.
Realism, i. 67.
Reason, how evolved from instinct, i. 154.
Reasoning involves classification, i. 31; ii. 106; quantitative and qualitative, ii. 102.
Reconciliation between Kant and Hume, i. 72, 149; ii. 160.
Redi, his panegyric on wine, i. 412; his experiments on decaying meat, i. 419.
Reflex action, ii. 149.
Reid, i. 77—79.
Relational and nutritive systems of organs, ii. 86.
Relations, equality of, ii. 100; of animals in time, i 452.
Relative truth, criterion of, i. 71.
Relativity, canon of, i. 10; full meaning of the doctrine, i. 91.
Religion not antagonistic to science, i. 184; its relations to morality, ii. 357, 465; of Humanity, how reached by Comte, i. 261; ii. 417.
Religions of antiquity, their function, ii. 266.
Repentance cannot ward off punishment, ii. 455.
Representativeness, its importance as an intellectual faculty, ii. 312.
Retina, structure of, ii. 62.
Reversion of domesticated animals toward wild type, ii. 13.
Revolution of 1789, ii. 480.
Rhythm of motion, i. 297—313.
Right and wrong, how different from pleasure and pain, ii. 337.
Ring of the asteroids perturbed by Jupiter, i. 370.
Rings detached from solar nebula, i. 361; hoop-shaped and quoit-shaped, i. 365.
Robespierre, ii. 482, 485.
Roman church, grandeur of its work, ii. 219.

Rome, significance of its rule, ii. 206, 215, 218.
Rotifera as illustrating dependence of vitality on moisture, i. 334.
Rousseau, J. J., his theory of a primitive contract, ii. 221; his anarchical doctrines, ii. 479.
Rudimentary organs, i. 455.

Saemann's theory of the disappearance of the lunar air and water, i. 381.
Sahara, effects of its submergence, 404.
Saint-Simon, wherein different from Comte, i. 260.
Sainte-Beuve, i. 29.
Sanctions for morality furnished by religious systems, ii. 454.
Santals, religion of, ii. 458.
Satanic presence in nature, ii. 458.
Satellites, distribution of, i. 374.
Saturation and substitution, i. 225.
Saturn, eclipses caused by his rings, i. 375; why he has rings, i. 376; his physical condition, i. 378.
Savages, their want of foresight, ii. 247, 303; moral condition of, ii. 350.
Scales and lever, i. 36.
Scepticism, i. 45, 86; its function, ii. 229, 411.
Schelling, i. 48, 52, 77, 99; his theory of "intellectual intuition," i. 124.
Scherer, E., ii. 383.
Schlegel, A. W., his hypothesis of word-budding, i. 66.
Scholastic philosophy, its great value, i. 123.
Schopenhauer, A., on Hegel, i. 124.
Science and common knowledge, i. 27—38; ii. 297; enormous progress of since 1830, i. 229, 251; originated in mythology, i. 177.
Sciences, Comte's classification of, i. 189—215; cannot be arranged in a linear series, i. 208; conditions which determine their relative progress, i. 209—212; Mr. Spencer's triple division of, i. 215; tabular view of, i. 219; device for representing their relative rates of progress, i. 223.
Secession, war of, compared with Punic wars, ii. 249.
Segregation as a consequence of the persistence of force, i. 355.
Selection, ii. 9.
Self-creation, i. 7.
Self-existence, i. 7.
Self-regarding virtues, ii. 357.
Sensation, how different from perception, ii. 113; peripherally or centrally initiated, ii. 116; relativity of, i. 17, 18.
Sensations and ideas, ii. 111.
Sense-organs differentiated from dermal structures, ii. 89.
Sequences which are not causal, i. 151.
Servetus, i. 65.
Sexual selection, ii. 27.
Shaler, N. S., his theory of the rattlesnake's rattle, ii. 28.
Shark, brain of, ii. 133.
Shells in England and the Mediterranean, ii. 55.
Siberian fungus, its psychical effects, i. 414.
Siberian mammoths, i. 321.
Sidereal astronomy, why condemned by Comte, i. 260.
Silurian rocks not strictly palæozoic, ii. 38.
Similarity and dissimilarity, ii. 118.
Sin, divine judgment on, i. 199; scientific doctrine of, ii. 455; anthropomorphic doctrine of, as yet the most useful, ii. 470.
Sizes of planets, i. 366.
Sleep, physiological explanation of, i. 306.
Smith, Adam, i. 113; his remark about a god of Weight, i. 195; his principle of division of labour, i. 207.
Smith, Goldwin, on the science of history, ii. 172.
Social environment, ii. 197; rapid change of, in recent times, ii. 335.
Social evolution, definition of, ii. 223; closely akin to organic evolution, ii. 225; prerequisites to the discovery of the law of, ii. 233; opens a new chapter in the history of the world, ii. 293; connected with representativeness, ii. 315; origin of, ii. 340—363.
Sociality and gregariousness, ii. 341.
Society, morphological development of, ii. 215.
Sociogeny, i. 222.
Sociology a concrete science, i. 213; prevision in, ii. 169; great difficulty of the study, ii. 191; position of the science, ii. 198.
Solar energy, how transformed on the earth, i. 407.
Solar nebula, its primitive rotation, i. 360; its original shape, i. 361, 389.
Solar ray, composition of, i. 19.
Solar spots, scouted at by Aristotelians, i. 110.
Solidity of matter, i. 3, 373.
Sounds, constitution of, ii. 123.
Spallanzani and the germ-theory, i. 420.
Special-creation hypothesis, i. 440.

Specialists, narrowness of, i. 241.
Species, bifurcation of, ii. 18.
Spectrum-analysis, i. 202, 207, 249; its latest indications, i. 388; enables us to measure the direct approach or recession of a star, i. 487.
Spencer, Herbert, his greatness as a psychologist, i. 163; his refutation of the theory of the "Three Stages," i. 173; his refutation of the Comtean classification, i. 204; his distinction between abstractness and generality, i. 214; his triple division of sciences, i. 216; his opinion of Comte's speculations, i. 227; comparison of his achievements with Newton's, i. 326, 351; his explanation of the retrograde rotation of Uranus, i. 365; his hypothesis regarding the asteroids, i. 370; his theory of the distribution of nebulæ, i. 388; on the functions of cerebrum and cerebellum, ii. 138; on the genesis of nervous systems, ii. 146; "Ideas do not govern the world," ii. 242; emendation of his phrase "nervous shock," ii. 444; his refutation of materialism, ii. 446; description of the state of society toward which we are progressing, ii. 495.
Spinoza, i. 24; erroneousness of his method, i. 116; produced a crisis in philosophy, i. 117; on the personality of God, ii. 409.
Spirit, ii. 395, 449.
Spirits in pharmacy, i. 197.
"Spiritualism," superstition of, ii. 379.
Spontaneous generation, i. 129, 243.
Stahl, i. 127, 419.
Statical and dynamical habits of thought, ii. 371, 473.
*Status* and contract, ii. 221.
Stimulus, metaphysical doctrine of, i. 197; dynamically defined, i. 412.
Stewart, Balfour, i. 395.
Struggle for life, ii. 12.
Struthious birds, ii. 67.
Subjective method defined, i. 98.
Subsidence and elevation, ii. 39.
Sun, source of his heat, i. 359; must ultimately become cold, i. 392.
Sun-spots and rain-fall, i. 406.
Sympathetic nerve, its action on the bloodvessels, i. 306.
Sympathy, ii. 352.

Tactile sensations, how compounded, ii. 129.
Tactual sense, in man and lobster, i. 17.
Taine, H. A., ii. 123.
*Tear* and *larme*, i. 446.
Teleological hypothesis, its logical weakness, ii. 385; overthrown by the discovery of natural selection, ii. 397; origin of, ii. 399.
Tennyson, ii. 85, 462.
Theism, i. 7; does not necessarily imply personality of God, ii. 424.
"Theological," sometimes unfortunately used by Comte, i. 196.
Thermodynamics, i. 34.
Thought and phosphorus, ii. 436; wherein dependent on solar radiations, i. 413.
Three stages, Comte's theory of, i. 168; ii. 238, 245, 478.
Tides, rhythm of, i, 305; checking planetary rotation, i. 359, 393.
Timaios of Plato, i. 102.
*Timbre*, or quality of sound, source of, ii. 125.
Torricelli's discovery of atmospheric pressure, i. 209.
Toxodon, ii. 41.
Transit-lines in brain, ii. 139.
Transitional forms, alleged paucity of, ii. 33.
Transubstantiation and transaccidentation, i. 123.
Trees in Europe and America, ii. 55.
Truth, test of, i. 11, 45—71, 286; ii. 162; definition of, i. 45; ii. 246; does not apply where experience is transcended, i. 11; ii. 391.

Undulation, how necessitated, i. 300.
Undulatory theory of light, i. 300.
Unembodied spirit, ii. 395.
Uniformity of belief and practice, its dangers, ii. 273.
Unit of mind, ii. 131.
Universal proposition inferred from single instance, i. 55.
Universe, origin of, i. 6; how far unknowable, i. 15; ii. 413.
Unknowable, doctrine of, rejected by Positivism, i 82. 169, 262; misunderstandings to which the term has given rise, ii. 469.
Uranus, his retrograde rotation, i. 356, 365.
Use and disuse, ii. 17.

Verification, i. 108, 127.
Vibration of particles, i. 20, 47.
Vibrissæ, ii. 90.
Vico's theory of cycles, i. 310.

Violins, why they become mellow with age, ii. 143.
Virgil and spontaneous generation, i. 418.
Virtual velocities, i. 36, 40.
Visual perception not originally cognizant of distance, ii. 108.
Visual sensations, how compounded, ii. 127.
Vision and touch, ii. 90; range of, in savages and civilized men, ii. 299.
Vital Principle, i. 127, 197, 422.
Volition, rise of, ii. 156; definition of, ii. 177; theory of the lawlessness of, i. 198; ii. 180.
Voltaire's Micromégas, i. 81.
Von Baer, i. 40, 208, 342.

WAGNER, Moritz, his testimony in favour of the derivation theory, i. 463.
Wallace, A. R., on natural selection, ii. 5; his brilliant theory of the action of natural selection on man, ii. 318; his experience with an infant orang-outang, ii. 343.
Warfare, its tendency to disappear, ii. 247.
Waste and repair in brain, ii. 140.
Water unchanged in its passage through the animal organism, i. 410.
Whales and ichthyosaurians, ii. 58.
Whately, R., ii. 193.
Whewell, W., on final causes, ii. 384.
Will, freedom of, i. 54, 198; ii. 173.
Winslow, Forbes, ii. 20.
Witchcraft, belief in, ii. 379.
Wollaston obtained crystals of quartz, i. 242.
Worship, its object not the known out the unknown, ii. 420.
Wright, Chauncey, i. 105.
Wrought-iron rendered crystalline by vibration, i. 330.
Wyrouboff on the scope of geology, i 200.

YOUNG, Thomas, i. 130.

ZOOLOGY, as related to biology, i. 272.