A FEW WORDS
ON
EVOLUTION AND CREATION
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EVOLUTION

AND

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A FEW WORDS

ON

EVOLUTION AND CREATION

A THESIS

MAINTAINING

THAT THE WORLD WAS NOT MADE OF MATTER
BY THE DEVELOPMENT OF ONE POTENCY,
BUT BY THAT OF INNUMERABLE
SPECIFIC POWERS

BY

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LONDON

JOHN LENG & CO., 186 FLEET STREET
AND 7 BANK STREET, DUNDEE

1882

P R E F A C E.

THE doctrine of Evolution has become, as it were, a fashion in the literary world ; so much so, that it is no uncommon topic even in after-dinner talk : and all who do not conform thereto are ridiculed for still entertaining antiquated notions. I am fully aware that in opposing this doctrine, which has been adopted by many eminent Professors, I lay myself open to the charge of great presumption ; and justly so, if I objected to their science : the point at issue between us is not, however, a scientific, but a philosophical question, which they candidly admit has not as yet been fully answered.

It is a curious coincidence that both the ancient and modern doctrines of the Evolution of all things from matter have run the same course of opposition to the established theism of their

respective times. Unhappily the controversy between modern Theologians and Evolutionists, in Germany as well as in this country, has been conducted with great acrimony ; and, as is common in such cases, with more zeal than discretion, which has betrayed both parties into errors of judgment. And as the title of my book may lead some to think that I am also about to engage in this strife, I avail myself of this occasion to state that the subject of Creation will be studiously avoided until the doctrine of Evolution, in its relation to science and philosophy, has been discussed : and then, and not till then, I will have recourse to Divine revelation to obtain a knowledge of the origin of things, which man has in vain sought for in his investigations of Nature.

Many may be of opinion that it would have been better if I had altogether omitted the subject of Creation ; but, if they will peruse the following pages, they will find that it is an essential part of my work : for the doctrine of Natural Powers, which I am about to advocate, legitimately leads up from man, the highest power of the material world, to the great First Cause, the Supreme Power

of the Universe. In setting forth this doctrine, and contrasting it with that of Evolution, the reader will meet with much repetition, which could not well be dispensed with, as it is requisite to keep him in mind of its peculiar views ; but in the case of Evolution this is not needed, as its principles are well understood.

For a quarter of a century I have watched the progress of science, and observed its bearing on my hypothesis concerning the constitution of Nature ; and that I have been well satisfied with the result may be owing to a bias in favour of my hobby ; for to be thus biassed is a common failing of the mind ; so true it is, that

Philosophers whene'er they find
• Some fav'rite system to their mind,
In ev'ry point to make it fit,
Will force all Nature to submit.

In order to ascertain whether my judgment has been so warped, I now submit my doctrine to public criticism, in the hope that it may be impartially considered.

Among the various topics which were discussed by the Church Congress, lately held at Derby, the

relation between "Science and Faith" was the subject of several able addresses. And since the clergy are now disposed to take a dispassionate and reasonable view of the opinions of scientists, I would fain hope that my Doctrine of Powers may be acceptable, as it maintains that the reason that underlies all the works of Nature is the Divine design on which the world was created.

SEAFIELD HOUSE, MAGDALEN PLACE,
DUNDEE, *September* 1882.

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ERRATA.

- Page 26—12 lines from top—for *latter* read *former* state.
,, 115—In the bottom line—for *functions* read *faculties*.
,, 145—2 lines from top-- before *species* insert *fossil*.
,, 260—8 lines from bottom--before *phenomena* insert *physical*.

Homo, naturæ minister et interpret, tantum facit et intelligit, quantum, de naturæ ordine, re vel mente observaverit ; nec amplius scit, aut potest. . . . Scientia et potentia humana in idem coincidunt, quia ignoratio causæ destituit effectum. Natura enim non nisi parendo vincitur : et quod in contemplatione instar causæ est ; id in operatione instar regulæ est. . . . Via nostrâ et ratio (ut sæpe perspicue diximus) ea est ; ut non opera ex operibus, sive experimenta ex experimentis (ut empirici) sed ex operibus et experimentis causas et axiomata, atque ex causis et axiomatibus rursus nova opera et experimenta (ut legitimi naturæ interpret) extrahamus.

—Bacon, Nov. Org. Lib. 1., Aph. i., iii. et cxvii.

EVOLUTION AND CREATION.

CHAPTER I.

Introductory Remarks—Explanatory and Critical.

Evolution an ancient Speculation.—2. Its Claim to a Scientific Basis.—3. Reasons for not accepting this Doctrine.—4. It is still an open Question.—5. The Doctrines of Evolution and Potent Causation defined.—6. Definitions of Science and Philosophy.—7. The Meaning of the words Force and Power.—8. Grove on the Physical Forces.—9. And on their mutual Convertibility. —10. The Correlation of Powers. —11. The Analogy of Physical and Social Laws.—12. Conclusion.

THE origin of all things from Matter is one of the oldest speculations on record; it is one of the many intellectual conceptions of the ancient Greek philosophers, which has survived until the present time. During its descent to us, it has undergone various transformations corresponding with the progress of natural knowledge; and now, in our day, it has assumed the form of the doctrine of Evolution, which is said to be a better speculation than any of its predecessors, "because it is grounded on exact and verified research."

2. The advocates of Evolution are so confident that their doctrine is a true interpretation of natural phenomena

that they do not hesitate to assert that it is no longer a speculation but a fact. They are not, however, justified, I think, in making such an assertion; for this doctrine is "grounded on the assumption of an all-becoming potency of matter," which, to say the least, is very questionable: and most certainly it is not based on any principle inductively arrived at, and verified by scientific research; and lacking such a foundation the assumption is not philosophical. "Pure reason," as the late Baden Powell* justly observed, "out of its own resources may create theories apart from all observation of Nature; but to make them applicable to anything in Nature, such creations of the mind must involve some *small* assumption of material properties or mechanical conditions, which can only be, in some form or another, ultimately derived from observation: what is borrowed may be *very little*, but it must be something; and it is a point of interesting research to the philosopher to endeavour to ascend to the fewest and simplest possible of such principles." Evolutionists profess to have attained such a principle in the potency of matter; in this, however, they seem to be inconsistent, for they repudiate, with utter scorn, the idea of potencies and forces as the activities of Nature: moreover, no such matter is known to exist; the only matter that we do know has solely the physical properties of attraction and repulsion.

3. It is not surprising that the doctrine of Evolution has been so generally accepted as the legitimate outcome of

* Essay on the Spirit of Inductive Philosophy, p. 35.

science, since it has been zealously advocated by many eminent Professors, who have pleaded their cause with such fascinating eloquence, accompanied with such a profusion of experimental illustration, as is rarely to be met with in learned discourses. This doctrine, however, has been opposed by several men of note in the scientific world, who have adduced good reasons for their dissent; and since all their efforts to arrest its progress have been of little avail, any further attempt to do so may be deemed to be labour in vain; and may also be regarded as a presumptuous undertaking. My apology for entering on such a forlorn hope is, that I have some arguments to advance against this doctrine, which are different from those which have been hitherto brought forward against it; but if this were all that I had to say, I would not have trespassed upon public attention. I am desirous of pointing out that my doctrine of Powers, which was published twenty years ago,* seems to afford a better solution of the constitution of Nature than that of Evolution: and should it, on examination, prove to be so, it would be of more avail than anything that has been hitherto advanced. "There is," says G. H. Lewes,† "but one effective mode of displacing an error, and that is to replace it by a conception which, while readily adjusting itself to conceptions firmly held on other points, is seen to explain facts more completely." Both doctrines are philosophical speculations; which of the two is the better depends on its giving a

* *The Philosophy of Nature.* Longman. 1860.

† *Problems of Life and Mind*, vol. i., p. 7.

more rational explanation of natural phenomena; and it is the object of the following pages to subject them to this test: a test to which there can be no objection, for as Professor Haeckel,* the great German Evolutionist, remarks, "Nothing is more helpful for the understanding of scientific controversies than a contrasted statement, as definite and clear as possible, of the leading propositions of the contending doctrines."

4. I do not expect that my view of Nature will receive from Evolutionists a patient and unbiased hearing; but I am sanguine that many intelligent persons may be disposed to give it an attentive consideration; and in order to aid them in so doing, I purpose giving, in passing, the meaning of terms and other explanations. And as some of my readers may not be aware that Evolution is far from being an established doctrine, I will quote a few passages to show that it confessedly has not as yet fully solved its problem.

In his presidential address to the British Association at Exeter, Professor Stokes† stated two of the difficulties which beset Evolution. "Admitting to the full, as highly probable though not completely demonstrated, the applicability to living beings of the laws which have been ascertained with reference to dead matter, I feel constrained at the same time to admit the existence of a mysterious *something* lying beyond, a something *sui generis*, which I regard, not as balancing and suspending the ordinary

* Freedom in Science and Teaching, p. 1.

† As quoted in "The Unseen Universe," p. 184.

physical laws, but as working with them and through them to the attainment of a designed end. What this *something*, which we call life, may be, is a profound mystery. . . . When from the phenomena of life we pass to those of mind, we enter a region still more profoundly mysterious. . . . Science can be expected to do but little to help us here, since the instrument of research is itself the object of investigation.” “As a unifying generalization,” says James Solly,* “the doctrine of Evolution is clearly limited by the fact of the correlation of mental and physical phenomena. These two regions may seem to manifest the same law, yet they cannot be identified. All the laws of Evolution can never help us to understand the first genesis of mind. . . . The mental sequence is unlike any physical succession, and so cannot be further explained by being brought under a more general law. Even if this huge difficulty of the genesis of mind be got over, there still remain limits to the explanation effected by the doctrine of Evolution.” And to the same purport Professor Tyndall† testifies that, “Associated with the wonderful mechanism of the animal body, we have phenomena no less certain than those of physics; but between which we discern no necessary connection. A man, for example, can say I feel, I think; but how does consciousness infuse itself into the problem? . . . The passage from the physics of the brain to the

* *Encyclopædia Britannica*. Ninth Edition. Vol. viii., p. 770—
Evolution.

† *Fragments of Science*. Sixth Edition. Vol. ii., pp. 75 and 76.

corresponding facts of consciousness is inconceivable as a result of mechanics. How these processes are connected is an insoluble problem. The chasm between the two classes of phenomena remains intellectually impassable."

The latter statements are those of zealous Evolutionists, who admit that their doctrine cannot completely solve the problem, which it professes to have demonstrated: it is therefore an open question for others to attempt the explanation of the development of the natural world; and I hope, in the sequel, to show that the chasm, which Evolutionists have found to be impassable, is easily bridged over by my doctrine of vital powers.

5. Before proceeding further, it may be well to define the nature of the doctrines that are to be contrasted in the following pages. "The Evolution-hypothesis," says Professor Haeckel, "in its widest sense as a philosophy of the universe, assumes that a vast, uniform, and uninterrupted process of development obtains throughout Nature; that all natural phenomena without exception—from the motion of the heavenly bodies to the fall of a stone, from the growth of plants to the consciousness of man—obey one and the same great law of causation; for all may be ultimately referred to the mechanism of atoms." "The most general meaning of Evolution," says James Solly, "may be defined as follows. It includes all theories respecting the origin and order of the world; it regards the higher or more complex forms of existence as following and depending on the lower or simpler forms, a gradual transition from the uniform to the varied; and it assumes the cause of this process to be immanent in the world

itself that is thus transformed. The hypothesis of Evolution aims at answering a number of questions respecting the becoming or genesis of things." Professor Huxley* sets forth, in his "Essay on the Genealogy of Animals," that "The fundamental doctrine of Evolution is, that the whole world, living and not living, is the result of the mutual interaction, according to definite laws, of the forces possessed by the molecules of which the primitive nebulousity of the universe is composed. And if this be true, it is no less certain that the existing world lay potentially in the cosmic vapour."

On the other hand, according to my "Philosophy of Nature," all natural things—matter, chemical elements, and living organisms—are compounds of two or more powers, which, by their interaction according to their respective laws, produce physical, chemical, and vital phenomena. So that the relation subsisting between powers and phenomena is that of cause and effect: and accordingly I call my hypothesis the doctrine of Potent Causation, in order to distinguish it from the modern doctrine of Sequent Causation.

6. Several terms have already occurred which have more than one meaning; and as they will hereafter confront us at every turn, it will not be a needless preliminary to say a few words about them, as thereby interruptions will be avoided; and another good purpose will be answered, as it will afford me occasion for stating why I dissent from some philosophical assumptions which

* As quoted in Dr Elam's "Winds of Doctrine," p. 40.

have been adopted by modern science in the explanation of phenomena. It is needful to note the difference between the terms Science and Philosophy, which are so blended together in scientific subjects, that the uninitiated are apt to regard the whole as related to Science.

Science only treats of natural phenomena—the appearance of things—under the two heads of statics and dynamics, that is, of things at rest or in motion. Natural History comes under the former head; it investigates the likeness of things, arranging like with like as groups of various degrees, till they are ultimately classified into a System of Nature. Dynamic Science, on the other hand, treats of the changes which things undergo, as manifested by three kinds of phenomena—the physical, chemical, and vital—which respectively form the subject of Physics, Chemistry, and Biology. “Science assumes,” says T. H. Herbert,* “that material phenomena are material objects; and all goes well, and is self-consistent, so long as it keeps within the bounds of this assumption: but when it trenches beyond this limit, and affirms that the same holds good outside as well as within this limitation, then it is inconsistent with itself, for it no longer treats of Science, but of Philosophy.”

The province of Philosophy, on the other hand, is of a totally different character: it does not deal with things as they appear to the senses, but as they are discerned by the intellect of the mind; and thus we obtain a knowledge of things as they *are*, that is, of the realities that underlie

*The Realistic Assumptions of Modern Science, p. 452.

the phenomena of Nature. Imagination is the handmaid of Philosophy; "not that play of the fancy," as Professor Tyndall* justly remarks, "which can give to airy nothings a local habitation and a name, but that power which enables the mind to conceive realities, which lie beyond the range of the senses." I have quoted this passage because it affords me a justification of much that I have to say concerning the unseen realities of Nature. A true Philosophy must be founded on the ultimate facts of Science; it is, as it were, a science of the sciences, an interpreter of the reason in Nature, and aims at attaining a systematic knowledge of all her realities, "the *veræ causæ* of phenomena."

7. The word force, as commonly used, has two meanings; it may signify the act of working, or the agent by which the work is performed: nature, life, and many other words are in the same case, owing to a want of sufficient copiousness in our language. This metonymy does not prove to be a serious defect in ordinary intercourse, as the context makes the sense of these words obvious: but in scientific discourses the twofold meaning of words occasions much confusion, which makes it very desirable that every term should have a definite meaning. The word force is used by some as if it were merely an abstract dynamical expression of the sequence of phenomena; and yet they frequently use this word in such a manner as to imply that it is an agent efficiently engaged in their production. The double meaning of force not unaptly represents the

* Fragments of Science, vol. i., p. 76.

difference which subsists between the advocates of the old and modern science. Lately the word has been superseded by that of energy, which is, indeed, preferable; for force expressly denotes only the physical activity concerned in the motion of bodies, but it does not indicate the activity that is concerned in combination and organization. The words force and energy do not convey the sense in which I use them, viz., as the expression of the state of powers, when they put forth their force or energise. Powers are capable of being at one time active or dynamic, and at another passive or statical; but force and energy only occur in the latter state, when powers are visibly efficient: it is in this sense that the word force was used by Sir John Herschel, Whewell, and others; and thus Faraday says,* “What I mean by the word force is the *cause* of physical action, the source or sources of all possible changes amongst the particles or materials of the universe.” From the Evolutionist’s point of view, this idea of natural powers, as the *cause* of phenomena, will seem to be absurdly ridiculous: *sed risum teneatis, amici*; and withhold passing judgment until you have heard all that I have to say in support of this doctrine.

8. Having taken a general view of the points at issue, this subject must now be considered more in detail: and for this purpose I will select a few passages from Sir W. R. Grove’s standard work on the Physical Forces, as this will enable me to contrast our respective views; and in my remarks thereon I will retain his word “force,” but in

* Experimental Researches, p. 460.

order to keep my readers in mind of the sense in which I use this word, I will occasionally insert in brackets, immediately after it, the words "*dynamic power*," that is, power in a state of energy. "The term force," says Grove,* "although used in very different senses by different authors, in its limited sense may be defined as that which produces or resists motion. . . . I use the term force as meaning that active principle inseparable from matter, which is supposed to induce various changes. The word *force*, and the idea it aims at expressing, might be objected to by the physical philosopher on similar grounds to those which apply to the word *cause*; as it represents a subtile mental conception, and not a sensuous perception or phenomenon."

The definition of force, above given, says as plainly as words can, that it is a principle of activity capable of putting bodies in motion: and if force [dynamic power] can do this, it is evidently the cause of the phenomenon. Grove was perfectly aware that such an objection might be raised, and he meets it in the following manner.

"Though the term force," he says,† "has a potential meaning, to depart from which would render language unintelligible, we must guard against supposing that we know more of phenomena by saying they are produced by something, which something is only a word derived from the constancy and similarity of the phenomenon we seek to explain by it. . . . No further insight into

* *The Correlation of Physical Forces.* Third Edition, p. 16.

† *Ibid.* p. 18.

why an apple falls is acquired by saying it is forced to fall, or it falls by the force of gravitation : by the latter expression we are able to relate it most usefully to other phenomena ; but we still know no more of the particular phenomenon than that under certain circumstances the apple does fall."

If this, indeed, be all that can be known of the phenomenon, common sense, in this case, is on a par with Science ; for an unlearned person knows, by practical experience, that under certain circumstances—such as the apple being ripe, or shaken from the tree—it will fall to the ground. Science can surely give a more satisfactory explanation of this fact ; for it teaches us that *gravity* is a force, ever drawing or tending to draw all things toward the centre of the earth : consequently the apple, suspended on the tree, is continually under its influence, so that when free to move it will be forcibly drawn down to the ground. This simple fact clearly indicates a well-marked difference between force [dynamic power] and motion ; the one being the cause of motion, and the other the effect of force : and it also shows that the fall of the apple was not the effect of an antecedent motion ; for the apple prior thereto was in a state of rest. Grove cautions us against supposing that force, though it has a potential meaning, is the something by which the phenomenon was produced. Why was such a caution given ? It was because the usual signification of force is inconsistent with the modern doctrine of sequent causation, an unverified speculation, on which scientists found their explanation of many phenomena. In the sequel it will be seen that other old

terms have been similarly treated by Evolutionists ; but they cannot avoid using them, so firmly are they rooted in the mind as the true expression of the things signified. Thus confirming the words of an ancient sage,

Naturam expellas furcâ, sed tamen usque recurret.

9. The doctrine of the mutual convertibility of natural forces has also been adopted by Evolutionists, and relied on as affording strong evidence in support of their hypothesis : but I hope to show that its validity is very questionable. “The position which I seek to establish,” says Grove,* “is that the various affections of matter, which constitute the main objects of experimental physics, viz., heat, light, electricity, magnetism, chemical affinity and motion, are all correlatives, or have reciprocal dependence : that neither, taken abstractedly, can be said to be the essential cause of the others, but that either may produce or be convertible into any of the others ; thus heat may, mediately or immediately, produce electricity, and electricity may produce heat ; and so of the rest, each merging itself as the force it produces becomes developed. And the same must hold good of other forces ; it being an irresistible inference from observed phenomena that a force cannot originate otherwise than by devolution from some pre-existing force or forces.”

If the mutual convertibility of forces has been *correctly* inferred from observed phenomena, then, of course, the conclusion drawn from this premiss is irresistible ; but I

* Idem, p. 15.

do not think that this has been accomplished. "Heat may, mediately or immediately, produce electricity," and *vice versa*; but this is not a case of the mutual convertibility of different kinds of forces, for heat and electricity are only different modes of the physical power, repulsion, which assumes one or other of these modes according to the condition of the molecular body on which it acts, as hereafter will be more fully detailed. It is very remarkable that about half of Grove's Essay treats only of heat, electricity, and motion; and only a twelfth part is given to gravitation, cohesion, and magnetism: and of this small portion, gravitating force, which is more accurately known than any other force, only occupies a few sentences. Such a treatment of the modes of the physical power, *attraction*, indicates that they do not belong to the same category as the modes of the physical power, *repulsion*: and such a distinctly marked difference ought not to have been so lightly passed over. On my view of the subject, the physical power, attraction, when it acts on different media—atoms, molecules, or masses—assumes the various forms of centripetal force, cohesion, and magnetism; and so likewise, under similar circumstances, the physical power, repulsion, assumes the forms or modes of centrifugal force, heat, and electricity. So that heat and electricity acting on molecular bodies, in a condition suitable for the change, may mutually assume the mode of the other. I admit, therefore, that there is some truth in Grove's theory, but not the whole truth; it holds good, under certain conditions, between the modes of each kind of physical power; but not between the modes of the correlative

powers, attraction and repulsion, which as antagonists inseparably co-exist in every physical phenomenon.

10. Such a true correlation of physical powers did not escape Grove's attention. "To many of the cases," he says,* "which we have been considering, the term *correlation* may be applied in more strict accordance with its original sense. Thus in regard to the forces of electricity and magnetism in a dynamic state; we cannot electrify a substance without magnetising it; and we cannot magnetise it without electrifying it: each molecule the instant it is affected by one of these forces is affected by the other, but in transverse directions; the forces are inseparable and mutually dependent—correlative, but not identical."

There are, indeed, other cases of a true correlation of physical powers: for whenever a physical power is manifested by a special phenomenon, it is in a dynamic state, and its correlative is also present in a latent passive state. Besides the case of correlation mentioned by Grove, there is that of the centripetal and centrifugal forces, which interacting according to their respective laws, cause the celestial orbs to rotate on their axes, and to revolve around their centres of motion; there is also that of the molecular forces, cohesion and heat, which contract and expand bodies, producing the changes called the states of matter; and also, as I hope to show, there is another correlation, that of the radiant forces, heat and actinism, as manifested in the solar spectrum.

* Idem, p. 202.

11. I have dwelt long on the subject of the physical forces, because it has an important bearing on the doctrine of Evolution; and will enable me to dispense hereafter with much repetition. Before concluding, it is requisite to say a few words about Law. "Law," says G. H. Lewes,* "was originally supposed to have not an objective existence in phenomena, but an objective existence independent of phenomena; and this ancient error is still alive. By one of the illusions into which Philosophy easily glides, a law of Nature is supposed to hold a position with respect to natural objects analogous to that held by legislative enactments with respect to social life. The connotations of language inevitably transfer this conception of the regulation of conduct to the regulation of Nature; and we have great difficulty in keeping the two conceptions apart: even careful writers are apt to express themselves ambiguously, supposing that Law is independent of the phenomena which it rules. Many years ago I proposed the abandonment of the word Law in relation to physical phenomena; but I found that the reform was impracticable, for the word is too deeply rooted."

This is another instance of modern philosophers rejecting old terms as errors and illusions; they do not suit them, but they have striven in vain to avoid using them. If "the connotations of language inevitably transfer the regulation of conduct to the regulation of Nature," it is because man, the author of the connotations, considered the analogy to be trustworthy. A law of Nature is certainly "independ-

* Problems of Life and Mind, vol. i., p. 307.

dent of phenomena," just as social law is of human conduct ; in the latter case this is evident, for Law is not addressed to conduct, but to man, that he may regulate his conduct according to Law ; and it is not unreasonable to suppose that natural laws appertain to natural powers, for the regulation of their actions in the production of natural phenomena. "A physical law," says Sir John Herschel, "may be a rule of action, but it is not action."

The tendency of modern Philosophy is to make all Nature commensurate to the Procrustean standard of her dogmas ; and in confirmation of this opinion I will quote another author of the same school. "It is not enough," says Professor Helmholtz,* "to be acquainted with facts ; scientific knowledge begins only when their *laws* and their *causes* are unveiled. . . . The laws of Nature are not things that we can evolve by any speculative method ; on the contrary, we have to discover them in the facts ; and we have to test them by repeated observation and experiment under varying circumstances. Before we can say that our knowledge of any one law of Nature is complete, it must hold good without exception. The law, then, takes the form of an objective power ; and for that reason we call it a *force*."

This paradoxical identity of law and force is an innovation which transcends the definition of force as "the abstract statical expression of the conditions necessary for the manifestation of phenomena." This is very perplexing, but the further consideration of the subject must be postponed.

* Lectures on Scientific Subjects, p. 13 and p. 370.

12. In the discussion of Evolution, on which we are about to enter, I purpose, before considering the problem of life, to devote three chapters to the nature of matter and of chemical substances, deeming it a necessary preliminary for a right understanding of the relations subsisting between them and living organisms; and by so doing advance will be made regularly from the simplest to the most complicated subjects. This will, of course, occasion many lengthened details; but this cannot be avoided, as it is the discussion of facts *pro* and *con* that can alone fulfil my object, viz., the testing of the opposing doctrines in order to ascertain which gives the better explanation of phenomena.

When this discussion is completed, the subject of Creation will occupy the tenth and concluding chapter. Then I will give my reasons for maintaining the old faith that the human soul—the highest of natural powers—is related not only to a material, but also to a spiritual world, which has been made known to us by a divine revelation; and I hope also to show, by several natural analogies, that such a revelation is reasonable, and absolutely requisite for the full development of human nature.

CHAPTER II.

The Material World—And the Original Nebula.

Matter the Basis of all Things.—2. Opinions concerning its Nature.—3. None of them satisfactory.—4. Ether of space, the long sought-for Matter.—5. Ether a Compound of the Physical Powers.—6. Such a Composition said to be inconceivable.—7. The World originally an Ethereal Orb.—8. Description of the Original Nebula.—9. Its Composition.—10. Origin of the Chemical Elements.—11. The Orbital Motions of Celestial Bodies.—12. M. Faye on the Duality of the Physical Forces, Attraction and Repulsion.

1. Matter, as the “Physical Basis of Life,” holds such a fundamental position in the doctrine of Evolution, that it is an indispensable requisite to ascertain its nature, if possible, before entering upon the discussion of this doctrine. It would seem to be a self-evident truth that the Earth, man’s dwelling-place, is essentially a material world; for the contemplation of natural things, from the days of ancient Greece to the present time, has ever suggested the idea that all these things, though differing from one another, have something in common, called matter. And yet, long as this idea has been familiar to man, and numerous as have been his speculations concerning this substance, he is still searching for a satisfactory answer to the question, What is Matter?

2. Formerly physicists rested content with defining matter as that which possesses the properties of extension, impenetrability, divisibility, and form: but since all tangible things—chemical substances, plants, and animals—have such properties, the definition imparts no knowledge concerning *that* to which these properties belong: it only indicates that matter is present in all natural things, which are something more than matter, in that they possess, in addition to the properties of matter, other specific properties.

At the beginning of the present century, Dr Thomas Young,* after having stated various opinions concerning the nature of matter, observes that “If we are asked for a definition of matter, it will be somewhat difficult to avoid circuitous expressions. We may make gravity a test of matter, but then we must say that whatever is attracted is also to be denominated matter. A similar difficulty would occur if we attempted to define matter by its impenetrability or mutual repulsion. We must, therefore, take it for granted that matter is known without a definition.”

“I confess,” says T. P. Kirkman,† “that I am unable to find that most universal of all things called *matter*, which is not force, but the condition of force; not motion, but the thing moved; not space, but occupying space. . . . I believe with Boscovich that the smallest *locus* of force is a point without parts; and that no two force-points are in contact. . . . And if we consider molecules to be primary aggregates of force-points or atoms, the notions

* Lectures on Natural Philosophy. Kelland's Edition. Vol. i., p. 465.

† Philosophy without Assumption, pp. 73, 76, and 81.

of Boscovich about dynamical science differ in nothing, that I am aware of, from those of the Materialists."

Sir W. Thomson, in his address to the British Association in 1871, says that "We must now no longer look upon the atom with Boscovich, as a mystic point endowed with inertia, and the attribute of attracting or repelling other such centres, with forces depending upon the intervening distances; but we must realize the atom as a piece of matter of measurable dimensions, with shape, motion, and laws of action; intelligible subjects of scientific investigation." "We cannot, of course," say Thomson and Tait,* "give a definition of matter which will satisfy the metaphysician, but the naturalist may be content to know matter as that which can be perceived by the senses; or that which can be acted upon, or can exert force. The latter, and indeed the former of these definitions, involve the idea of force, which, in point of fact, is a direct object of sense, and probably of all our senses, and certainly of the muscular sense."

"Force," says G. H. Lewes,† "being that which renders matter knowable, we know matter in knowing force; and know force in knowing matter. How much we know of either is another question. The two abstractions *matter* and *force* are but two aspects of the same thing. Force is not something superadded to matter, it is really viewed in their dynamic aspect; and matter is not something different from force, but really viewed in their statical or

* Treatise on Natural Philosophy, vol. i., sect. 207.

† Problems of Life and Mind, vol. ii., pp. 233, 263, and 264.

passive state. . . . By force we understand activity ; and what activity is to an agent, that is force to matter. . . . In its widest sense matter is the symbol of all its known properties, active and passive—*i.e.*, subjectively as feeling and change of feeling, or objectively as agent and action.”

More quotations on this subject might be made, but they would only perplex the reader, who probably has not gathered from those given any clear idea of what is meant by the word matter : so, after all, he is reduced to a mere faith in the existence of matter ; and must “take it for granted that matter is known without a definition.”

3. The reason why all attempts to define matter have hitherto failed is, I think, because the object of these attempts is not matter, but some kind of chemical substance—a molecular body, commonly called “gross matter.” In order to arrive at the matter contained in these substances, all their peculiar properties—the chemical—are mentally abstracted, which leaves a residue of material properties, by which the presence of matter is inferred, but cannot be discerned as an object of sense. It is by a like process that Evolutionists abstract vital properties from living organisms, leaving only the chemical substances of which their bodies are composed ; and then, of course, these substances constitute the sole subject of their observations. Old metaphysicians carried this mental process still further, for they abstracted from natural things all their properties, and called the imaginary residuum matter, which they supposed to be the inert substratum of all properties ; but by so doing they

virtually eliminated matter from the world, for that which has no properties cannot be known as a natural object. Thus, although all believe in the existence of matter, it has for ages remained a mysterious thing beyond human ken; but natural mysteries are not incomprehensible: they only need a diligent and persevering investigation; as we know by experience that many things which were mysterious to our forefathers have been rationally explained.

4. By the researches of modern Science, it has been ascertained that space, in which the stellar orbs revolve, is not a *vacuum*, but filled with an extremely subtile fluid, called ether, the medium by which the sun's rays are transmitted to our planet, diffusing light and heat thereon: and it is now very generally admitted that this ether is material; but all are not agreed as to its exact nature. "If it be admitted," says Grove,* "that the sun and planets have atmospheres—and little doubt now exists on this point—ether, the highly-attenuated medium of space, being an expansion of some or all these atmospheres, would furnish matter for the transmission of heat and light. . . . The matter of space I regard as possessing the qualities of ordinary or gross matter, and particularly that of weight; though from its extreme rarefaction, it would manifest these properties in an infinitely small degree." This hypothesis was advanced more than twenty years ago, and since then several similar ones have been put forth by eminent men; and very

* The Correlation of Physical Forces, pp. 147 and 149.

recently—March 1882—by C. W. Siemens, in an elaborate and interesting speculation “On the Conservation of Solar Energy.” “For the purposes of my theory,” he says,* “stellar space is supposed to be filled with highly rarefied gaseous matter, including probably hydrogen, oxygen, nitrogen, carbon, and their compounds, besides solid materials in the form of dust. This being the case, each planetary body would attract to itself an atmosphere depending for its density upon its relative attractive importance. . . . In support of this view it may be urged, that in following out the molecular theory of gases as laid down by Clausius, Clerk Maxwell, and Thomson, it would be difficult to assign a limit to a gaseous atmosphere in space.”

It is, indeed, not easy to fix a limit to the atmospheres of the sun and its planets, owing to the tendency of gaseous molecules to repel each other ; it is, however, probable that they are bounded by the gravitating attraction of the respective bodies which they surround ; for the sun seems to be so limited, as its atmosphere does not extend half way to the planet Mercury. It is not probable that planets formed their atmospheres by attracting the gaseous matter of stellar space : Laplace’s nebular theory gives, I think, a more satisfactory account of their origin. Even granting that space is filled with highly rarefied chemical gases, such a medium, in which molecules are very distant from each other, would not suffice for the transmission of the sun’s rays ; for this purpose the interstices would require

*Proceedings of the Royal Society, vol. xxxiii., p. 391.

to be filled with more suitable matter, the ether of space. There is also a serious objection to the material contents of space being chemical gases and vapours, for they could not escape condensation in the interstices of our atmosphere and earth, and also combination therewith; a state of things not known to exist. I would rather say that the ether of space is not a chemical, but a purely material gas of extreme tenuity and elasticity, from which all natural bodies have derived their matter: and if so, ether is the matter which for ages had been sought for in vain.

5. The thesis which I maintain is, that ether is pure uncombined matter; it is not a tangible or visible object, but it can be known by its properties. That it has some low degree of *weight* is proved by the resistance it opposes to the course of Encke's comet, which is being thereby gradually diminished in the periods of its annual orbits round the sun; and that it has *volume* cannot be doubted, since it fills all space; it has also the properties of moving and being moved; for there is good reason to believe that its atoms, like the molecules of chemical gases, normally rotate, and undulate when acted on by the sun's rays. Now weight and volume, and the capacity of moving and being moved, are the statical and dynamic properties usually assigned to matter; and since ether possesses all these physical properties, and no other kind of property, it is reasonable to conclude that it is pure matter in a gaseous state.

For mechanical reasons, Sir John Herschel conceived that ether partook rather of the nature of a colloid or

gelatinous solid than that of a gas: an opinion which has been generally accepted; it is, however, hard to conceive that a thing so extremely rare and elastic as ether can be other than a gas. There can be little doubt that the atoms of ether are immeasurably nearer to each other than the molecules of a colloid, or even of the densest solid; and at the same time have the highest degree of elasticity; it, therefore, seems to be pre-eminently qualified for the instantaneous transmission of the sun's rays. Some idea of its unique constitution may be gathered from the following account by T. Rawson Birks.* "The mean distance of the particles of free ether must be less, and is probably far less, than one ten-millionth of an inch. The violet rays of light make 60,000 undulations in one inch. With the limit assumed above there would be only 167 ether particles in the length of a wave. In like manner 250 would be the number in the length of a red ray, and the difference about 80. It seems plain that, in a discontinuous medium of the kind supposed, no vibration can be propagated to any distance of which the length is not some multiple of the mean interval from atom to atom. But the black lines of the speculum divide it into a much greater number of different shades or kinds of light. Hence it seems to follow that the distance of the atoms must be less than $\frac{1}{10,000,000}$ in., and may be very greatly less."

Assuming, then, that ether is pure matter, as indicated by its solely possessing material—that is, physical properties—it remains to ascertain the nature of these properties.

* On Matter and Ether, p. 14.

Weight is the pressure produced by one body resting upon another, and is attributed to the force of gravitating power, a mode of physical attraction that tends to draw the particles of bodies, as well as the bodies themselves, toward a common centre; the amount of this force depends on the mass or quantity of matter, each' atom of which is a unit of gravitating power. Hence it follows that weight, one of the properties of matter, is the effect produced by the action of the physical power, attraction, when it energises according to the law of gravitation. Again, it is known that cohesion, another mode of attraction, never succeeds in drawing molecules into actual contact; for its action is resisted by heat, a mode of repulsive power which keeps them asunder; consequently the bulk or volume of a body depends on the reaction of this correlative power. On this view, matter is not an unknown something, endowed with an all-becoming potency; but an actually existing thing, ether, a binary compound of the universal physical powers, attraction and repulsion—powers which inseparably co-exist, and are “correlative, but not identical:” and it is by the interaction of these powers, according to their respective laws, that all physical phenomena, the various motions of bodies, are produced.

Such, I conceive, is the nature of matter; and in order to illustrate its character, I will contrast it with the conception of others as above quoted. Thomson and Tait give two definitions of matter, which involve the idea of force as manifested by the senses; this only applies to gross matter, and not to pure matter, ether, whose forces

are not "direct objects of sense," for they are only known by inference from facts. And G. H. Lewes says that matter and force are but two aspects of the same thing; and that in its widest sense matter is the symbol of all its properties, statical and dynamical; and that unless this *bipolar* aspect be admitted we shall fall into the error of supposing two distinct entities, matter and force. On my view matter is a compound of two simple powers, attraction and repulsion; we know nothing that has the two aspects of matter and force; but we may, in a sense, regard the constituent powers as "two aspects of the same thing," matter; and it is to these powers that the statical and dynamical properties of matter belong.

6. The dynamical constitution of matter, which I am advocating—viz., that it is a binary compound of the physical powers, attraction and repulsion—has been objected to as inconceivable; such forces, it is said, cannot act unless there be something, such as inert matter, to be attracted and repelled. To this I reply, Do not Physicists and Evolutionists frequently discourse about the interaction of molecular forces? Such an interaction is not, therefore, inconceivable, but doubtless it is hard to be apprehended by those who believe that there is such a thing in Nature as inert matter; and yet the same persons admit that all the particles of matter mutually attract and repel each other; but how they can do this, unless they have essentially corresponding potencies, is still harder to apprehend. My view of the compound nature of matter will, I think, enable me to smooth the way to an understanding of this subject.

The whole expanse of ether, which fills space, is a vast aggregation of atoms, and consequently also of their units of attraction and repulsion, which conjointly act on each other, giving rise to universal and tangential currents of centripetal and centrifugal forces. An ethereal atom, *ex hypothesi*, has a spherical form, resulting from the interaction of its physical powers, which cause it to rotate on its axis. Such a material atom is not a force-point, like that of Boscovich, without parts—a mere abstract expression of a *minimum* of force, as the point in Geometry is that of space—but it is an actual body, the parts of which are two units of correlative physical powers; so that it does not require, as Boscovich's atom does, “the presence of at least another atom to enable it to act;” for it has, as its essential constituents, the powers of attraction and repulsion, which, interacting, cause tangential currents around a common centre of rotation. Nor is the ethereal atom like that which Sir W. Thomson describes; it has, indeed, “shape, motion, and laws of action;” but it is not “a piece of matter of measurable dimensions.” It is very probable that his atom is measurable, for Stoney has deduced from Maxwell's kinetic theory of gases a limit to the number of atoms in a given space; but such atoms are chemical molecules, as is admitted, which are aggregates of myriads, if not millions, of material—that is, ethereal atoms. If, then, the measurement of the hydrogen atom, the lightest molecule of the chemical elements, has been correctly determined, it requires about eight thousand millions of these atoms in a row to fill the space of one inch; so that, compared with it, that of the ethereal atom

would be so extremely minute that the idea of a "measurable dimension" could scarcely enter into its definition.

The ether of space, a homogeneous incompressible fluid, is, perhaps, better adapted than any molecular fluid for the illustration of Professor Helmholtz's remarkable theory of vortex lines, or tubes, in an infinite fluid, which, rotating, return on themselves, forming closed vortex-rings. "These properties of vortex-rings suggested to Sir W. Thomson," says J. Clerk Maxwell,* "the possibility of founding on them a new form of the atomic theory. The conditions which must be satisfied by an atom are—permanence in magnitude, capability of internal motion or vibration, and a sufficient amount of possible characteristics to account for the difference between atoms of different kinds. . . . The vortex-ring of Helmholtz, imagined as the true form of the atom by Thomson, satisfies more of these conditions than any atom hitherto imagined. In the first place, it is quantitatively permanent as regards its volume and its strength, two independent quantities. It is also qualitatively permanent as regards its degree of implication, whether 'knottedness' on itself, or 'linkedness' with other vortex-rings. . . . When the vortex atom is once set in motion, all its properties are absolutely fixed and determined by the laws of motion of the primitive fluid, which are fully expressed in the fundamental equations. . . . His primitive fluid has no other properties than inertia, invariable density, and perfect mobility."

* *Encyclo. Britan.* Article Atom. Vol. iii., p. 45.

This account of the vortex-atom applies very well to the ethereal atom, which is invariable in weight and volume, and spontaneously—without being set in motion—rotates by the interaction of its constituent powers, and ever continues to do so statically, like a top asleep, for the units of its powers are *in equilibrio*; and there is no need of postulating for it “possible characteristics,” for it is not a molecule of which there are many kinds, but a material atom, which is identically the same as all other atoms of matter. Such is the ethereal atom, a vortex-ring rotating in an “infinite fluid,” the ether of space, which is similarly constituted, for it is one vast spherical orb, an aggregate of all ethereal atoms; and “the vortex lines” of this rotating orb “return on themselves, forming closed vortex-rings” of centripetal and centrifugal forces, which embrace and regulate the rotatory and orbital movements of all the celestial bodies.

7. Let it, then, be granted that the ether of space is a vast orb, actuated by its co-existing correlative forces, which cause it to rotate on its axis; and if so it follows that the world originally consisted solely of matter; and that from it was derived all the matter which enters into the composition of stellar and terrestrial bodies; and consequently also all their physical forces. If it be asked, What is the origin of this ethereal orb? I answer that this is a question with which neither Science nor Philosophy has any concern; for the province of one is only to investigate natural phenomena, and that of the other to search out the causes of phenomena: within these limits they are competent to give reasonable opinions; but when

they transgress these bounds their dicta are of little worth. "Natural Science," says Professor Haeckel,* "teaches that matter is eternal and imperishable, for experience has never shown us that even the smallest particle of matter has come into existence or passed away. . . . Hence the naturalist can no more imagine the coming into existence of matter than he can imagine its disappearance from the world: he, therefore, looks upon the existing quantity of matter as a given fact." The existence of ether is also "a given fact;" and with this knowledge we must, for the present, rest content.

The assumption that the world was originally a universal sphere of ether is doubtless a great flight of the imagination, but it is not "an airy nothing" of the fancy; for, if I mistake not, this is its actual condition even at the present day. It is admitted that ether not only fills all space, but also the interstices of all natural bodies contained therein; and thus its continuity is maintained unbroken: and there is reason to believe that its constituent forces traverse all space, "holding in their grasp, not only our solar system, but also the innumerable systems of the heavens themselves."

The assertion that ether is the source whence the matter of all the stellar bodies was derived may seem, at first glance, to be very improbable; for these bodies have collectively an enormous weight, indicating a corresponding amount of matter; but this difficulty disappears when the prodigious volume of the ether is taken into account;

*The History of Creation, vol. i., p. 8.

for in comparison therewith the total volume of all these bodies is, as it were, a mere drop in the ocean. So that, although ether is an extremely rarefied fluid, yet its total weight must far exceed that of all the orbs contained therein. And since matter, on my view, is a compound of the physical forces, attraction and repulsion, ether must also be the source from which stellar bodies derive their forces: these forces are distributed throughout the world in various quantities, but they do not suffer either increase or diminution; and, in this sense, the conservation of attraction and repulsion is a law of Nature.

Let us contrast such a condition of the world with what Professor Tyndall* has set forth in his Essay on the Constitution of Nature. "The universe possesses two kinds of property, which are mutually convertible. The diminution of either carries with it the advancement of the other, the total value of the property remaining unchanged. Taking repulsion as well as attraction into account, the principle of conservation is a constant quantity. . . . This, then, is the rhythmic play of Nature as regards her forces. Throughout all her regions she oscillates from *tension* to *vis viva*, and from *vis viva* to *tension*. Thus beats the heart of the universe, but without increase or diminution of its total stock of force."

As I read this statement, the property of the universe is force, the two kinds of which are attraction and repulsion, subsequently termed the forces of Nature. On my view,

* Fragments of Science, vol. i., pp. 19 and 21.

attraction and repulsion are not mutually convertible, as already stated (Ch. i., par. 10): they are distinct powers, which inseparably co-exist in every phenomenon, as antagonists; there is no such thing in Nature as a single independent force, possessing such totally opposite properties as those of attraction and repulsion. Either of the co-existing physical powers may be in a dynamic state; and then as a *vis viva* or force is capable of producing phenomena; and during this, its correlative power is in a passive state of *tension*. When the operation is completed, the dynamic power has parted with its *vis viva*, and both powers then are in a state of statical equilibrium: so that if there be a successive repetition of such an operation, then the physical powers, attraction and repulsion, oscillate from a state of *vis viva* to that of *tension*.

8. The ether of space is not an object of sense, and yet to the intellectual vision of the mind it is a material substance, which plays a most important part in the performance of natural phenomena. The celestial bodies which revolve in this boundless ether far beyond our reach are only visible as luminous objects, yet they also have furnished the mind with a vast field of astronomical knowledge: and it is now proposed to notice some of these bodies, as far as they are connected with the ethereal orb by the common bond of the centripetal and centrifugal forces.

The solar system is the part of the heavens with which we are best acquainted. Around the sun, the centre of this system, several planets revolve at different distances therefrom; and around some of these one or more moons

or satellites circulate; and all their orbits are performed by the interaction of centripetal and centrifugal forces, which tend toward or from the centre of the system. Our sun is one of the numerous fixed stars that bespangle the heavens; and probably each of these, like the sun, is the centre of a system of planets, which are invisible to us in consequence of their reflected light being too feeble to penetrate through the vast region of intervening ether. Besides these bodies and comets—which are only casual visitors—there are in the heavens numerous remote and irregularly-shaped bodies, which appear as luminous clouds, called *nebulæ*. It is only during the last hundred years that we have learnt, by the researches of the Herschels, father and son, that the *nebulæ* are undergoing a series of changes, indicating that they may be eventually condensed into fixed stars. And on this assumption Laplace founded and constructed his celebrated nebular theory of the solar system, which is generally accepted. “It has,” says Comte,* “the eminent merit of requiring for the formation of the solar system only the simple agents of weight and heat which meet us everywhere; and which are the only principles of action which are absolutely general.”

9. If the solar system was thus formed, it may be reasonably inferred that the systems of the fixed stars had a similar origin; and that the *nebulæ* of all these systems were successively thrown off from a nebula, originally formed within and around the centre of the

* *The Positive Philosophy.* Martineau's Edition. Vol. i., p. 211

ethereal sphere that fills all space ; by which the world has been developed into one stupendous system of celestial bodies. This Original Nebula must not be confounded with “the primitive nebulosity” of Evolutionists, which seems to be no other than the nebula of the solar system ; for in it alone is life known to occur. Let it, then, be granted that all nebulæ were derived from such a universal original nebula ; then the question arises, What is it that made it to differ from the ethereal orb in which it occurs ?

It was always supposed that nebulæ, like comets, were gaseous and vaporous bodies ; it was not, however, until the last few years that this notion has been verified by spectrum analysis. It was long known to chemists that various metallic salts imparted peculiar colours to the flame of the blowpipe, by which they were volatilised ; but it was Professor Kirchoff who discovered that the spectra, obtained from such flames by passing their light through a glass prism, gave bright lines coincident with the dark lines of Fraunhofer : and this is the origin of the new method of investigation, called *spectrum analysis*. By this method it has been ascertained that the intensely heated photosphere of the sun contains several chemical elements like those which occur in the composition of the earth ; and, according to Angström’s experiments, these are hydrogen, and thirteen metals. In the examination of the spectra of fixed stars, W. Huggins and Dr. Miller* detected the presence of ten elements, viz :—Hydrogen, nitrogen, and eight metals ; and in the spectra of eight

* Philosophical Transactions, vol. 154, pp. 413 and 437. (1864.)

stellar and resolvable nebulae, they found indications of a glowing gas, and in all of them three bright lines, those of hydrogen, nitrogen, and of a third undetermined. So that there is good reason for supposing that the chemical elements of which our sun and the fixed stars are composed were derived from their respective nebulae, and ultimately from the original nebula of the universe.

We are now in a position to answer the question concerning the difference between this nebula and the ethereal orb. The latter consists solely of matter, a binary compound of the physical powers, attraction and repulsion; the former, of the chemical elements, each of which—as will be demonstrated in the sequel—is a compound of matter, and a specific chemical power. Evolutionists, on the other hand, describe the “primitive” or solar nebula as composed of molecules, and maintain that these are different kinds of matter, spontaneously evolved therefrom by a process of differentiation. This, as the first stage in the development of the potency of matter, ought to have been substantiated by weighty evidence; but the little that has been advanced in its support is by Herbert Spencer,* who tells us that “the elements are various groupings formed by an integration of matter, and concomitant dissipation of motion, during which matter passed from an indefinite incoherent homogeneity to a definite coherent heterogeneity.” But he does not tell us what matter is; or how this homogeneous aggregate of like atoms became different kinds of elements, the basis of each

* *First Principles*, p. 396.

being a peculiar molecule, consisting of a definite quantity of matter.

10. According to my view of Nature, there is but one kind of matter, an aggregate of material atoms, possessing solely the properties of matter; whereas the elements possess two kinds of properties, for besides the material or physical they have others of such a peculiar nature that they are called *chemical*, to distinguish them from physical properties. And I maintain that the difference between matter and the chemical elements makes as complete a breach in the continuity of the doctrine of Evolution, as that between chemical substances and living organisms: they are two distinct kinds of things; and there is no evidence that one kind of thing can be evolved from another of a different nature. It is admitted that we know not how matter came into the world, and must rest content with the fact that it exists there; and the same holds good in respect to the chemical elements: in both cases the cause of their origin must be sought for from without, rather than within the world. "The formation of the molecule," says Clerk Maxwell,* "is an event not belonging to that order of nature under which we live. It is an operation of a kind which is not, so far as we are aware, going on in the earth or in the sun or the stars, either now or since these bodies began to be formed. It must be referred to the epoch, not of the formation of the earth or of the solar system, but of the establishment of the existing order of nature; and till not only these worlds

* Encyclo. Britan., vol. iii., p. 49.

and systems, but the very order of nature itself is dissolved, we have no reason to expect the occurrence of any operation of a similar kind."

It is very conceivable that chemical powers may have been introduced into the midst of the ethereal orb, the original material world; and that, then, these powers, acting according to the law of their nature, would combine with definite and different quantities of matter to form the molecular bodies of the chemical elements: and such a condensation of ethereal atoms would be accompanied by an enormous extrication of heat, a mode of repulsive power, the cause of the successive separation of the outer zones of the original nebula, to form the various nebulæ of the stellar systems.

11. It now remains to say a few words about the physical powers by which the orbits of stellar bodies are regulated. According to the doctrine of vortices advocated by Descartes and Kepler, centrifugal force is the grand influence by which the motions of the celestial orbs are regulated; but now centripetal force, acting according to the law of gravitation—as taught by its discoverer, Sir Isaac Newton—is regarded as "the universal law that takes up all the facts of astronomy." It is, indeed, admitted that another force is *in initio* conjoined with that of gravity, as required by Galileo's law of the composition of forces; and accordingly it is assumed that each planet was put in motion by a tangential force applied once for all, which would have propelled it onward in a straight line for ever, if the attractive force of gravity had not drawn it into a curvilinear course around the sun.

“If we could,” says Comte,* “start projectiles with a sufficient and continuous force beyond the resisting atmosphere, we should find them the models of the planetary system, or, in other words, astronomy would become an artillery problem, simplified by the absence of a resisting medium.” Would not such a prodigious force, in all probability, shatter any projectile into fragments long before it attained the limit of the atmosphere?

“In framing a theory,” says Sir John Herschel,† “which shall render a rational account of any phenomenon, we have first to consider the agents on which it depends, or the causes to which we regard it as ultimately referable. These agents are not to be arbitrarily assumed; they must be such as we have good inductive grounds to believe do exist in Nature, and do perform a part in phenomena analogous to those we could render an account of; or such whose presence in the actual case can be demonstrated by unequivocal signs. They must be *veræ causæ*, which we can not only show to exist and to act, but the law of whose actions we can derive independently by direct induction from experiments purposely instituted.”

These requirements are surely not satisfied by invoking a *Deus ex machinâ* to fulfil the office of a tangential force in the planetary orbits; nor does it give any account of how it came to pass that a planet was placed alone in the ether of space to be so experimented on by physical forces. It is more reasonable to suppose that no planet was ever

* The Positive Philosophy, vol. i., p. 181.

† Discourses on the Study of Natural Philosophy (209), p. 197.

free from the grasp of the correlative and co-existing centripetal and centrifugal forces. The nebula from which a planet is derived was, during the whole development of its system, so conditioned; and so was the zone of the nebula after it was cast off, and whilst it was being rolled up into a planet, which revolved in the space occupied by its parent zone under the influence of the same central forces.

“If Kepler’s forces were destroyed,” says Whewell,* “the planet would instantly stop; if Newton’s were annihilated, it would go on uniformly in a straight line.” I would rather say that in the former case the planet would fall on the sun; and in the latter, it would fly off into space and revolve in a parabolic orbit, as a comet, around some other stellar centre. But such postulates imagine what cannot happen; for the forces which maintain the sun and its planets in their orbits are those of the original nebula, from which they were all derived; and which “hold in their grasp not only the solar system, but also the innumerable systems of the heavens themselves.” On this view both Newton and Kepler were equally right and wrong, in that neither of them took into account both sides of the question.

12. About the same time that I suggested in my *Philosophy of Nature* that the forces concerned in astronomical phenomena were those of the co-existing correlative powers of attraction and repulsion, M. Faye, an eminent French astronomer, advanced a somewhat similar view of the twofold nature of physical forces. He was led to infer

* *History of the Inductive Sciences*, vol. ii., p. 19.

the presence of a repulsive force in some remarkable phenomena of comets; and he asks,* “Is this repulsive tangential force real or apparent? If it be a real force, it remains to inquire what such a force can be, which is able to contend in the heavens with gravitation, and thus to break the unity of astronomical science.” And he concludes that “the celestial world does not obey one force alone, attraction, but a duality of forces, attraction and repulsion. The former depends solely on the mass, the latter on heat; the one acts through all matter without suffering any diminution; the other is intercepted by a simple screen. Both these forces are universal, for they occur everywhere throughout the system of Nature.” From this statement it is evident that our views, though similar, are not identical. We agree that celestial bodies obey a duality—or, as I *now* would rather say, a correlation—of attractive and repulsive forces; but we disagree in that his forces are gravity and radiant heat; whereas both of mine are central forces, correlative modes of attraction and repulsion, which pervade the universe, and cause all the motions of celestial orbs. The radiant heat of the sun is another mode of repulsion, which, during the perihelion of comets, drives away their nebular-like tails from following the same course as their denser heads.

Long, and perhaps tedious, as the subject of this chapter has been, it would require much more space to do it ample justice: I trust, however, that sufficient has been said to

* Comptes Rendus des Séances de l'Académie des Sciences.
Août 1861.

convey my meaning of matter and the physical powers, of which it is composed. "The ultimate problem of physics," says Professor Tyndall,* "is to reduce matter to its lowest condition of divisibility, and force to its simplest manifestations; and then by synthesis to construct from these elements the world as it stands. We are still a long way off from the final solution of this problem; and when the solution comes it will be more one of spiritual insight than actual observation." My view of matter and of its correlative physical forces seems, in some measure, to satisfy the conditions of this problem. We surely can no further go in the reduction of "matter to its lowest condition of divisibility" than the ethereal atom, the unit of matter; and "the simplest manifestation of force" occurs when physical powers, in their dynamic state, energise and produce the phenomena of attraction and repulsion.

* *Fragments of Science*, vol. ii., p. 94.

CHAPTER III.

The Molecules of Matter—And Molecular Phenomena.

Introduction.—2. The Action of Radiant Heat on the Ether of space.—3. Light and Heat not identical.—4. Their Nature manifested in the Solar Spectrum.—5. Different Natures cannot be identical.—6. The States of Matter.—7. Latent Heat.—8. Physical Forces correlative, but not identical.—9. The Conduction of Heat in Different Media.—10. The Polar Force Magnetism.—11. Its correlative, Electricity.—12. Conclusion.

1. The earth, water, and air of our planet, as already stated, are compounds of the chemical elements, the physical basis of which is, in each element, a molecule or little mass of material atoms, which is distinguished from all other molecules by possessing a peculiarly definite weight. Terrestrial things, for the most part, are tangible as well as visible; and are therefore better adapted for experimental examination than the celestial bodies, which have hitherto engaged our attention: but even in these terrestrial things the mind is able to discern objects which cannot be seen or handled.

Some may deem it needless to dwell long on the subject of molecular physics in a discussion on Evolution; but I hope to show that it has an important bearing thereon. Hitherto we have only had one mode of the correlative physical powers, attraction and repulsion, under considera-

tion; but in molecular physics we shall have to deal with all the other modes of the physical forces, and shall then have occasion to point out that they are not indiscriminately convertible: and since much reliance is placed on the mutual convertibility of forces by Evolutionists, it is only by passing physical phenomena under a careful review that I can hope to show that this doctrine is not trustworthy.

2. We know that when bodies here on earth are in a state of ignition, they emit rays of light and heat, and from this it is inferred that the sun is also an ignited body; and, as in the former case ignition results from a condensation of molecules occasioned by chemical combination, it is not improbable that, by the same means, the solar nebula, during the *whole course* of its condensation, has emitted, and continues to emit, light and heat. "As this was considered by physicists," says C. W. Siemens,* "to be an insufficient source of the sun's heat, Sir W. Thomson suggested that it might be due to the falling of meteorolites on the sun, each pound of which would produce a large amount of heat units. But in considering more fully the enormous amount of such bodies that would be required for the maintenance of the solar temperature, he abandoned this hypothesis for that of simple transfer of heat from the interior of a fluid sun to the surface by means of convection-currents: and this latter hypothesis appears, at the present time, to be also supported by Professor Stokes and other leading physicists."

* Proceedings of the Royal Society, vol. xxxiii., p. 390.

It does, indeed, seem probable that the solar nebula, in its present advanced, and possibly exhausted stage of planetary development, should be reduced, at its interior, to the state of a fluid sun, surrounded by a nebular zone—the photosphere—but separated therefrom by a vast intervening space of ether, through which dark heat is radiated, which, impinging on the nebular zone, would maintain it in a constant state of luminous ignition; and thus the waste of the photosphere's radiant heat is compensated.

As the sun's rays impinge on the ethereal atoms of space, they drive them forward in a straight direction against the nearest atoms in their path, to which they impart their motion; and then recoil, being drawn back to their former position by the tangential force of the physical power, attraction, which causes them to vibrate transversely with great rapidity. By a successive and continuous repetition of this process, the ethereal undulations are propagated instantaneously through the vast region of space; and thus “the light of the firmament comes to us across the direction of the solar rays.” When these rays, at length, enter into the highest region of our atmosphere, they come into contact with the molecules of extremely rarefied air; and then the transverse motions of the ethereal atoms cause the aerial molecules also to vibrate, producing the azure blue of the sky—just as the electric discharge through highly rarefied air in Geissler's vacuum tube, illuminates the residual molecules with a violet light. But I need not dwell on a subject that has been so beautifully elucidated by Professor Tyndall in his *Fragments of Science*.

3. By the action of radiant heat on ether—whether that of space, or of the interstices of bodies—its atoms are only made to undulate and vibrate ; but when these correlative motions act on molecular substances, then a great variety of phenomena are produced according to the media affected. If these motions impinge on the organs of sight and of the tactual sense, then we have the sensations of light and heat. According to the teaching of modern science, light and heat are different modes of one and the same thing, motion ; and are held to be mutually convertible. Thus Sir W. R. Grove has adduced many facts in illustration of this view ; in which light and heat are successively manifested, sometimes one or other of them being the antecedent in the succession. Professor Tyndall also, with his wonted skilful tact, has experimentally illustrated the same thing, and regards this as sufficient proof of their identity. And recently Sir W. Thomson, in his article “Heat,”* advances the following argument to prove, as stated in the margin, that light and heat are identical. “The process of transference of heat from one body to another body at a distance through an intervening medium is called radiation. The condition of the intervening matter, in virtue of which heat is thus transferred, is called light ; and radiant heat is light if we could but see it with the eye, and not merely discern it, as we do, that it is perfectly continuous in quality with the species radiant heat, which we see with the material eye through its affecting the retina with the sense of light. Thus a

* *Encyclo. Britan.*, vol. xi., p. 577. Sect. 70.

white hot poker, in a room perfectly darkened, is seen as a brilliant white light gradually becoming reddish and less bright until it absolutely fades from vision in a dull red glow. Long after it has ceased to be visible to the eye, the fact that heat is still being transferred from it to colder bodies around it is proved by our sense of heat when near it. By considering the whole phenomenon of the white hot mass, without much experimental investigation, we judge that there is a perfect continuity through the whole process ; in the first part of which the radiant heat is visible, and in the second part invisible, to the human eye : and thorough experimental investigation confirms this conclusion. Thus radiant heat is brought under the undulatory theory of light, which in its turn becomes annexed to heat as a magnificent outlying province of the kinetic theory of heat."

The ethereal motions, which are manifested to consciousness as light and heat by their action on distinct organs of sense, are not identical. Light and heat are not "perfectly continuous in quality," for the one is caused by the transverse vibrations, and the other by the longitudinal undulations of the ethereal atoms ; the motion of the one is short and extremely rapid, that of the other longer and much slower : and both these tangential motions cannot be discerned by the same organ of sense ; for the eye only can perceive the vibrations, and the tactual sense the undulations of ether. The sensation resulting from the action of radiant heat on the eye, when it proceeds from an intensely ignited body, is not a sense of light, but of pain ; so that when the light is very brilliant we cannot

see the ignited body—the sun, for instance—unless the intensity of the heat rays be intercepted by an absorbent substance. The light of a white hot poker gradually fades away as the poker cools, because the ethereal vibrations diminish, *pari passu*, in velocity; and at length become too slow to cause the sensation of light; but, long after this, heat may be felt, because the sense of touch is affected by a different motion of ether, that of undulations, which are stronger but much slower than vibrations. Contemplating this series of phenomena, I fail to perceive that “there is perfect continuity through the whole process,” for the motions of the ethereal atoms are diverse in quality, and tangential to each other in direction; both kinds of motion fall within the province of kinematics; but thermotics cannot be brought into the province of optics.

4. I will now endeavour to show that light and heat are not mutually convertible; they are caused by the interaction of radiant physical forces, which “are inseparable and mutually dependent, correlative, but not identical.” When a pencil of the sun’s rays is passed through a glass-prism a coloured spectrum, like that of the rainbow, is produced, which may aid me in making my view of this correlation intelligible. At one end of the spectrum, and even beyond the red band, heat is at a *maximum*, and gradually diminishes toward the opposite end, where it is at a *minimum*; and, *vice versa*, another ray force, called *actinism*, is strongest in the violet band, and becomes gradually weaker in its course to the red end of the spectrum. Thus it would appear that these two kinds of ray-force co-exist as correlatives in every portion of the

spectrum, but in different proportions according to their position therein—precisely as centripetal and centrifugal forces are associated in respect to the centre of celestial bodies ; the former being at a *maximum* at the centre, and the latter at the circumference of the sphere. Radiant heat is a well-known mode of repulsive power ; but we are not so well acquainted with the nature of actinism : for the following reasons I conceive that it is a mode of the physical power, attraction. First, because the transverse vibrations of ether, by which the presence of actinism is manifested to the eye as light, result, as already stated,* from the attraction of gravitation, which causes the recoil of ethereal atoms, when the radiant heat of the sun has been transmitted onward to other atoms. And, secondly, because actinism facilitates chemical action by approximating the molecules of the elements, as when it changes the salts of silver, on which the photographic art depends ; and which promotes vegetation by aiding the chemical process of assimilation ; a process more active in spring than in autumn, when heat prevails, and by its repulsive force counteracts its energy. On this view, the various coloured bands of the spectrum are produced by the attractive force of actinism moving the ethereal atoms with different degrees of velocity ; and the calorific bands, in like manner, are produced by the repulsive force of radiant heat : and this would seem to be an additional reason why the sensations of light and heat are of such different characters.

* Chap. ii., par. 3.

5. It seems to me astonishing that scientists should be so bent on maintaining the identity of things that are distinguished from each other by such well marked different properties: in addition to this of light and heat, I have already had to point out the great difference between matter and chemical elements. I would here make some remarks on this subject, but as this has been lately done by the Duke of Argyll,* I cannot do better than subjoin his sentiments thereon. "What, then, is this unity of Nature? Is it a fact or an imagination; is it a reality, or is it a dream? But there is another question which comes before these, What do we mean by unity? In what sense can it be said that the innumerable variety of things are nevertheless *one*? It has been said that all knowledge consists in the perception of difference. This is not accurate; but it is true that the perception of difference is the necessary *foundation* of all knowledge. Knowledge is the perception of relations: to know a thing and to understand it, is to know it in its relation to other things. The first step in this knowledge is to know it as distinguished from other things; and thus the perception of difference comes before the perception of all other and higher relations. It is well, therefore, to remember that no increase of knowledge can be acquired by a wilful forgetfulness of distinctions. We may choose to call two things one, because we choose to look at them in one respect only, and to disregard them in other respects, quite as obvious and

* Contemporary Review, Septr. No., 1880, p. 356. On the Unity of Nature.

perhaps more important : and thus a purely artificial unity is created, which represents nothing but a comparatively insignificant incident in the system of Nature."

6. When the radiant heat of the sun impinges on the earth, it is absorbed by its molecules, and assumes the form of ordinary heat—molecular repulsive force—the property of which is to drive molecules further apart, until solids are converted into liquids, and liquids into the aerial form of gases or vapours. These different conditions of bodies are called the three states of matter. All molecular bodies cannot undergo these changes : it is, however, probable that all the elements are capable of existing in these different states ; for the most refractory metals have been melted and volatilised, and the most permanent gases liquefied and even solidified by subjecting them to enormous pressure, and at the same time to intense cold to carry off the heat disengaged during their condensation. The melting of solids and the boiling of liquids is the usual mode of expressing the change of bodies from one state to another ; but the course of Nature is different, the order which she followed in the development of the earth was by liquefying gases, and then by solidifying liquids.

M. Boutigny considered the spheroidal form, which liquids assume when dropt on very hot metallic surfaces, to be another state of matter ; but it seems rather to be a peculiar condition, which enables liquids, being free from adhesion to solids by the repulsion of heat, to assume their normal spherical form : the same takes place when liquids are free under other conditions ; thus rain falls in drops, and dew on cabbage leaves collects into minute beads, and

run together into large globules. But what is more *àpropos* to Boutigny's case, when water is distilled in a glass retort, it sometimes happens that the current of steam suddenly ceases to pass into the condenser, though the heat of the lamp continues unchanged; and this is occasioned by a layer of high pressure steam bodily suspending the water above the bottom of the retort, giving it a very oblate spherical form.

Very recently Mr Crookes has suggested that there may be a fourth or ultra-gaseous state of matter. "Matter in its fourth state," he says,* "is the ultimate result of gaseous expansion. By great rarefaction the free path of molecules is made so long that the hits in a given time may be disregarded in comparison to the misses, in which case the average molecule is allowed to obey its own motions or laws without interference; and if the mean path be comparable to the dimensions of the containing vessel, the properties which constitute gaseity are reduced to a *minimum*, and the matter then becomes exalted to an ultra-gaseous state. . . . A gas is nothing more than an assemblage of molecules contemplated from a simplified point of view. When we deal with phenomena in which we are obliged to contemplate the molecules individually, we must not speak of the assemblage as a gas."

There surely can be no need of such a distinction; for however highly the gaseous state be exalted, this rarefied elastic condition of a molecular body is still that of a gas; even at the very highest limit of the atmosphere, where

* Proceedings of the Royal Society, vol. xxx., pp. 471 and 472.

the earth's attraction is at *zero*, the air, though extremely expanded, is as much entitled to be called air as when it rests on the earth's surface in a condensed state. According to Mr Crookes, "the gaseous state remains so long as the collisions [of molecules] continue to be infinite in number, and of inconceivable irregularity." This is rather the description of a gas, when subjected to extraneous force, such as that of radiant heat or an electric discharge; a condition in which both a rarefied and condensed gas behaves alike: if all such forces were avoided, by keeping the gas at rest by an equable temperature and pressure, there is reason to believe that its molecules, being far apart, and so free to move, would normally rotate on their axes without coming into contact with one another, and yet lacking such a conflict, it would be a perfect gas. In such a gas, each molecule is as distinct an individual as the planets in the solar system; and if "we must not speak of the assemblage [of such molecules] as a gas," neither must we call the assemblage of molecules in a liquefied body a liquid, nor that in a solidified body a solid. I may be wrong, but I think that a fourth state of matter has not been established, either by M. Boutigny or Mr Crookes.

7. The different states of matter depend upon the relative quantities of their molecular forces, cohesion and heat. Thus, when cohesion is in the ascendant, it keeps the molecules of bodies stationary by firmly uniting them together into solids; and its excess must be balanced by its correlative force, heat, before any change can take place; and during the accomplishment of this equalisation,

the heat will appear to be lost or rendered latent ; but, in fact, it is still effectually employed in balancing its correlative force, cohesion. The result of this process is the conversion of the solid body into the liquid state : thus a liquid is, as regards its antagonistic forces, like a machine at the point of moving ; it is in a statical state, so that more heat will convert it into a gas, and an abstraction of heat will reduce it to a solid. The force of cohesion, like that of centripetal force in stellar bodies, is the basis or invariable *quantity* in molecular bodies ; whereas heat is a variable *quality*, the energising principle in a great variety of physical phenomena.

When solids are heated, they gradually expand, and manifest a corresponding increase of temperature until they arrive at the melting point ; and then, though the heat be continuously applied in the same ratio, the temperature does not rise until the solid is entirely melted : to effect this change a large quantity of heat is expended, but not destroyed : it has only passed from one mode of action to another, viz., from dynamically moving the solid's molecules apart, to statically retaining them in a new position, which enables them to move freely on each other, which constitutes the liquid state. So, likewise, when a liquid is heated until it is converted into a vapour or gas, the process is similar, but on a larger scale : for a much greater quantity of heat is required, and the effect produced is proportionally greater ; the molecules now are not only free to be moved, but actually repel each other, so that, unless restrained by external pressure, they fly apart until the gas is indefinitely expanded.

8. In thus speaking of heat as a mode of repulsive power, capable of causing certain effects, instead of regarding it as a mode of motion, I am aware that I lay myself open to the charge of absurdly advocating the existence of an imponderable entity. But by so doing I am only calling the thing by its proper name ; a spade is a spade, and no ingenuity can make it another thing : and yet how hard do many strive to do the impossible. “Though I am obliged,” says Grove,* “in order to be intelligible, to talk of heat as an entity, and of its conduction, radiation, &c., yet these expressions are, in fact, inconsistent with the dynamic theory, which regards heat as motion and nothing else. . . . Heat, which we are at present considering, cannot be insulated. We cannot remove it from a substance and retain it as heat ; we can only transmit it to another substance, either as heat or some other mode of force. We only know certain changes of matter, for which changes heat is a generic name ; the *thing* heat is unknown.”

It is true that neither heat, nor any mode of either attractive or repulsive forces, can be removed from a substance, and retained in an insulated state as a simple physical force : and, on my view, the reason of this fact is, that every mode of repulsion co-exists with its correlative mode of attraction ; for there is no such thing in Nature as a single independent force or power. If heat can be transmitted from one substance to another, it must be something more than “a generic name for certain changes

* *Correlation of Physical Forces*, pp. 56 and 59.

of matter :” and this something, heat, is not “unknown,” for it is known by its peculiar properties, the only way by which things can be known. “Heat,” Grove says, “can only be transmitted to another substance, either as heat or some mode of force :” this is precisely what I maintain, that physical powers, real entities, are transmitted from one body to another, producing various kinds of motion according to the medium on which they act. Motions the effects of power are not transmitted ; but when a moving body comes near another body, the force that caused its motion is transferred to it, and in like manner puts it in motion. Motions are not, like forces, the cause of the effect that follows, but the effects produced by forces. Grove virtually admits this when he says (at page 203), “The word motion is only applied to the effect, and not to the force ; and chemical affinity is generally applied to the force, and not to the effect ; but light, heat, electricity, and magnetism are constantly used in both senses.”

Professor Tait,* at a Meeting of the British Association, maintained the objective reality of force or energy by the following argument. “Our conviction of the objective reality of matter is based mainly upon the fact, discovered by experiment, that we cannot in the slightest degree alter its quantity ; we cannot destroy, nor can we produce even the smallest portion of matter. For the same reason, if we find anything else in the physical world whose quantity we cannot alter, we are bound to admit its

* Quoted from Herbert’s “The Realistic Assumptions of Modern Science,” p. 271.

objective reality. Heat, therefore, as well as other physical forces, though not forms of matter, must be looked upon as being as real as matter, simply because they have been found to be forms of energy, which in all their mutations satisfies the test of an objective reality."

On this quotation Mr T. M. Herbert makes the following reasonable comment. "The proper rule and boast of Science is, that it does not go beyond physical causes, the antecedent phenomena of events, and that it has abandoned the search for efficient causes, the powers which produce effects. To maintain the objective reality of energy, is to pass beyond the world of phenomena. If Science is justified in transcending phenomena, then our contention, that things as they *seem* demand things *unseen* to account for them, receives a new justification."

A predominant physical power may be either that of attraction or repulsion; and when energising it imparts its own character to the resulting motion, and passes from a dynamic into a statical state: and then the correlative power, in its turn, may become a *vis viva*, and give the body on which it acts a different kind of motion in an opposite direction. This action and reaction of the correlative physical powers may be made more plain by the following illustration.

Water when converted into vapour by the heat of the sun's rays ascends to a great height in the atmosphere; and being there condensed descends as rain, producing streams, which are often used, during their course to the ocean, for turning mills that perform a great variety of mechanical work. "This work," it is said, "is due to

the sun's rays, for energy is not created by the machinery ; the work performed by the water in its descent to a lower level is merely the parcelling out and distribution of work expended in raising it to the height from which it fell."* My explanation of the facts is different. The heat of the sun's rays does, indeed, convert the water into vapour, which ascends high into the air ; but having arrived there the sun's heat has finished its work : the vapour now, in its turn, becomes, like the sun, a radiating body, and diffuses the heat which it had received throughout the surrounding air ; and then returning to its former state of water descends to the earth as rain. This descent is due to the action of gravitating power, which was ever present both in the original water and in the vapour, but for a time was rendered latent by the predominance of the sun's repulsive force ; but being now freed therefrom, the condensed vapour, as rain, is drawn by gravity back to the earth, and by its action the stream formed by the rainfall seeks a lower level : the downward course of the stream, and its momentum that turns the mill's wheel, is not, therefore, due to the sun, but to the force of gravity. It may, however, be objected that the stream's force is *consequent* on the antecedent elevation of the water, which proves that it was caused by the sun's heat ; for such a sequence most physicists believe to be the cause of physical phenomena. It is evident that in this case, such a doctrine of causation is placed on the horns of a dilemma : for since gravity acted on the water previous to its evapo-

* Fragments of Science, vol. ii., p. 47.

ration by the sun's rays, it must, therefore, be the cause of the water's elevation contrary to the law of gravitation: a conclusion which may be fairly pronounced to be a *reductio ad absurdum*.

9. The passage of heat through solid bodies is called conduction; and these bodies vary much in their capacity for conducting heat. Metals are the best conductors, as might be expected; for their molecules are very near each other, and they are also elementary substances which favour conduction: they differ, however, much in this respect; but as a general rule, the denser the metal the better it conducts. Amorphous solids conduct equally well in every direction, and Senarmont ascertained that crystals of the regular system do so likewise; whereas those belonging to the other systems conduct best in the direction of their optical axes. These facts show that conduction is modified by the manner in which the molecules of solids are arranged; for it varies on the lines of lesser or greater degrees of resistance to the passage of heat: so that the condition of the medium through which heat passes is an important factor in the explanation of conduction.

“With one exception,” says Professor Tyndall,* “I found that the conductivity of solids augmented with their diathermancy: the exception was furnished by a cube of perfect rock-crystal, which conducted slightly better than a cube of rock-salt, which has very high conducting power. The molecules of rock-salt glide with facility through the

* Philosophical Transactions, 1861.

interstitial ether, but the ease of motion which they enjoy must facilitate their mutual collision. Their motion, instead of being expended on the interstitial ether, and communicated by it to the external ether, is in great part transferred from particle to particle; or, in other words, is freely conducted. When a molecule of 'alum, on the contrary, approaches a neighbouring molecule, it produces a swell in the intervening ether, which swell is in part transmitted, not to the molecules, but to the general ether of space, and thus lost as regards conduction. This lateral waste prevents the motion from penetrating the alum to any great extent, and this substance is called a bad conductor."

From my point of view, these phenomena receive a somewhat different explanation. Conduction takes place with various degrees of rapidity according to the composition and molecular arrangement of solid bodies. In the case of rock-crystal, its chemical equivalent is a little lower in weight than that of rock-salt; so that its molecules require less heat to make them radiating bodies; and are, therefore, slightly better conductors than those of rock-salt. The reverse of this might have been expected; for rock-salt belongs to the regular system of crystals, which affords a freer passage for the transmission of heat. The molecules of solids are so firmly held together by cohesion that they do not, I think, enjoy any facility of gliding through the interstitial ether so as to come into mutual collision; it seems to me more probable that they absorb the heat that impinges on them, and thereby become radiant bodies, which transmit the heat onwards through

the intervening ether to the nearest molecules in the direction of its course; and by the successive repetition of this process conduction is effected. It is not far to seek for the reason why a crystal of alum is a very bad conductor of heat, compared with a crystal of rock-salt. The latter is a compound of two chemical elements, whereas the former consists of four binary compounds—alumina, potassa, sulphuric acid, and ice, that is, solid water—and consequently the molecules are far heavier than those of rock-salt, and require the absorption of a much larger amount of heat to become radiating bodies; but what is, perhaps, a far greater means of retarding the passage of heat through alum is the presence of ice, which has a high power of intercepting heat, and the continual absorption of heat by these causes may partially disintegrate the crystal, and make it still more impervious to heat. Transverse vibrations may be communicated laterally to the external ether; but the course of longitudinal undulations, those of heat, cannot, I think, suffer lateral waste.

When heat is applied to the lower portion of gases, it is transmitted by convection, as in the case of liquids; that is, the molecules absorb heat and expand, and thus becoming lighter than the incumbent molecules, they are forced upwards by the downward pressure of the heavier molecules according to the law of gravity. But when radiant heat is transmitted laterally through gases and vapours, the resulting phenomena vary according to the weight and volume of their molecules. We are indebted for most that we know on this branch of molecular physics to the able

researches of Professor Tyndall ; and this forms the subject of his communication to the Royal Society above quoted, from which I will again select some interesting and instructive passages. “In the experiments recorded in the foregoing pages, we have dealt with free atoms [molecules], both simple and compound ; and it has been found that in all cases absorption of heat takes place. The meaning of this, according to the dynamic theory of heat, is that no atom is capable of existing in vibrating ether without accepting a portion of its motion. . . . No matter what the quality may be which enables any atom to accept such motion, the same quality must enable it to impart motion to still ether. From the existence of absorption we may, on theoretic grounds, infallibly infer a capacity of radiation, and from the existence of radiation we may infer, with equal certainty, a capacity of absorption : and each of them must be regarded as a measure of the other. Great differences have been shown, by the above experiments, to exist among gases as to their powers of absorption and radiation. What specific property is it that makes one molecule a strong absorber of heat, while another offers scarcely any impediment to the passage of radiant heat ? I think that the experiments throw some light upon this question. For we have found that the *elementary* gases—hydrogen, oxygen, and nitrogen—possess absorptive and radiative powers beyond comparison less than those of the compound gases. Uniting the atomic theory with the conception of an ether, this result appears to be exactly what ought to be expected. Taking Dalton’s idea of an elementary body as a sphere,

and supposing such a sphere to be set in motion in moving ether, the communication of motion by the atom in the first instance, and the acceptance of it in the second, must be less than when a number of such atoms are grouped together, and move as a system. Thus a small effect is produced on a mixture of hydrogen and oxygen or on that of hydrogen and nitrogen; but when aqueous vapour and ammoniacal gas are formed by the chemical union of these mixtures, then the action of radiant heat thereon produces an enormous effect."

The molecules of gases are far more free to move than those of solids, and yet the transmission of heat through them is not now ascribed to their collision, but to the absorption and radiation of heat from molecule to molecule. The molecules of the elementary gases, comparatively to their size, are far apart from each other, immersed, as it were, in an expanse of interstitial ether: so that being beyond the attraction of cohesion they are free to rotate on their axes individually by the interaction of their correlative "molecular forces." So when radiant heat impinges on one side of the rotating molecules it is absorbed, and is radiated from the molecules as they turn from the source of heat; somewhat in the same manner as the earth gives up by night the heat it received from the sun by day: the difference between them is, that in the former case the process is so instantaneously performed that the absorbed and radiated heat are equal. The absorptive and radiative powers of the elementary gases are less than those of the compound gases, because the molecules of the latter have a greater weight and volume; and,

therefore, require more heat to make them radiating bodies, and also rotate more slowly on their axes, which diminishes the rate at which heat is transmitted.

10. The last correlative mode of the physical powers, attraction and repulsion, which remains to be considered, is that of magnetism and electricity. These powers are cosmical as far as regards our little world, the solar system ; but they are not cosmical in the sense of being universal, for centripetal and centrifugal forces are the only modes of attraction and repulsion entitled to this character.

“The distribution of terrestrial magnetism,” says Mrs Somerville,* “is very complicated. It is an unseen power whose influence extends over every part of the earth, depending on the heat and motion of the sun, on galvanic currents circulating in the earth, on unequal temperature of the globe, on changes of temperature which elicit magnetic and electric currents. What part any of these causes have individually on the general result, or the reasons of its perpetual changes, are altogether unknown.” Much as we have yet to learn on this subject, it is, however, well known that magnetism cannot exist apart from electricity, and *vice versa* : for the instant a substance is affected by one of these forces it is affected by the other, but in transverse directions. So that to these forces, as pointed out by Sir W. Grove, “the term correlation may be applied in accordance with its original meaning ; for they are inseparably and mutually dependent—correlative, but not identical.”

* The Connection of the Physical Sciences, p. 341.

Molecular bodies, when under the influence of magnetism and electricity, manifest polar phenomena ; that is, movements in opposite directions, tangential currents, which are related to molecules, as the central forces are to the ethereal atoms : and when these currents pass from one medium into another they apparently seem to be broken ; and such indications are termed the north and south poles of the magnet, and the positive and negative poles of electrified bodies. This property of polarity distinguishes magnetism and electricity from all other molecular forces ; so that we are now entering on a distinct branch of physics. I am aware that the phenomenon of crystallisation is ascribed to a molecular polarity : but the force of cohesion is, I think, adequate to the building up of crystalline molecules into large crystals by the union of their facets.

The remarkable fact of the magnetic needle pointing to the north pole of the earth suggested that the terrestrial globe itself may be a magnet : and that it really is such a magnet seems to be demonstrated by its imparting, like ordinary magnets, its influence to a steel bar by induction. A steel wire statically suspended is indifferently attracted at either of its ends by a magnet ; but if a magnetised steel wire be so treated, one end of it is attracted and the other repelled by the north pole of a magnet ; that is, attraction takes place when different poles are presented to each other ; and repulsion, when the poles are of the same kind. A magnetised wire, however long it may be, has only one north and south pole ; but if divided into a hundred or more parts, each part will have

opposite poles, which mutually attract and repel each other; and if all these parts be arranged in a line having their north poles pointing in the same direction, they will attract each other and unite into a continuous chain, which has now, as before division, only one north and south pole. This fact seems to indicate that the molecules of a magnet may be arranged in a similar manner. If the two poles of a magnet be united by its keeper, or the ends of the above-mentioned chain be brought into contact, there is no longer a manifestation of north and south poles: it would, therefore, appear that the normal condition of magnetic force is that of a continuous and re-entering current; and that the departure therefrom, as in the unarmed magnet, is more apparent than real; for the current still circulates, but through different media. This accords well with the more prevalent opinion that there are not two kinds, but only one kind of magnetic force: and according to my view this force is a mode of the physical power, attraction, the correlative of electricity, a mode of repulsion. Now gravitation is also a mode of the physical power, attraction; but, as Clerk Maxwell* says, "it differs from the electric and magnetic forces in this respect, that the bodies between which it acts cannot be divided into two opposite kinds, one positive and the other negative, but are in respect of gravitation all of the same kind, and that the force between them is in every case attractive. To account for such a force by means of a stress in an intervening medium, on

* *Encyclo. Britan.*, vol. iii., p. 64.

the plan adopted for electric and magnetic forces, we must assume a stress of an opposite kind from that already mentioned. We must suppose that there is a pressure in the direction of the lines of force, combined with a tension in all directions at right angles to the line of force. Such a state of stress would, no doubt, account for the observed effects of gravitation; we have not, however, been able hitherto to imagine any physical cause for such a state of stress."

I am inclined to think that the reason why diverse poles are not manifested by gravitation is because it flows onward in uninterrupted re-entering currents in the ethereal medium of space; just as happens when currents of electricity and magnetism flow in closed currents through the same kind of medium. The currents of gravitation are always accompanied by tangential currents of its correlative centrifugal force; so that "there is a pressure in the direction of the lines of force, combined with a tension in all directions at right angle to the line of force," which is all that is requisite to explain the action of gravitation, and that of magnetism on the same principle.

11. Electricity is a force of a totally different character from that of magnetism; but in respect to polarity and its transmission in currents from molecule to molecule, both forces are similarly constituted. "Judging," says Faraday,* "from facts only, there is not as yet the slightest reason for considering the influence present in the electric current as a compound influence. It has never been

* *Experimental Researches in Electricity*, par. 517, 1627, 416.

resolved into simpler influences, and may, perhaps, be best conceived of as an axis of power, having contrary forces, exactly equal in amount, in contrary directions. It is essentially connected with the very nature of the electric current that it is always the same. . . . It appears to me to be impossible to assume a current of positive or one of negative force alone ; or of two at once with any predominance of one over the other. . . . I am persuaded that the polar forces of electricity, as in induction or electrolytic action, show effects at a distance only by means of the polarised contiguous and intervening particles : and I have been led to suspect that all polar forces act in the same general manner. . . . It is apparently of polar forces that such should be the case ; for one force either finds or develops the contrary force near it, and therefore has no occasion to seek for it at a distance. . . . I think that these researches tend to confirm the view first taken, namely, that ordinary inductive action, and the effects dependent upon it, are due to an action of the continuous particles of the dielectric interposed between the charged surfaces, or parts which constitute, as it were, the termination of the effect. The great point of this conception is the making the dielectric of essential importance, instead of leaving it, as it were, a mere accidental circumstance, having no influence over the phenomena."

These important results of Faraday's researches show that the electric and magnetic currents consist of a continuous and successive polarisation of different molecular media ; and that it only manifests poles at the point of its passage into and from another medium. So that, as he

says, "the electric poles are mere ways or doors by which the current passes into and out of the interposed dielectric." At these points there is no breach in the continuity of the current; it flows onward, just as that produced by radiant heat does in its passage through different media; the one by absorption and radiation, the other by the polarisation of molecules. He rightly affirms that "the influence in the electric current is not a compound influence;" and yet he speaks of this current "as having contrary forces, exactly equal in amount, but in contrary directions." I may have misapprehended Faraday's statement, but these two forces seem to refer to the attractions and repulsions which take place when the same or opposite poles of two charged bodies are brought near to each other. In either case the result does not arise from an antagonism of forces of a different nature; but from the effort of one and the same electric force to maintain its current in the same direction, by which it forms a closed circuit. Faraday in another passage alludes to magnetism, "the lateral or transverse forces of the electric current," which, he says, in their simplest forms appear "as attraction or repulsion according as the currents are in the same or different directions." In this case, it can be experimentally demonstrated that attraction and repulsion are not caused by two distinct forces flowing or capable of flowing in currents of different directions: for if the south pole of a more powerful magnet be brought near the south pole of a mounted magnet, pointing to the north, the latter will swing round, and its north pole will point in the same direction as the north pole of the stronger magnet, showing

that the current in both magnets is in one and the same direction. In every polar phenomenon two forces of an opposite nature are indeed concerned, but these do not belong solely to magnetism or electricity; they are the forces of these correlative powers themselves, which produce axial and equatorial currents, which flow around each other, like the central forces of stellar bodies.

This antagonism of the polar molecular forces enables us to understand some curious facts which occur during the production of these forces. Thus during the magnetisation of iron heat is evolved, indicating a condensation of its molecules by magnetic force, a mode of attraction similar to what takes place when iron is mechanically compressed. Joule, who discovered this fact during his experiments on magnetic induction, ascertained that the entire volume of the iron is not altered; for what it gains in length it loses in breadth, which shows that the action of magnetism on the molecules of iron is analogous to wire-drawing. On the other hand, electricity gives rise to a phenomenon of an opposite character; for its tendency is to shorten a wire and to increase its thickness: and so this repulsive force subverts the constrained position of molecules occasioned by wire-drawing.

Chemical compounds in the solid state are non-conductors of electricity, but when melted become very good conductors of this polar force: this is the reverse of what takes place in the case of heat. "If, therefore," says Faraday,* "the properties of heat and electricity, in rela-

* Ibid, p. 118, par. 416 and par. 413.

tion to conduction, are not incompatible, still they are most strongly contrasted, one being lost as the other is gained. We may hope hereafter to understand the reason of these phenomena. . . . In almost all the instances as yet observed, the substances experimented with have been those which were not only compound bodies, but such as contain elements known to arrange themselves at the opposite poles ; and were also such as could be decomposed by the electric current. When conduction took place, decomposition occurred ; when decomposition ceased, conduction ceased also : and it becomes a fair and important question, Whether the conduction itself may not, whenever the law holds good, be a consequence not merely of the capability, but of the act of decomposition ? And that question may be accompanied by another, namely, Whether solidification does not prevent electrical conduction, merely by chaining the particles in their places, under the influence of aggregation, and thus preventing their separation in the manner necessary for decomposition ?” These questions indicate that it is intended that they should be affirmatively answered ; and the answers are so convincing that they cannot fail to obtain general assent.

12. As far as we have advanced in the exposition of natural powers, the following conclusions have been arrived at, viz. :—That the ether of space is pure matter, possessing no other than the material, that is, physical properties, which constitute its nature : and that these properties are the attributes of the physical powers of attraction and repulsion, of which the ether is composed. That the

world originally was simply a material world, consisting of one vast orb of ether ; and that from this orb the original nebula, and all the celestial bodies evolved therefrom, derived all the matter contained in their molecular bodies, and consequently all their physical forces. And, lastly, that during the condensation and cooling of our terrestrial nebula, its gases and vapours uniting formed all the lifeless things of our planet—earth, air, and water—which are commonly regarded as various kinds of gross matter, all of which are the molecular bodies of chemical substances. If in the investigation of these bodies we mentally abstract—that is, take no account of the chemical powers with which they are united—then these different kinds of molecules constitute the subject of molecular physics: this science treats of the changes which these little masses undergo by the interaction of their molecular powers ; but of no other phenomena, for material, that is physical powers, when they act and react on each other, can only produce various kinds of motion.

CHAPTER IV.

The Chemical Powers—And their Phenomena.

Introduction.—2. Constitution of the Chemical Elements.—3. The Definite Weights of their Molecules.—4. The Crystalline Forms of Molecules.—5. Affinity, the Force of Chemical Powers.—6. Various opinions thereon.—7. Grove on the Identity of Attraction and Affinity.—8. Tyndall on the same subject.—9. Faraday on the Identity of Affinity and Electricity.—10. On Electro-Chemical Decomposition.—11. The Interaction of the Chemical Powers.—12. Conclusion.

1. Chemists, by analysis, have detected in lifeless things about sixty different substances, called chemical elements, not because they are absolutely simple substances, but because, as yet, they have resisted decomposition. The result of this analysis is regarded by Evolutionists as a proof that these elements are only various kinds of matter; but this is not correct: for the lifeless things analysed, commonly called gross matter, are chemical compounds; so that the products obtained are not different kinds of matter, but different kinds of chemical elements, all of which, besides material properties, possess others of a very peculiar character. Things are only known by their properties; and as the presence of physical powers in the elements is known by their material properties, so is the presence of chemical powers demonstrated by their peculiar properties.

2. Each element, though a simple chemical substance, is a compound of a molecule, or little mass of matter, consisting of a definite quantity of ethereal—that is, material—atoms, and of a specific chemical power; the former is the quantitative, and the latter the qualitative constituent of the element; so that there are as many kinds of molecules as there are chemical powers. The different modes of molecular forces, and the results of their interaction, have been already described: but before considering the nature of the chemical powers and their interactions, it is expedient to say a few words about the constitution of molecules.

3. The number of material atoms in each kind of molecule cannot be absolutely determined, so that our knowledge of this subject can only be relative to an adopted standard of unity; and as hydrogen is the lightest of all the elements, it has been more generally accepted than that of any other, as the unit of chemical equivalents. It was thought, at one time, that the weight of every element was a simple multiple of hydrogen; but more accurate analyses made it necessary to express the weights of the elements in decimal fractions, as in the following examples. Thus hydrogen being unity 1·000, carbon is 11·970, nitrogen 14·010, oxygen 15·960, sulphur 31·980, chlorine 35·360, and so on up to the highest, bismuth, 207·500. Now, if it be assumed that the molecule of hydrogen is composed of 1,000 ethereal atoms, then, deleting the decimal point in the above notations, they aptly represent the number of material atoms in the molecule of each kind of element. And we thus get rid of the notion,

which is now so prevalent, that the elements are atoms, and their compounds molecules; for the material basis of every chemical substance, whether simple or compound, is a molecule, or little mass of material atoms. "By admitting," says Sir John Herschel,* "that the particles [molecules] of bodies consist not of a few only, as hitherto done by Dalton and others, but of a great multitude of thousands, or perhaps millions, of atoms, not only may the facts of crystallography be represented, but much light also thrown upon many points in the theory of the absorption of light, the colours of bodies, and their power of conducting heat. And the great stumbling-block of atomic chemistry—the necessary subdivision of an atom—would at once disappear under such a mode of considering its ingredients."

The specific quantity of matter in the molecule of each element is permanently unalterable; for, however complicated may be the substance into which the element enters, when recovered therefrom it always retains its specific weight. Such a definite composition of every kind of molecule gives it, as Sir John Herschel† says, "the essential character of a manufactured article," which "effectually destroys the idea of an eternal self-existent matter." Different as all these molecules are from each other, they have all been formed from one and the same matter, each one according to a peculiar pattern or design.

"No theory of Evolution," says Professor Maxwell,‡

* *Essays*, p. 231.

† *On the Study of Natural Philosophy*, p. 38.

‡ Quoted by J. W. Reynolds, in "*The Supernatural in Nature.*"

“can be formed to account for the similarity of the molecules throughout the universe; for Evolution implies continuous change, and the molecule is incapable of change or destruction. Though in the course of ages catastrophes have occurred, and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules of which these systems are built—the foundation-stones of the material universe—remain unbroken and unworn.”

4. The weight of the chemical molecule is not, however, its only physical property; it has also, like the material atom that enters into its composition, the correlative property of volume; and the volume of natural bodies is never void of form; in the material atom it is spherical, but in the molecule it is crystalline. We know that the molecules of some elements have respectively a peculiar form of crystal; and this probably holds good in all: for the union of numerous atomic spheres into one body would necessarily assume a symmetrical figure: we can never expect to be able to discern the form of an individual molecule; but when numerous molecules of the same kind are aggregated together, the resulting crystal is very conspicuous. There is reason to believe that all the molecules of the same kind have identically the same form; or, in the words of G. H. Lewes, the molecule is “the whole crystal writ small.”

“When a solution of common salt,” says Professor Tyndall,* “is slowly evaporated a crystalline mass is

* *Fragments of Science*, vol. ii., pp. 81 and 85.

obtained, a mimic representation of the architecture of Egypt, little pyramids formed by terrace rising above terrace from base to apex. Guided by the analogy of the constructive power of crystallisation, you may, if you like, suppose that swarming among the constituent molecules of the salt there is an invisible population, controlled and coerced by some invisible master, in placing the atomic blocks in their position. This, however, is not the scientific idea. This idea is, that the molecules act upon each other without the intervention of slave labour; that they attract and repel each other, at certain definite points or poles, and in certain definite directions: and that the pyramidal form is the result of this play of attraction and repulsion. . . . The formation of a crystal is, in the eyes of many scientific thinkers, a purely mechanical problem."

This graphic description of the analogy between the construction of the Egyptian and saline pyramids is very suggestive; but it does not prove, I think, that the formation of a crystal is a purely mechanical problem. In both cases a special work is performed by appropriate agents, according to a predetermined design; in the one case, under the direction of a superintending intelligent agent; and in the other, under that of physical powers. On my view of the subject there is also in both cases a preliminary work to be performed, in preparing the blocks for the builder according to a particular pattern. The blocks of stone and brick used in building the Egyptian pyramid are the production of a mechanical art under the supervision of a skilful agent. So, in like manner, the mole-

cular blocks of the crystalline pyramid are compounds of two elements, formed by their chemical powers, interacting according to special designs, the laws of their formative energies. When the materials of both are ready for building—that is, when the blocks have been brought to the locality of the pyramid, and when the solution has been evaporated so as to set the molecules free—then the works respectively are carried on by slave labour and by physical powers, under the guidance of agents regulated by special plans. In the case of the saline pyramid the molecules do not act by attracting and repelling each other, at certain definite points and poles; the pyramidal form is not the result of this play of attraction and repulsion; the only part that repulsion plays is in the evaporation of the solution of the salt; but this is not effected by molecular repulsion, but by an extraneous influence; and then molecular cohesion is in the ascendant, and unites the cubical molecules by their sides only in forming terraces one above another from base to apex. I have contrasted our different views of this crystallisation in order to point out that it is not phenomena that follow laws, but natural powers acting according to law that produce phenomena.

The formative property of chemical powers was probably exercised only once for all in the construction of the chemical elements by their union with the material atoms of ether, which resulted in the production of the original nebula: and this building up of the crystalline molecules was not “the first structural effort of Nature,” for she had previously given material atoms a spheroidal

form, effected by the interaction of the attractive and repulsive forces of the physical powers. The nature of physical and chemical powers is very different, as clearly indicated by their respective phenomena; those of the former are only various modes of motion, whereas those of the latter are different kinds of combination.

5. Let us now consider the nature of that peculiar power, commonly called chemical force or affinity. The first and most obvious characteristic of affinity is, that it unites dissimilar substances into homogeneous compounds: and this led Newton to think "that chemical combinations cannot be conceived of in any other way than as an attraction of particles." There can be little doubt that chemical powers partake somewhat of the nature of physical attraction: and I am inclined to think that they are related to it, as species are to their genus; that is, they unite molecules, but not indiscriminately as attraction does, for they only combine different kinds of molecules, and that too, as it were, by preference, selecting some and rejecting others. It is this elective attraction or affinity that denotes the specific difference between chemical and physical attraction.

6. At the present day scientific opinion is much divided concerning the nature of chemical force: some maintain with Newton that it is the same as physical attraction; others, that it is electricity, a force the nature of which is directly opposite to that of attraction, for it is a mode of repulsion, which decomposes chemical compounds into their elements. In order to illustrate this, I propose making a few remarks on the views of these different parties, and to

contrast them with the one I am advocating, viz., that chemical force is an energy *sui generis*, that of chemical power, and that there are as many species of this power as there are chemical elements, as each of these is a compound of a special molecule and a specific chemical power.

7. Sir W. Grove is of opinion that chemical force is, like all other forces, a mode of motion; and that its relation to attraction and electricity is that they are mutually convertible: but I had better state it in his own words. "Chemical affinity," he says,* "is that mode of force of which the mind has hitherto formed the least definite idea. . . . The nearest approach, perhaps, that we can make to a comprehension of chemical action, is by regarding it—vaguely, perhaps—as a molecular attraction or motion. It will directly produce motion of definite masses, by the resultant of the molecular changes it induces: thus the projectile effects of gunpowder may be cited as familiar instances of motion produced by chemical action. It may, however, be a question whether, in this case, the force which occasions the motion of the mass is a conversion of the force of chemical affinity, or whether it is not rather a liberation of other forces existing in a state of static equilibrium. . . . But at all events, through the medium of electricity, chemical affinity may be directly and quantitatively converted into the other mode of force."

The difficulty of forming a definite idea of affinity, and of determining whether it or physical force produces

* The Correlation of Physical Forces, pp. 164 and 174.

certain changes, is here candidly admitted; and as long as affinity is regarded as a mode of force capable of being converted into the physical forces of attraction and electricity, this perplexity will be an insoluble mystery. When chemical powers energise they do not act directly on material molecules and put them in motion; but they act on each other, producing new combinations: and the physical phenomena attendant on chemical action and reaction are produced by the interaction of the physical forces of the molecular bodies concerned in the operation. Thus whilst the result of the latter reaction is some mode of motion, that of the former is the production of new compounds; effects which are as dissimilar as their causes: and such different things are correctly distinguished by the terms chemical and physical. The part which physical forces perform when applied to chemical substances is not that of conversion into chemical forces, but that of so approximating the molecules of these substances as to enable the chemical forces to interact. For instance, when chemical substances are solid, their molecules are so firmly bound together by the attraction of cohesion that they cannot get intermingled, so as to bring their chemical forces within the sphere of action: hence the old maxim, that bodies do not act chemically on each other unless in solution; and though there are exceptions, the rule generally holds good. Again, many elements, both solids and gases, when mixed together will remain perfectly passive, though having a strong affinity for each other. Gunpowder is a mixture of such solid substances, and when intensely heated by an ignited body or an

electric spark, some grains of it are fused, thus enabling its elements to combine with extrication of intense heat, which extends almost instantaneously to the rest of the powder, causing an explosion in consequence of the great volume of gases and vapours thus produced: in this phenomenon the change of composition is chemical, and the projectile effect is physical. In the case of mixed gases, their elasticity keeps their molecules far apart beyond the sphere of action, but by compression or other means they may be brought near, and then combination takes place. So that in both cases, whether attraction or repulsion be the physical force that facilitates combination, there is no conversion of one kind of force into another. In every case of chemical action, affinity has done its work when it has effected new combinations; and the physical forces concerned in these operations, whether antecedent or subsequent to combination, perform no other office than that of imparting to the molecules of the chemical substances various kinds of motion.

8. "As regards the convertibility into heat," says Professor Tyndall,* "gravity and chemical affinity stand precisely on the same footing: the attraction in the one case is as indestructible as in the other. . . . Nobody means to affirm that the mutual attraction of oxygen for hydrogen ceases after the atoms have combined to form water. What is meant in the case of chemical affinity is, that the pull of affinity acting through a certain space imparts a motion of translation of one atom

* *Fragments of Science*, vol. i., p. 11.

toward the other. This motion is not heat, nor is the force that produces it heat. But when the atoms strike and recoil, the motion of translation is converted into a motion of vibration, which is heat. In this sense, and in this sense only, is chemical affinity converted into heat."

I admit that the convertibility of gravity and affinity into heat stands precisely on the same footing; but I maintain that neither of these attractive forces can be, in any sense, converted into the repulsive force heat. What evidence have we that affinity can exert a pull capable of imparting a motion of translation of the atoms of oxygen and hydrogen toward each other? Such a motion is not a chemical, but a physical effect. We know that the molecules of these gases, at the ordinary temperature and pressure, though possessing a strong affinity for each other, will not approximate unless brought together by the action of extraneous physical force; and then they will be pulled toward each other by attraction, or driven against each other by repulsion within the influence of affinity, by which they will be combined and form water. Some light is thrown on the nature of the *pull* that causes the motion of translation, when a clean plate of the metal, platinum, is plunged into a mixture of these gases. In a short time, the surface of the metal will be covered with dew; the presence of moisture indicates that the gases have combined and formed water; and we have not far to seek for the cause of the motion of translation that brought their atoms within the range of chemical combination. Platinum is a metal of great density, owing to the high degree of cohesive attraction

by which its molecules are held together; so that in a mixture of oxygen and hydrogen, it acts thereon in the same manner as the earth does on its surrounding atmosphere. The layer of gases next the metal suffers condensation, their molecules being drawn together by the gravitating attraction of the metal, which absorbs the heat disengaged by the condensation; and the gases thus approximated by the *pull* of the metal's gravity enter into combination. The metal undergoes no chemical change; but it gradually becomes hotter and hotter until it attains a state of ignition; and then the remaining gases unite, not silently as before, but with explosion, owing to their being instantaneously and totally combined. Here, then, we have chemical action by repulsion, a different force from that of attraction: the approximation of molecules by physical action is the condition of union in both cases; in the one the atoms are drawn, and in the other violently driven together, so as to bring them within the sphere of chemical action. In the early stage of the experiment there is no striking and recoil of atoms; on the contrary, they are quietly drawn together by the cohesive force of the metal. It is not this motion which causes the heat; the heat that raises the temperature of the metal is the latent heat of the gases, which is liberated during their condensation: the resulting vibration is not heat, but the effect of heat.

What I am striving to show is, that the elements are compounds of physical and chemical powers; and when two elements interact they accordingly give rise to both physical and chemical phenomena: and if it be borne in

mind—that physical powers only produce various modes of motion, and that chemical powers only produce different kinds of combination—there ought to be no difficulty in mentally separating these two kinds of phenomena, and making them distinct subjects of investigation. No chemical power can act on itself; and in this respect it is like physical powers, for neither attraction nor repulsion can so energise: there is action and reaction in every phenomenon; and this only takes place by the interaction of two or more antagonistic powers.

9. Having considered and rejected the hypothesis that gravity and affinity are modes of one and the same force, there remains to consider the hypothesis that affinity is identically the same as electricity, a mode of the physical power, repulsion. Sir Humphrey Davy claimed the credit of having first advanced this doctrine; but this, whether justly or not, has been disputed: he, however, certainly was the first to support it by a series of brilliant experiments, which introduced a new mode of chemical investigation. Since then, Berzelius has most ably advocated this doctrine, and reduced it to a more definite system; but to Faraday is due the merit of having completed the evidence in its favour by demonstrating the equivalence of chemical and electrical phenomena.

“The electricity of the voltaic pile,” says Faraday,* “is entirely due to chemical action, and is proportionate in its intensity to the intensity of the affinities concerned in its production. This definite production is one of the

* *Experimental Researches in Electricity*, pars. 916, 918, 947.

strongest proofs that electricity is of chemical origin. . . . All the facts show us that the power, commonly called chemical affinity, can be communicated to a distance through metals ; that the electric current is only another form of the forces of chemical affinity ; or, in other words, that the forces termed chemical affinity and electricity are one and the same. . . . In one mode of chemical action we can transfer the power onwards, and make it produce elsewhere its equivalent action ; and in the other, it is not transferred, but exerted wholly on the spot. The first is the case of volta-electric excitation ; the other is that of ordinary chemical affinity : but both are chemical actions, due to one force or principle."

I have already expressed my opinion that forces so different as those of affinity and electricity ought not to be regarded as identical. The properties of these forces are distinctly unlike ; and we only know things by their properties : they produce opposite effects ; the one forms compounds, whereas the other decomposes them. Affinity is an elective force by which one chemical power acts on another of a different kind, combining with that for which it has the strongest attraction to the exclusion of others ; electricity, on the other hand, is a polar mode of repulsive power which can only produce polar phenomena by its interaction with its correlative power, magnetism. When one chemical substance acts on another, and combination takes place, this is usually attended by a discharge of repulsive force, owing to the molecular condensation of one or both of the interacting substances ; and if this occurs under suitable conditions, such as the arrangements of the

galvanic battery, then this force assumes the mode of electricity, and may be conducted by wires to energise elsewhere. If this force be employed in decomposing a binary chemical compound, it does not do so chemically—as affinity does when it has a stronger attraction for one of the constituents of the compound and sets the other free—but physically as a repulsive force it drives the elements of the compound asunder, and arranges them apart at the opposite poles of the battery. So, then, it is not chemical force that is transmitted by the wire, but electricity: indeed such a transmission is impossible, for the chemical powers of the elements are indissolubly united with their respective molecules, which cannot be transferred through wires. It is true that voltaic electricity is of chemical origin; but it is not a fact “that the power commonly called chemical affinity can be communicated to a distance through metallic wires:” it is electricity that is so conveyed, and its action in effecting decomposition is not a chemical but a physical operation. That the same quantity of electricity produced by chemical action in the battery should cause an equivalent amount of decomposition at a distance is an interesting fact; but it does not prove that affinity and electricity are “one and the same power:” it only shows that chemical combination has evolved sufficient electricity to decompose a like amount of a chemical compound.

10. The ability of voltaic electricity to effect chemical decomposition is one of the most important properties of this repulsive energy; and for this reason I reserved its consideration until the subject of chemistry engaged our

attention. When the poles of the voltaic battery are in contact with a compound in a decomposable condition—that is, in a liquid state, either that of solution or fusion by heat, when its molecules are free to move—then its constituents severally collect at the opposite poles of the battery, with which they either unite or remain free in the adjacent liquid; and in order to avoid the former occurrence, platina-wires are used for the poles, as this metal is acted on by few substances.

“Passing,” says Faraday,* “to the consideration of electro-chemical decomposition, it appears to me that the effect is produced by an internal corpuscular action, exerted according to the direction of the electric current; and that it is due to a force either superadded to, or giving direction to, ordinary chemical affinity of the bodies present. The body under decomposition may be considered as a mass of acting particles, all those that are included in the course of the electric current contributing to the final effect; and it is because the ordinary chemical affinity is relieved, weakened, or partly neutralised by the influence of the electric current in one direction parallel to the course of the latter, and strengthened or added to in the opposite direction, that the combining particles have a tendency to pass in opposite courses. . . . The theory which I have ventured to put forth requires that in a compound body, capable of electro-chemical decomposition, the elementary particles have a mutual relation to and influence upon each other, extending beyond those

* Ibid, pars. 518, 523, 524, 550.

with which they are immediately combined. Thus, in water, a particle of hydrogen in combination with oxygen is considered as not altogether indifferent to other particles of oxygen, although they are combined with other particles of hydrogen; but to have an affinity or attraction towards them, which, though it does not at all approach in force, under ordinary circumstances, to that by which it is combined to its own particle, can, under the electric influence, exerted in a definite direction, be made even to surpass it.

. . . I have now stated in general terms the view I entertain of the cause of electro-chemical decomposition. I conceive the effects to arise from forces which are *internal*, relative to the matter under decomposition; and not *external*, as they might be considered if directly dependent upon the poles. . . . I think, therefore, it would be more directly expressive of the facts, to speak of such a body in relation to the current passing through it, rather than to the poles in contact with it; and say that, whilst under decomposition, oxygen, chlorine, iodine, acids, &c., are rendered at the negative extremity of the current; and combustibles, metals, alkalies, bases, &c., at its positive extremity. I do not believe that a substance can be transferred in the electric current beyond the point where it ceases to find particles with which it can combine. . . .

Some of the most beautiful and surprising cases of electro-chemical decomposition and transfer which Sir Humphrey Davy described were those in which acids were passed through alkalies, and alkalies through acids; and the way in which substances having the most powerful attractions for each other were thus prevented from combining,

excited the utmost astonishment. But if I be right, that which made the wonder is in fact the *essential condition* of transfer; the more alkali there is in the course of an acid, the more will the transfer be facilitated."

Faraday's theory of electro-chemical decomposition is not, I think, altogether satisfactory: on several points his remarks are most important; and I am indebted to them for being able to form any opinion on the subject. In searching for an explanation of this complicated process, let us trace the course of the electric current from the beginning; and mark the molecular changes that occur in the liquid medium at the different stages of the current's progress. The first stage is simply that of conduction: and Faraday tells us that "to produce decomposition, an electric current must not only exist, but also have a certain intensity before it can overcome the quiescent affinities opposed to it; otherwise it will be simply conduction without producing chemical effects." Let the liquid medium, through which the electric current is to be transmitted from pole to pole, be water, a binary compound of oxygen and hydrogen: then the first question that arises is, What is the condition of the aqueous molecules when under the influence of the electric current? Whatever it may be, one thing we know, that it is instantaneously produced: for in the wires of the galvanic battery, however long, when the poles are brought near each other, a continuous current immediately circulates through them; and the same takes place when the poles—the ends of the wires—are plunged into water at some distance from each other, and thus the molecules of the water in the course of the

current become electrified. Now, we know that when a body is in such a condition, it is at the same time magnetised by a tangential current of its correlative force. For this reason it is justifiable to suppose that each molecule of water in the course of the current is so conditioned, and that by the interaction of these forces it will be made to rotate on its axis, in the direction of the dynamic electric current, around the tangential magnetic current in a statical state.

The second stage in the progress of this phenomenon is that of decomposition, which occurs when the intensity of the current is sufficient for the separation of the oxygen and hydrogen of the water. Conduction and decomposition appear to be simultaneous, though it may be that the former was antecedent. The molecules of the water in the course of the current being now polarised and decomposed, the oxygen-molecules are, I conceive, simultaneously turned toward the negative pole of the battery, whilst the hydrogen-molecules are retained at the positive pole by the tangential magnetic current : consequently the oxygen of each aqueous molecule comes into contact with the free hydrogen of the molecule immediately before it, and uniting therewith reproduces a molecule of water to maintain the electric current. And as all the molecules in the course of the current are thus affected, at the same instant, a molecule of oxygen will be rendered at the negative pole, and one of hydrogen will be retained at the positive pole ; and as long as the current traverses the water this process will be continuously repeated : and as oxygen and hydrogen accumulate at their respective poles,

globules of these gases are formed, and ascend through the water, which descends into their place ; and thus continuous molecules are maintained for the uninterrupted transit of the electric current.

From what has now been said, it will be seen that the points on which I differ from Faraday are the following. He considers that “a particle of hydrogen in combination with oxygen is not altogether indifferent to other particles of oxygen, although they are combined with other particles of hydrogen.” On my view there is no need for imagining such an affinity of hydrogen for oxygen ; for both these elements are polarised and set free by the decomposing energy of the electric current, within combining distance of each other ; so that every oxygen-molecule in the series combines with the hydrogen-molecule immediately before it to form water. This view is consistent with Faraday’s remark—“I do not believe that a substance can be transferred in the electric current beyond the point where it ceases to find particles with which it can combine.” Another point on which we differ is this : He says, “It is because the ordinary chemical affinity is relieved, weakened, or partially neutralized by the influence of the electric current in one direction, and strengthened or added to in the opposite direction, that the combining particles have a tendency to pass in opposite directions.” This seems to be an attempt to explain the passage of oxygen to the negative pole, and of hydrogen to the positive pole ; which is generally supposed to take place. On the other hand, I conceive that the *modus operandi* consists in all the oxygen-molecules of the decomposed water being simul-

taneously turned towards the negative pole, whilst the hydrogen-molecules remain stationary ; and by the successive decomposition and reproduction of the aqueous molecules, oxygen is rendered at the negative, and hydrogen retained at the positive pole : so there is no need of the elements passing in opposite courses ; for oxygen is continuously delivered at the negative pole by the dynamic energy of electricity, and hydrogen retained at the positive pole by the tangential force of magnetism.

11. When two chemical elements combine they form a binary compound, in which one of the elements is the basic and the other the typical ingredient ; in such a compound the properties of the elements disappear, and are replaced by others, which belong to the compound : just as in the case of physical forces, when steam and ice act on each other and become water, the molecular forces, cohesion and heat, become latent or passive, and the resulting water acquires physical properties of its own. When two equivalents of an element combine with one equivalent of another element, then the resulting compound manifests the character of the predominant element, which may be either the basic or typical element of the compound. This is distinctly denoted by special terms in the case of salts composed of two binary compounds ; thus we have *neutral*, *sub*, and *super* salts. The elements of three or more kinds also combine in various proportions, forming homogeneous compounds, more or less complex. This general notice of them must suffice, for it is a large subject, and not required for the matter in hand.

CHAPTER V.

Complex Chemical Compounds—The Basis of Living Organisms.

Classification of Plants and Animals.—2. Protoplasm a Complex Chemical Substance.—3. Different Views of its Formation.—4. Chemical Forces alone cannot form Protoplasm.—5. Vital Power, the Subtile Influence, or Cause of Vital Phenomena.—6. Vital Power is not Transformed Heat.—7. Nor an Abstract Expression of Vital Conditions.—8. Objections to Vital Power Answered ; it is not a Force, but an Authority.—9. Its Controlling and Directing Influence.—10. The Potency of Matter cannot Develop Living Organisms.

1. Man is, as Lord Bacon said, the interpreter of Nature : and, in the exercise of this function, it came to pass that he was led by the analogy of his own living nature to regard all the things, which compose the little world in which he dwells, to be comprised in the two grand classes of living and lifeless things : again, perceiving that the things of each class were not all alike, he divided them into two sub-classes ; the lifeless into matter and chemical substances—the nature of which has already been considered—and the living into plants and animals, the nature of which will now occupy our attention.

The higher kinds of plants and animals are easily distinguished from one another ; but the lowest kinds of each are so similar that even the learned are often puzzled to

determine whether they are plants or animals. Formerly it was thought that all organisms could be arranged in a linear series gradually ascending from the lowest to the highest, but as our knowledge of them advanced it was found that such a notion is untenable. Naturalists are now inclined to regard the lowest organisms as constituting, as it were, the trunk of the tree of life, from which plants and animals branch off in two directions, forming distinct kingdoms; and from these main branches proceed various smaller branches—the sub-kingdoms, which again are divided into branchlets and twigs, representing the genera and species.

In order to simplify the subject of our inquiry, it is proposed to restrict our remarks to the animal kingdom; this will not, however, affect the question at issue, as the development of both kingdoms is similar in principle. The reason why the very lowest plants and animals are so like each other is, that they are merely minute cells or cellules, in the physical structure and chemical composition of which no difference can be detected. Such, also, is the character of the germinal cells of higher organisms, which grow by the addition of innumerable cells, formed and organised during their development. So that *cellules* may be regarded as the units of living bodies; just as *molecules* are the units of chemical substances, and as *atoms* are those of matter. It is in this sense that I use the words atoms, molecules, and cellules; and when in quotations these words are used in a different sense, I will occasionally take the liberty of inserting mine between brackets.

2. As the basis or substance of the chemical elements consists of definite quantities of matter, so the body of animals—all that is visible and tangible—is composed of complex chemical compounds, which Evolutionists have called protoplasm, a name which, if solely used in the sense of a lifeless compound, conveniently represents the basis of living organisms. Protoplasm is said to be like the white of an unboiled egg, both in appearance and in composition: and this is the albumen of chemists, consisting of carbon, oxygen, hydrogen, and nitrogen, with a small per centage of sulphur and phosphorus. Many other animal substances, such as fibrin, casein, &c., have a similar composition, though physically somewhat different. Mülder was of opinion that this similarity is due to their containing a common principle which he termed *protein*; this, however, has not been generally accepted. The characteristic feature of these substances is the quantity of nitrogen which they contain; and similar compounds occur also in the most nutritious kinds of vegetable food, especially in the seeds of the cereal grasses, and of leguminous plants: this is an important fact, for ruminating animals directly, and carnivorous animals indirectly, depend thereon for their nourishment. Here, then, the question naturally suggests itself, Whence do plants obtain their food? They subsist chiefly on carbonic acid, water, air, and ammonia, all of which are lifeless chemical substances: manures derived from the remains of plants and animals are also conducive to vegetable growth; but they are so in consequence of their decay, during which the aforesaid substances are eliminated.

3. The transformation of lifeless things into the organised compounds of plants is regarded as strong evidence that protoplasm can be spontaneously evolved from chemical substances, but I hope, in the sequel, to show that chemical forces alone cannot produce such unique compounds. Evolutionists think otherwise: they, indeed, admit that protoplasm has not as yet been experimentally formed, but they believe that it will be eventually accomplished. "The chasm between the inorganic and the organic," says Herbert Spencer,* "is being filled up: some four or five thousand compounds, once regarded as exclusively organic, have been produced artificially from inorganic matter; and chemists do not doubt their ability to produce the highest forms of organic matter."

Chemists, like other persons, may be too sanguine of success in their pursuits; such confidence, however, is of little worth as an argument on an important question. A very large portion of the thousand compounds are purely inorganic chemical compounds, in no wise analogous to the organised substances of which living organisms are composed; for these have a cellular structure, whereas the others are crystalline or formless substances. It is true that in the infancy of science chemists did not understand this difference; but a quarter of a century ago—a long time in the history of modern Evolution—Professor Miller drew a clear line of distinction between the so-called organic compounds and organised substances. And G. H. Lewes, though an advocate of Evolution, does not credit

* *Principles of Psychology*, vol. i., p. 137.

this ability of chemists. "The skill of man," he says,* "has already made some organic substances, and may eventually succeed in making a cell: but the making of albumen or the construction of an organism in the laboratory would not in the least affect the foundation of biology, would not obliterate the radical difference between organisms and anorganisms. It is the specialty of organic phenomena which gives them a special place, although the specialty may only be due to a complication of general agencies." I would rather say that the specialty of organic, like that of all other kinds of phenomena, is solely due to a power *sui generis*, which in this case is called vital power or vitality, to distinguish it from all other powers.

4. Since chemical forces cannot form protoplasm, it may be fairly inferred that another factor of a different nature interacting therewith is concerned in the production of this substance; for it only occurs as the product of pre-existing animals. "Our food is assimilated," says Professor Huxley,† "by the processes of a singular laboratory, which will dissolve a certain portion of the modified food; and the solution so formed will pass into the veins: and the subtile influences to which it will then be subjected will convert dead protoplasm into living protoplasm."

On this explanation I would observe that it is certainly a singular laboratory in which our food is assimilated; and that the agent which works therein must be equally singular, for he effects such changes that no chemist can produce. We are not told what "the subtile influences"

* The Physical Basis of Mind, p. 12.

† Addresses and Reviews, p. 145.

are that can convert dead into living protoplasm. I am inclined to think that there is no such thing as "living protoplasm," that all the materials of which the body is composed are merely organized chemical compounds, such as we find in a corpse immediately vital power ceases to co-operate with the corporeal powers in producing vital phenomena. From the Professor's point of view, the difference between food and the organized substances of the body seems to be that the latter, by subtile influences, have acquired a vital property, which the former does not possess. And in illustration of this view, he adduces the properties of water, which are different from those of its constituents. These cases, however, are not analogous. Water, like all other binary compounds, does not manifest the properties of its elements, for these being *in equilibrio* neutralise each other; but has only those belonging to the resulting compound; in this case the results are purely physical and chemical. So all the organized compounds have properties different from their constituents, but they cannot be chemically formed unless subjected to the "subtile influence" of another factor *sui generis*, and that, too, in a cellular medium of a singular construction.

5. The admission that "subtile influences" are present in living organisms comes very near acknowledging that of vital powers, the causes of vital phenomena; though this is denied by Evolutionists, who regard the idea of such entities as very absurd. "The broad distinctions," says T. T. Dyer,* "which exist between every known

* Encyclo. Britan., vol. iii., p. 681. On Biology.

form of living substance, and every other component of the material world, justify the separation of the biological sciences from all others. But it must not be supposed that the differences between living and not living matter are such as to justify the assumption that the forces at work in the one are different from those which are to be met with in the other. Considered apart from the phenomena of consciousness, the phenomena of life are all dependent upon the working of the same physical and chemical forces as those which are active in the rest of the world. It may be convenient to use the terms 'vitality' and 'vital force' to denote the causes of certain groups of natural operations, as we employ the names 'electricity' and 'electrical force' to denote others; but it ceases to be proper to do so if such names imply the absurd assumption that electricity and vitality are entities, playing the part of efficient causes of electrical and vital phenomena. A mass of living protoplasm is simply a molecular machine of great complexity, the total results of the workings of which, or its vital phenomena, depend, on the one hand, upon its construction, and on the other, upon the energy supplied to it; and to speak of 'vitality' as anything but the name of a series of operations, is as if one should talk of the 'horology' of a clock." To the same effect G. H. Lewes* says, that "the vital force of an organism may be likened to the mechanical force of a machine. No one really tries to reach and modify a mechanical force (which is a pure abstraction), he only

* Problems of Life and Mind, vol. i., p. 110.

tries to reach and modify the mechanical conditions (which are the reals), certain that if he lessen the friction of the parts he will increase the mechanical product. And so the biologist now only tries to reach and modify those biological conditions, which he considers as causes, and condenses them all into a single expression, and calls them vital forces."

Neither vitality nor mechanical force is an abstract term denoting a series of operations or the conditions of peculiar workings. The name vitality distinctly expresses what it signifies—viz., the force or power of an organism which produces a series of peculiar phenomena, different from those of physical and chemical forces, and therefore appropriately called vital phenomena. And to say that it is "convenient to use the term vitality, but not proper to do so if it implies an entity playing the part of an efficient cause"—that is, to use it in its proper sense—is another instance, of which several have been already mentioned, of the vain attempts to impose on terms a meaning which they cannot bear, in order to adapt them to incongruous dogmas. The body of an organism is not "a mass of living protoplasm," but of merely chemical protoplasm; and such a protoplasmic body is somewhat analogous to a molecular machine; for, in both cases, their working depends on the energy of an additional force, lacking which there are neither vital nor mechanical phenomena. The chemical and physical forces in an organism are indeed the same as those that are at work in the outer world; but they are carried on therein under different conditions: they do not act independently as purely

physical and chemical forces, but are under the control and direction of vital power, acting in a singular cellular medium, which enables them to work differently from what they can do in the outer world. Vital powers are the true causes of vital phenomena; and this is more intelligible than regarding a series of operations and their conditions as the causes of phenomena: at all events, such an idea of vital power is not so absurd as "the 'horology' of a clock."

6. Modern science has also rejected the idea of vital power, on the plea that it is a needless multiplication of natural forces; for it maintains that vitality is only a modification of the physical force, heat. This view was first advanced by Dr Carpenter; and it is certainly a legitimate extension of Grove's doctrine of the mutual convertibility of natural forces. "The pre-existence of living organisms," he says,* "through which alone heat can be converted into vital force, is necessary: it is the specialty of the mutual substratum, thus furnishing the medium or instrument of metamorphosis, which establishes and must ever maintain a well-marked boundary between physical and vital forces. . . . The variety of forms called forth by the agency of heat, which may be regarded as the products of its operations upon living germs, does not present any real obstacle to the reception of this doctrine. . . . It is necessary to admit that this force is modified in its actions by the properties of the germ; just as the general force of chemical affinity manifests itself differently in the reactions of each element." Writing upon the same

* Philosophical Transactions for 1850, p. 752.

subject in another place, Dr Carpenter says,* “Although there may be nothing in the aspect or sensible properties of the germ of a polype to distinguish it from that of a man, yet we find that each develops itself, if the requisite conditions be supplied, into its typical form and no other. . . . The special attribute of the organic germ is the power of utilising, after its own particular fashion, the heat which it receives, and of applying it as a constructive power to the building up of the fabric after its characteristic type.”

These quotations tell strongly, I think, against the doctrine in support of which they were adduced. There is no occasion for such a conversion of heat into vital force; for this force is present during the whole existence of the organism, the medium into which the heat enters. Heat is a molecular force, a mode of repulsion, and when it acts upon the molecular bodies of living germs—all of which are alike—a variety of forms cannot be produced by the interaction of the same factors. Heat supplies the requisite condition to enable the vital power of each germ to develop its special typical form and no other: and when heat is utilized in building up the special fabric of a germ, it is not the fabric that utilizes the heat, but the specific vital power of each kind of germ. Heat is not “modified in its actions by the properties of the germs, just as the general force of chemical affinity manifests itself differently in the reactions of each element;” for this implies that there is only one general chemical force, like that of heat:

* Quarterly Journal of Science, pp. 80 and 89.

but there is no such force in Nature ; it is only an abstract expression of those properties which are common to all the specific chemical powers ; just as the term vitality denotes those of all the specific vital powers—the specialty of each kind of vital power is the possession of all the *common* properties of vitality conjoined with a peculiar property, which makes it to differ from all other kinds. The modification in the action of each germ is not, therefore, due to heat, but to the specific vital power which is united to the molecular body of each germ.

As much stress is laid by Evolutionists on the convertibility of heat into vital force, this subject must not be summarily dismissed ; let us, then, hear what another authority has to say thereon. “ In tracing the phenomena of living things,” says Professor Tyndall,* “ through all their modifications, the most advanced philosophers of the present day declare that they ultimately arrive at a single source of power, from which all vital energy is derived : in short, it is considered as proved that all the energy which we derive from plants and animals is drawn from the sun. . . . The peculiarity of modern conclusions is that there is no creative energy whatever in the vegetable and animal organisms ; but that all the power which we obtain from the muscles of man and animals, as much as that which we develop from the combustion of wood and coal, has been produced at the sun’s expense. . . . If solar light and heat can be produced by the impact of dead matter, and if, from light and heat thus produced, we can

* Fragments of Science, vol. ii., pp. 46 to 50.

derive the energies which we are accustomed to call vital, it indubitably follows that vital energy may have a proximately mechanical origin. In what sense, then, is the sun to be regarded as the origin of vital energy? Let us try to give an intelligible answer to this question. Water may be raised from the sea level to a high elevation by being converted into vapour by the heat of the sun, and being there condensed, and descending as rain, which collecting into streams may produce a great variety of mechanical effects on its course to the ocean. But every form of power here indicated would be derived from the original power expended in raising the water to the height from which it fell. There is no energy *generated* by the machinery: the work performed by the water in descending is merely the parcelling out and distribution of the work expended in raising it. In precisely this sense is all the energy of plants and animals the distribution of a power originally exerted by the sun. . . . We name the force which draws the water earthward 'gravity,' and that which draws the atoms together 'chemical affinity;' but these different names must not mislead us regarding the qualitative identity of the two forces. They are both attractions: and, to the intellect, the falling of carbon atoms against oxygen atoms is not more difficult of conception than the falling of water to the earth. The building of the vegetable is effected by the sun, through the reduction of chemical compounds. The phenomena of animal life are more or less complicated reversals of these processes of reduction. We eat the vegetable, and we breathe the oxygen of the air; and in our bodies the

oxygen which had been lifted in the vegetable from the carbon and hydrogen by the action of the sun, again falls towards them, producing animal heat and developing animal forms. Through the most complicated phenomena of vitality this law runs: the vegetable is produced while a weight rises, and the animal is produced while a weight falls. But the question is not exhausted here. The water of our first illustration generates all the motion displayed in its descent, but the *form* of the motion depends on the character of the machinery interposed in the path of the water. So molecular forces determine the *form* which the solar energy will assume. In the separation of the carbon and the oxygen this energy may be so conditioned as to result, in the one case, in the formation of a cabbage, and in another case in the formation of an oak. So also as regards the reunion of the carbon and the oxygen, the molecular machinery through which the combining energy acts may in one case weave the texture of a frog, while in another it may weave the texture of a man. . . . The matter of the animal body is that of inorganic nature. There is no substance in the animal tissues which is not primarily derived from the earth, water, and air. Are the forces of organic matter, then, different in kind from those of inorganic matter? It is the compounding, in the organic world, of forces belonging equally to the inorganic that constitutes the miracle of vitality. Every portion of every animal body may be reduced to purely inorganic matter. A perfect reversal of this process would carry us from the inorganic to the organic: and such a reversal is at least conceivable."

I was induced to make this long quotation because the explanations which it gives of several important points in the doctrine of Evolution are so circumstantially stated that they afford me the means of contrasting my views therewith : in so doing, I shall have to enter into much detail ; but this needs no apology, as it is the very object of my work. Doubtless this eloquent exposition of the conversion of heat into vital power has convinced many that the problem of life has been solved on mechanical principles, but every clause of it seems to me to be very objectionable ; this, of course, may be owing to my regarding them from a different point of view ; but I will give my reasons for so thinking.

The burden of the argument is, that the energy of all living things is drawn from the sun ; but, as already stated, every germ, from the first moment of its existence, possesses the energy of life derived from its parent ; and from what now occurs, and has for ages occurred, we are justified in believing that it has been so from the beginning. “ There is indeed no energy *generated* by machinery,” for it is not its nature ; but it is the nature of living organisms : and this one fact alone is sufficient proof that living things are not analogous to machines, and therefore their actions are not to be solved as a mechanical problem. I am inclined to think that the sun’s heat is not the cause of life, but is only one of the conditions requisite for the energising of vital power which is originally in every germ, and is the sole cause of vital phenomena. For instance, seeds which have been long deeply buried in the earth germinate and grow to maturity when brought near

the surface under the influence of the sun's rays. Such seeds, however, are not lifeless organisms, for if they were the sun's heat would not vitalise them, but hasten their decay; when they are living seeds, then the part that the warmth of the sun plays is to put the molecules of the seed in motion, and thus enable vital power to emerge from a latent into an active state. That heat is only one of the conditions of vegetation is shown by the fact that grains of wheat have lain dormant for ages in mummy cases at Thebes, though exposed to a temperature sufficient for germination; when these seeds have been sown in a good soil, and thus exposed to moisture and air as well as to the heat of the sun, then they grow and produce prolific ears of corn. These physical agents do not impart vitality to the seeds, but give freedom of motion to their molecules, which facilitates the chemical process of assimilation under the direction of vital power; and thus suitable compounds are formed for the development of the plants.

Some portion of the above quotation—that relating to the mechanical power of streams, resulting from the evaporation of water by the sun—has already been discussed;* but it could not have been omitted without seriously damaging the train of the Professor's argument: the conclusion I then arrived at was, that when the heat of the sun had converted water into vapour, and raised it up high into the air, all its work was done; and that all which followed was due to gravity, a mode of attraction,

* Ch. iii., par. 10.

whereas the radiant heat of the sun is a mode of repulsion. Again, it is said "that all the power we develop from the combustion of wood and coal also comes from the sun." This idea is usually attributed to the late George Stephenson; but it seems also to have occurred to Sir John Herschel,* for in 1833 he stated that "the sun's rays are the ultimate source . . . of those great deposits of dynamic efficiency which are laid up for human use in our coal strata." It is, indeed, a pleasing fancy; but it is not, I think, an imagination legitimately founded on a scientific basis. The action of the sun's rays on growing plants is effected by two kinds of forces—radiant heat and actinism—one aids the process of assimilation, and the other by its attractive property promotes chemical action, and tends to produce liquid and solid compounds. Both these forces have done their work long before the plant is consolidated into wood and coal, in which the molecular force, cohesion, predominates over that of heat. The light and heat emitted during combustion are due to the carbon of wood and coal combining with the oxygen of the air, during which molecular condensation takes place, disengaging sufficient heat to cause ignition: precisely the same emission of light and heat is produced by the combustion of the diamond and of chemically prepared carbon, in which the sun's rays have not been concerned. We know that light and heat can also be obtained by friction, compression, and percussion: and "if from light and heat thus produced we *can* derive the energies called vital,"

* Outlines of Astronomy, p. 237, par. 399.

then of course "it indubitably follows that vital energy may have a mechanical origin;" but *if* we *cannot*, which I believe to be the true postulate, then indubitably the reverse follows. But such postulates are absolutely worthless.

"The falling of carbon atoms against oxygen atoms is no more difficult of conception than the falling of water to the earth: they are both attractions." They certainly cannot be explained on the same principle, for gravity and affinity are not the same kind of attraction, for they energise in a totally different manner: the former indiscriminately attracts molecules of every kind, aggregating them into masses; whereas the latter only combines molecules of different kinds, selecting some in preference, as it were, to others. These forces are not governed by the same laws; and, what is more to the point, neither of them is derived from the sun's heat, which is not an attractive but a repulsive force.

Again, it is said that "we eat the vegetable, and we breathe the oxygen of the air; and in our bodies the oxygen which had been lifted in the vegetable from carbon and hydrogen by the action of the sun, again falls towards them, producing animal heat and developing animal forms." This is a very fanciful idea, apparently formed expressly for adaptation to the mechanical explanation which immediately follows—viz., that "the vegetable is produced while a weight rises, and the animal is produced while a weight falls."

When we eat vegetable food, it is exposed to "subtile influences," by which it undergoes various complicated

chemical changes before suitable compounds are formed for the growth and renovation of our bodies : one of these changes is effected by the aeration of venous blood in the lungs, a process by which some carbon of the blood combines with the oxygen of the air to form carbonic acid gas which is discharged by respiration. This process is not dependent upon the sun's heat, for it can be performed for many years in utter darkness : nor is there any reason to believe that the air which we breathe derived its oxygen, in any considerable portion, from vegetation, which probably consumes as much and even more than it produces. We know that some kinds of plants will also grow in the dark, but then they are colourless, just as parts of plants are blanched when excluded from the light. It is only chlorophyl—the green colouring matter of leaves—that under the influence of sunshine gives out oxygen gas ; and this is rather due to actinism than to the heat of the sun's rays. In the case both of plants and animals the sun's heat is not the cause, but only a condition that favours the chemical changes that take place during their development ; and in these changes neither the falling together of the elements, nor their separation from each other, is characteristic of either plants or animals : for in both of them these correlative actions are in constant operation. The solar energy is not so conditioned by the germ as to give form to the resulting organism : nor can “ combining energy ”—that is, chemical affinity—acting through the “ molecular machinery ” of a germ, weave in one case the texture of a frog, and in another case that of a man. This machinery is protoplasm, a complex chemical

compound, and its elements in acting and reacting on each other can only give rise to other kinds of compounds: these lifeless things cannot transcend their nature by a process of spontaneous generation, and become living animals; a supposition which Tyndall himself has proved, by a series of exhaustive experiments, to be untenable. Chemical substances, whether organic or inorganic, are, indeed, actuated by the same physical and chemical forces; but their operations are so modified by the interaction of vital power as to give rise to products that do not occur in the inorganic world. And only in this sense do I admit that the co-operation of all these forces—physical, chemical, and vital—constitutes the mystery of living creatures.

In thus expressing my dissent to the modern doctrine “that all the energy of plants and animals is drawn from the sun,” I have striven, though giving my opinion freely, to do so dispassionately, and with due respect to the high authorities by whom it is maintained. I may be in error, but it seems to me that much of what has been advanced in support of Evolution has been vitiated by relying on the truth of two data—the mutual convertibility of natural forces, and the modern doctrine of causation—both of which rest on unverified assumptions.

7. “Vital force,” says G. H. Lewes,* “is the abstract statical expression of the complex conditions necessary to the manifestation of vital phenomena, or the abstract dynamical expression of the phenomena themselves. By some it is employed to designate an agent, a mysterious

* *The Physical Basis of Mind*, pp. 13 and 18.

principle having no kin to matter. . . . It is idle, it is worse, for it is misleading, to personify the organic conditions in a vital principle: idle, because we might with equal propriety personify the conditions of crystallisation in a crystal principle; misleading, because the artifice is quickly dropt out of sight, and the abstract term then becomes accepted as an entity, supposed to create or rule the phenomena it was invented to express."

The advocates of vitality do not regard it as "a mysterious principle having no kin to matter;" for it is only by its union therewith that the peculiar phenomena called *vital* can be produced: and so far from regarding it as a mysterious principle, they believe it to be as real a thing as matter itself. Nor do they personify the organic conditions, for this would indeed be as idle as personifying crystalline conditions: what they understand vital power to be is distinctly expressed by its name; it is that principle possessed by living things, which distinguishes them from all other things, viz., matter and chemical substances. The term vitality is not an abstract expression of organic conditions or of vital phenomena, but the name of a power which is the cause of vital phenomena: it is never dropt out of sight by its advocates, who ever put it plainly forward; whereas their opponents give it a meaning which it cannot appropriately bear.

8. The force concerned in the development of germs is regarded by Evolutionists as a serious objection to vital power. "All the force," says Dr Carpenter, "required to build up an oak or an elephant cannot be concentrated in a minute particle, which is only discernible by the aid of

the microscope. It is more reasonable to suppose that, by some way or other, fresh organising force is constantly supplied from without during the whole period of existence.

. . . The derivation of living organisms from primeval ancestors implies that the vital power of all their descendants must have been shut up originally in germ-cells, weighing but a small fraction of a grain. A more complete *reductio ad absurdum* can scarcely be brought against any other hypothesis: and we may, therefore, consider it as proved that, in some way or other, fresh organizing force is constantly supplied from without."

To this heavy charge, and severe sentence, I reply, in the first place, that food, the material of growth, is indeed supplied from without, and that it contains an abundant store of physical and chemical forces, which are instrumental in building up the huge fabrics of the oak and the elephant; but the food does not supply the organizing force which regulates the work of these instruments. It is vital power which is innate in germs, and which continues to energise as long as it exists, that utilizes the forces contained in the food in the construction and growth of the organism. In short, vital power has formative and organizing properties, by which it regulates the action of the physical powers of its body in the *acquisition* of food; and of its chemical forces in the *appropriation* of this food by assimilation; and lastly, it *utilizes* both these kinds of forces in building up and regulating the functions of its organs. Acquisition, appropriation, and utilization are the methods of vital power in the regulation not only of its corporeal, but also of its mental functions. In the

second place, the worth of the argument rests on the supposition that vital power is like the attractive force of gravity, capable of being weighed; whereas their natures are totally different: vital power is not a material, but an immaterial thing; and if the vital power of all the generations of any species—that of man, for instance—was conjoined with one grain of matter, its weight would not be altered. If it be asked, how it came to pass that such a power can be handed down without alteration from generation to generation, I can only reply that the propagation of its species is one of the peculiar properties of vital power, which, together with its properties of formation and organization, constitutes the general nature of all vital powers.

Vital powers do not act, like physical powers, directly and forcibly on material bodies, for they exert their energy rather as *authorities* presiding over and regulating the actions of the subordinate powers of their bodies. On this view, vital power does not immediately effect the physical and chemical changes that take place in the body, but by its controlling influence it so modifies the operations of these forces as to produce peculiar effects suitable for the preservation and well-being of the organism. And this distinctly different character of vital power shows that it is a principle *sui generis*; and that the effects which it produces by its co-operation with its corporeal powers are rightly termed vital phenomena.

9. The idea of a controlling and directing influence in living bodies has occurred to many inquirers; and, among others, Dr Carpenter has expressed himself very decidedly

on this subject. "The organism's assumption of its complete and perfect structure," he says,* "is the result of that perfect harmony and balancing of the several forces of growth, transformation, and multiplication, which indicate, in the most distinct manner, the controlling and sustaining action of an intelligent mind acting in accordance with a determinate plan." This introduction of "an intelligent mind" to explain vital functions, which the physical forces of the body are evidently incapable of performing, is an unscientific method of cutting the Gordian knot, which the hypothesis of transformed heat cannot untie. In the case of the old doctrine of vitality, there is no need of such a *Deus ex machinâ*, for its possession of a dominant influence over the physical and chemical forces of its body is an attribute of its nature, which it exercises according to the law of organization.

Dr Alleyne Nicholson† has well remarked on this subject that "The advocates of the physical theory of life have endeavoured to evade a difficulty by assuming the existence of an inherent 'directive force,' either in the protoplasm itself, as constituting one of its properties, or in the 'sun force' which protoplasm receives directly or indirectly. We hear a great deal about 'molecular organization,' 'atomic machinery,' 'formative power of matter,' and the like; but a little reflection will show the fallacy of all this. Given a steam-engine and coals, you still require something more to direct its actions; and you

* Phil. Trans., 1850, p. 773.

† The Nature of Life, p. 19.

cannot find that something in the machine or in the fuel. You get a certain amount of power or force, but that is all; you may use that power in an almost indefinite variety of ways by directing it in different directions. It is only man, however, who can determine the course which the power of the engine shall take. . . . The real problem is not as to the *nature* of the molecular movements of protoplasm, which give rise to vital phenomena, but as to the nature of the cause which determines the movements. The fundamental question is not, as Mr Croll says, ‘What is the particular force in action, or upon what does its exertion depend? but rather, What is it that causes the force to act in the particular manner that it does act?’ Here we appear to reach the kernel of the matter at issue. The living organism, however simple, constitutes the vehicle for the action of physical and chemical forces. Do these forces act in the living organism otherwise than they do in dead matter? And if so, what is it that causes this different action and determines its direction?” The cause of this difference must be sought for in the presence of a “subtile influence” which enables the physical forces to perform in living organisms what they cannot do in dead matter; and the opponents of the physical theory maintain that this influence is no other than vital power, of which there are as many kinds as there are species of living organisms.

10. The Bishop of Carlisle, in an article* on “The Unity of Nature,” has a passage which is closely related

* The Nineteenth Century. November 1879.

to the subject now under discussion. "When it is required to determine the orbit of a body about a given centre of force, the mere assignment of the law of this force is not sufficient for the solution of the problem; it is requisite also to know the distance, the direction, and the velocity of projection. As much will depend upon these conditions of projection as upon the law of the central force. In like manner, a quantity of protoplasm, with an assumed power of development, will not account for existing forms of life, without the additional hypothesis of some causative power to determine the initial circumstances. Given an original germ, and given some power which shall direct the particular original cause of the development of the germ, and the whole subsequent development is conceivable: but the germ and the law of development left to themselves may be as insufficient as the particle and the law of attraction. The ellipse, the parabola, and the hyperbola are all possible curves for a particle moving round a centre of force; and in the case of each one of these, the original conditions of projection, the initial motion, must have been delicately adjusted for its production. May we not infer from this a similar necessity of original delicate adjustment in the process of Evolution of a highly-organized creature from a protoplasmic germ? The general tendency is, I think, to suggest that neither gravitation nor Evolution carries us up to the prime cause of existing Nature; or renders the hypothesis of such an adjusting cause unnecessary."

I cordially accept this testimony that there is something more requisite for the motion of a body round its centre,

and for the development of an organism from its germ than a single force acting according to its law: and I may justly say to the Bishop, *rem acu tetegisti*. For, given a specific vital power in each kind of germ, acting according to its law of design, and co-operating with the physical and chemical powers of the germ, the subsequent development admits of a satisfactory explanation; as in like manner does the orbit of a body about its centre of force, if this centripetal force co-operates with a co-existing centrifugal force.

CHAPTER VI.

The Development of Animals—From Various Kinds of Germs.

Introduction.—2. The Evolution of Animals.—3. The Cell-Life of Amœbæ.—4. Germs, the Source of all Animals.—5. Definition of a Germ.—6. The Genesis of Germs.—7. The Old Doctrine of Design.—8. The Formation of Animals, said to be a Mechanical Problem.—9. No Transition between the Groups of Animals.—10. Description of Embryonic Development.—11. The Supposed Transformation of Animals.—12. And their Adaptation to Abnormal Media.—13. Darwin's Theory of Natural Selection: "The Origin of Species," and "The Descent of Man."

1. The doctrine of Evolution sets forth that all kinds of animals have been evolved—the higher from the lower in an ascending order—by the gradual development of the all-becoming Potency of Matter. The attention of Evolutionists has been almost solely directed to this subject, which is regarded as the stronghold of their doctrine, and has accordingly been invested with several principles that are deemed to be impregnable: so that any assault thereon must be conducted with great circumspection. It is proposed to devote this chapter to the discussion of these principles; and in the succeeding chapter to explain the development of organisms according to the doctrine of Vital Powers.

“If the doctrine of Evolution be true,” says Professor Huxley,* “it follows that however diverse different groups of animals may be, they must all, at one time or other, have been connected by gradational forms; so that from the highest animal down to the lowest speck of protoplasmic matter in which life is manifested, a series of gradations, leading from one end of the series to the other, either exists or has existed. But when we look upon living Nature we find a totally different state of things. We find that animals fall into groups, the different members of which are pretty closely allied together, but are separated by definitely larger or smaller breaks from other groups. In other words, no intermediate forms are met with to bridge over the gaps. . . . If, then, it could be shown that this state of things always existed, the facts would be fatal to the doctrine of Evolution. But the remains of animals have been discovered in various parts of the world, which have tended to fill up, more and more, the gaps in the existing series of animals.”

Professor Haeckel does not seem to place such perfect reliance on organic remains, as a sufficient proof of Evolution. “If the petrified remains of formerly living animals,” he says,† “really proceed from extinct primeval progenitors of the present organisms, then, without anything else, the comparison of petrifications ought to disclose to us the pedigree of organisms. . . . Simple and clear, however, as this may seem in theory, the task is extremely

* American Addresses, pp. 46 and 49.

† The History of Creation, vol. ii., p. 32.

complicated when it is taken in hand ; for the records that lie buried in the earth are imperfect beyond measure : and if we bear this in mind we shall not be surprised that we are still dependent upon many uncertain hypotheses, when endeavouring to sketch the pedigree of organic groups. We fortunately, however, possess other records besides fossils, which in many cases are of greater value ; the most important of these is embryology, the history of organic individuals."

These quotations from the works of eminent Evolutionists show that their doctrine is as yet far from being established on a sure foundation. "If the doctrine of Evolution be true," then, of course, "all animals are connected by gradational forms;" but, even granting that animals are so connected, this is no evidence that they have been evolved the higher from the lower, as the doctrine teaches. We are indebted to the geologist for our knowledge of the organic remains that are supposed to fill the gaps between the groups of existing animals : and it would be well if the Evolutionist adopted his principle, viz., that Nature, in times past, followed the same processes in forming the various strata of the earth as she does at the present day ; for such an ascending from the known to the unknown is the legitimate mode of investigation. "When we look upon living Nature we find" that each kind of animal only develops its own peculiar nature and no other type ; and this state of things has continued for ages : it is, therefore, reasonable to infer that this has been Nature's *modus operandi* from the beginning.

2. This, however, is not the teaching of Evolution. "I lean to the affirmative," says Professor Tyndall,* "that one of the consequences of the refrigeration of our planet, after its separation from the sun, was the development of organic forms. Structural forces were certainly in the mass, for in it lay the marvels of crystalline force; and who will set limits to the possible play of molecular forces in a cooling planet."

Man certainly cannot; but Nature has set a limit to all things in the capabilities of their respective natures; to each of which her law is: so far and no farther. There is good reason to believe that the terrestrial nebula was composed of chemical elements, as the earth is at the present day; consequently, on its refrigeration, the molecular force of cohesion would gradually become predominant, as its correlative force, heat, was dissipated by radiation: and then cohesion, a "structural force," would aggregate the crystalline molecules of the elements into crystalline masses, for such an operation is within the limit of cohesion's nature. So that the existence of crystalline force in a cooling planet is no marvel; but the development of organic forms during such a process would indeed be marvellous: for no living germs could escape destruction in the heat of a molten planet.

Professor Haeckel asserts that living things were evolved from lifeless things by a process of spontaneous generation; and he calls the original things so produced *Monera*, which he describes as soft, simple-celled creatures, the

* Fragments of Science, vol. ii., p. 51.

supposed progenitors of existing organisms: it is, however, due to him to add that he advanced this as "a genealogical hypothesis, an attempt to construct the pedigree of organisms, in the manner required by the theory of development." This is candid; but the opponents of Evolution cannot be expected to accept a doctrine constructed on such a principle.

3. The simplest known organism is the amœbæ, a species of protozoa, the lowest group of the animal kingdom. "It is a little cell," says Haeckel, "of albuminous matter, protoplasm, containing a nucleus or kernel; when freely moving, it is perpetually changing its form, by stretching out and drawing in irregular arm-like protuberances in every direction; but when it draws itself together and is at rest, it assumes a globular form."

Simple as is the structure of the amœba, its cell-life affords adumbrations of several important functions, which in the higher animals are performed by special organs. It *acquires* food from without by absorption, a physical process carried on by osmotic action through its membranous envelope. The food thus obtained is *appropriated* by the chemical process of assimilation; and doubtless the resulting product is aerated through the pores of its envelope, and thus prepared, it is *utilized* in the growth and reparation of the cell; and finally a circular contraction of the cell takes place, which gradually increases until the cell is divided into two individual cells; and thus the propagation of the species is effected. Recent researches render it very probable that nerve-force is the common property of all living things, both plants and

animals; and, if so, though it be almost at *zero* in the amœba, its envelope may be the means of transmitting the nervous energy that stimulates the protuberances of the cell to perform their various movements, in response to impressions made on it externally.

4. Simple and insignificant as an organized cell may appear to the casual observer, to the physiologist it is a most interesting object, for the germ of every organism has a similar structure and composition; and, indeed, the adult animal is in a great measure composed of cells: in short, these little cells or cellules, as already stated, are the units of living bodies, just as atoms and molecules are the units of material and chemical substances. It must not, however, be supposed that organisms are aggregates of amœbæ, because they are constructed of cellules; for this would be falling into a similar error that led chemists to suppose that all elements are multiples of hydrogen. "In the immense majority of both plants and animals," says Professor Huxley,* "it is certain that the germ is not merely a body in which life is dormant or potential, but is itself simply a detached portion of the substance of a pre-existing living body: and the evidence is yet to be adduced which will satisfy any cautious reasoner that *omne vivum ex vivo* is not as well-established a law of the existing course of Nature as *omne vivum ex ovo*." It is certainly a more comprehensive expression of the fact that every living thing, without exception, derives its being from a pre-existing organism: but it is a suicidal

* Encyclo. Britan., vol. viii., p. 746.

blow inflicted on his doctrine that living protoplasm can be evolved from lifeless chemical compounds.

5. "The definition of a germ," continues the Professor, "'as matter potentially alive, and having within itself the tendency to assume a definite living form,' appears to meet all the requirements of modern science. For, notwithstanding, it might be justly questioned whether a germ is not potentially, but actually alive, though its vital manifestations are reduced to a *minimum*: the term 'potential' may be fairly used in a sense broad enough to escape objection." With all deference, I would suggest a modification of this definition, and say that a germ is an organism potentially alive, having within itself a tendency, under certain conditions, to energise and assume the specific form of its progenitor.

The structure and composition of all germs are generally supposed to be alike: but Professor Tyndall is of opinion that a difference may exist, which, from the imperfection of our instruments, we cannot detect. "Many physiological observers," he says,* "appear to form a very inadequate estimate of the distance which separates the microscopic from the molecular limit; and often employ a phraseology calculated to mislead. When, for example, the contents of a cell are described without qualification, as 'perfectly homogeneous,' or as 'absolutely structureless,' because the microscope fails to distinguish any structure; or when two structures are pronounced to be 'without difference' because the microscope can detect none, then,

* Proceedings of the Royal Society, vol. xxvi., pp. 354 and 355.

I think, the microscope plays a mischievous part. A little consideration will make it plain that the microscope can have no voice in the question of ultimate germ-structure. . . . It cannot be too distinctly borne in mind that between the microscope and the true molecular limits there is room for infinite permutations and combinations."

The bearing of this on the doctrine of Evolution is, that if every kind of germ has a peculiar structure and composition, which are beyond the power of the microscope to reveal, then such a peculiarity would account for each kind of germ producing an organism of a specific type. This is clearly another instance of imagining a condition of things suitable "for the requirements of the doctrine of Evolution," which plays a much "more mischievous part than the microscope," which only gives the sight a more extended range of observation, by which our knowledge of things is greatly enlarged. Under the microscope a germ has the form and structure of a cell; and as the power of the microscope is increased, the germ is more and more magnified, but this is the only observable difference; it is, therefore, reasonable to infer therefrom that no other result would be obtained if the power of the microscope were increased a thousandfold. Even granting that the various kinds of germs are differently constituted, this would be of no avail for the doctrine of Evolution; it would not account for the supposed derivation of a higher from a lower organism: for such a peculiarity of germs would be the work of their respective parents; and the subsequent development of each germ would be due to the tendency within itself to assume the specific form of its

progenitor. "To explain differences of functions and development of a germ," says Clerk Maxwell, "without assuming differences of structure, is, therefore, to admit that the properties of a germ are not those of a purely material system." Precisely so; this is exactly what the advocates of vital power maintain; the germ is not part of a material, but of a biological system, which manifests properties which matter does not possess.

6. In the protozoa there is no ordinary generation; in some cases, however, a conjugation of cells occurs approximating to that mode of reproduction: they generally multiply by fission or gemmation. The germ of every metazoa—that is, of animals higher than the protozoa—is a complex nucleated cell, formed by the union of two different cells, the product respectively of male and female organs, either belonging to the same individual organism, or to two individuals of different sexes. The process of generation is very various, but, however brought about, the essential condition is, that the *sperm*, or male cell, must come into contact with the *germ*, or female cell, to which it imparts a *spermatozoon*, or living seed, which finds shelter and nourishment in the germ, until developed into an independent organism. Or, in the words of Professor Huxley,* "We now know that the female germ, or ovum, in all the higher animals, is a body which possesses the structure of a nucleated cell; that impregnation consists in the fusion of the substance of another more or less modified nucleated cell, the male germ, with the ovum;

* Op. Cit., pp. 747 and 746.

and that the structural components of the body of the embryo are all derived, by a process of division, from the coalesced male and female germs. . . . In all cases the process of Evolution consists in a succession of changes of the form, structure, and functions of the germ, by which it passes, step by step, from an extreme simplicity, or relative homogeneity, of visible structure, to a greater or less degree of complexity or heterogeneity; and the course of progressive differentiation is usually accompanied by growth, which is effected by intussusception. . . . In a great majority of cases the full-grown organism becomes what it is by absorption of not-living matter, and its conversion into living matter of a specific type."

At some risk of being deemed hypercritical, I would observe that "a succession of changes of the germ" is not a process of Evolution, but of development: we know that the nature of each kind of animal is developed, step by step, from its germ to maturity; but we do not know that this is accomplished by each step in the ascent being evolved from the lower condition of the animal. The assimilation of food, and the subsequent intussusception and nutrition that take place, are the means whereby the germ is developed into a full-grown organism; but this organism does not, I think, become what it is by the absorption of not-living matter and its conversion into living matter of a specific type. We know and can describe the succession of changes, and the course of differentiation; but all this gives no knowledge of the cause by which this state of things was effected. What

is it that produced this differentiation? To say that each successive change is the effect of the preceding change can only be justified by the modern law of causation, which gives no explanation of vital phenomena. What is required for this purpose is a biological law, and a biological cause that energises according to its law: and such a requirement seems to be satisfied by vital power, which is regulated in its actions by the law of organization. Thus every germ, at the beginning of its existence, is a binary compound, consisting of a protoplasmic body and a specific vital power, the cause of its future development: every vital power possesses a peculiar cluster of properties, which constitute its nature; and it is by the exercise of these properties, or faculties, be they few or many, that vital power gradually develops the organs of its body, and regulates their functions. During the development of the organism, some one or more of these faculties are for a time dormant, but become active as they are required. No vital power can stop short at any stage of its development and become a creature of a lower nature; nor can it transcend the limit of its nature, and become a higher animal. The nature of each kind of vital power is as permanent and unalterable as that of the chemical elements which form its protoplasmic body: living organisms may, from time to time, become extinct for lack of the conditions necessary for life: but as long as the maintenance of life is possible, each kind is preserved by the exercise of its propagative faculty. The formative faculty of vital power builds up and renovates its body according to its specific type and no other; which it does

by regulating its actions according to a predetermined design, the law of its nature.

7. Here, then, I again come into collision with the teaching of modern philosophy ; and must, therefore, trespass on the patience of my readers whilst I give my reasons for adhering to the old doctrine of design, as the plan on which every animal is constructed. But before doing so, I will make some quotations to show that the idea of design, though repudiated by Evolutionists, is like that of force and law, not easily excluded from their discourses.

“The study of development,” says Professor Huxley,* “proves that the doctrine of unity of *plan* is not merely a fancy, but it is the expression of deep-seated natural facts.” In illustration of this, he details the method of classification by which animals, according to their likeness, are arranged in groups, ascending one above another in order—species, genera, families, and sub-kingdoms—till they all culminate in the animal kingdom. And then he adds, “There is no animal, either recent or fossil, that does not fall into one or other of these sub-kingdoms : in other words, every animal is organised upon one or other of the five or more *plans*, whose existence renders classification possible.” And in another place he says,† “Morphology, a branch of biology, is a commentary upon and expansion of the proposition that widely different animals, and widely different parts of the same, are constructed upon the same

* Lay Sermons, Addresses, &c., pp. 111—114.

† Encyclo. Britan., vol. viii., p. 750.

plan. . . . No *à priori* difficulty can be said to stand in the way of Evolution, when it can be shown that all animals and plants proceed by modes of development, which are similar in principle, from a fundamental protoplasmic material."

In these extracts we have an explicit acknowledgment that all the groups of animals are organized on special plans, and that all these plans are co-ordinated parts of one general plan, the classification of the animal kingdom. On my view of "the filiation of the sciences," morphology is not a branch of biology—the science of vital phenomena—but a pure or abstract science of *form*, which is generally applicable to all kinds of natural forms, to material and chemical, as well as vital forms. Morphology treats solely of the forms of natural objects, and their classification, as natural history does of these objects themselves; and such a statical science can throw no light on the modes by which plants and animals are developed: the forms of these things may pass into each other by almost insensible shades, but this is no proof that they have been evolved from each other; it only shows that their forms correspond with the transitional shades of the design on which they have been constructed. In ordinary language, the word plan, in reference to work to be done, is the design of an artist, by which he either directly or indirectly regulates the operations requisite for the execution of the work. And it is in this sense, I conceive, that each vital power is the agent that directs the operations of the physical and chemical powers of its protoplasmic body in the development of its organs according to its specific

plan. This may not be the true solution of the problem of life ; but it seems to be more conformable than Evolution to Nature's "unity of plan," which is the "expression of deep-seated natural facts."

"Milne Edwards," says G. H. Lewes,* "states that the harmony of organic parts does not result from the influence which they exercise upon one another, but from their co-ordination by the influence of a common power, of a pre-conceived plan of a pre-existing force. And even Van Baer says, that 'the nature of the animal determines its development : for although every stage of development is only possible by pre-existing condition, yet the entire development is ruled and guided by the nature of the animal which is about to be.' The positive biologist will be at no loss to assign the errors of these physiologists to their metaphysical origin."

The physiologist, if so disposed, need be "at no loss to ascribe the error" of the positive biologist to his unverified philosophy ; but such animadversion can be of no avail for the advancement of knowledge. I am glad to find that the view of vital phenomena which I am advocating has the sanction of such eminent physiologists. Milne Edwards' idea that the co-ordination of organic parts is due to the influence of a pre-existing force and a pre-conceived plan, and Van Baer's opinion that the nature of the animal determines its development, stand out clear and intelligible, and are worthy of being discussed on scientific principles.

8. Professor Tyndall's illustration of the mechanical

* *The Physical Basis of Mind*, p. 93.

formation of crystals has been already considered ;* and in continuation he says, "Let us now pass from what we are accustomed to regard as a dead mineral to a living grain of corn. What has built together the molecules of the corn? If in the case of the crystals you have rejected the notion of an external architect, I think you are bound to reject it in the case of the grain, and to conclude that the molecules of the corn are also posited by the forces with which they act on each other. . . . Place the grain in the earth, and it grows. Given the grain and its environments, with their respective forces, the purely human intellect might, if sufficiently expanded, trace out *à priori* every step of the process of growth. . . . You see I am not mincing matters, but avowing nakedly what many thinkers more or less distinctly believe. The formation of a crystal, a plant, or an animal is, in their eyes, a purely mechanical problem, which differs from the problem of ordinary mechanics in the smallness of the masses, and the complexity of the process evolved."

Before answering the question, "What has built together the molecules of the corn?" we must know something about its formation. It is originally the product of generation, a process in which two distinct organs of the parent plant co-operate: by one organ the protoplasmic body of the grain is produced, and by the other it is fertilised; for a time the corn lies in a dormant state, till sown in the earth, and then it grows: but should the latter organ have failed to vitalise the grain, though it be perfect in form

* Ch. iv., par. 4.

and structure, it will rapidly decay. This shows that the molecular forces of the corn are alone incapable of developing an organism like the parent plant; but when it grows, the presence of a living architect, or rather of a living agent, vital power, is indicated, which, acting according to the plan or law of its nature, regulates the working of the molecular forces by which a plant of its specific type is produced. In short, the formation of a plant or an animal is not a mechanical, but a biological problem.

9. "In the present state of our knowledge," says Professor Huxley, "there is not the least evidence to prove that a form in the slightest degree transitional between any of the two groups of Vertebrata, Annulosa, Mollusca, and Cælenterata, either exists or has existed during the earth's history recorded by the geologist. Nevertheless, you must not for a moment suppose, because no such transitional forms are known, that the members of the sub-kingdoms are disconnected or independent of one another. On the contrary, in their earliest condition they are all alike; the primordial of a man, a dog, a bird, a fish, a beetle, and a polype are, in no essential structural respect, distinguishable."

It is true that all animals above the protozoa begin life as germs, which are so like one another that no *visible* difference can be detected, and yet they are not identical; for they have within them different potencies as manifested by their development into animals of various types: so that the similarity of their "primordials" is no proof that the members of the sub-kingdoms are connected by transitional forms. Claiming the precedent of Professor

Tyndall's contrasting the works of man with those of Nature, I venture to illustrate the breaks that occur between animal groups by the history of the Arts. At the dawn of each art, its plan is very simple, the mere germ of what it is about to be; and its processes are merely those of manipulation; and consequently the resulting work is equally simple: it is gradually improved by undergoing various modifications, until the idea of the original plan is worked out, or brought to an end by a supplementary idea, which produces a new and improved construction. Again, the art runs another and similar course; and so on until eventually it attains a higher standard of perfection. The lesson taught by this history is, that the works of Art, like those of Nature, have passed through several distinct types during their development from the simplest to the highest form. It is in these distinct stages of Art, in its progress to perfection, that I see an analogy to the groups of animals; for the break between two adjacent sub-kingdoms is owing to the introduction of a new and peculiar feature into the *plan* of the inferior group, and consequently the nature of the higher animal possesses one more property than the lower, which distinguishes them from one another. So that there is no transition between the groups: they do not pass into each other; but the construction of each depends on a modification of the general plan, as manifested by its peculiar development.

10. The link that is supposed to connect all the groups of animals into one unbroken series of structural transition is that of *embryonic development*, which is regarded

as one of the strongest evidences in favour of Evolution. In the development of the embryo the process does not stop short at a division of the germ into two cells, as in the case of the unicellular amœba, but proceeds in a geometrical progression, by which it is divided into 2, 4, 8, 16, and so on until it attains the *morula* stage, so called from its resemblance to a mulberry. As development proceeds, the cells of this multilocular morula, says Professor Huxley,* “diverge from one another in such a manner as to give rise to a central space, around which they arrange themselves as a coat or envelope ; and thus the morula becomes a vesicle filled with fluid, the *planula*. The wall of the planula is next pushed in on one side, or invaginated, whereby it is converted into a double sac with an opening, the *blastospore*, which leads into the cavity lined by the inner wall. This cavity is the primitive alimentary cavity ; its inner or invaginated layer is the *hypoblast*, the outer the *epiblast* ; and the embryo, in this stage, has a bag-like form, termed *gastrula*. In all the higher animals a layer of cells makes its appearance between the hypoblast and the epiblast, and is termed the *mesoblast*. In the further course of development, the epiblast becomes the *ectoderm*, or epidermic layer of the body ; the hypoblast becomes the *epithelium* of the middle portion of the alimentary canal ; and the mesoblast gives rise to all the other tissues, except the central nervous system, which originates from an ingrowth of the epiblast. With more or less modification in detail, the embryo has

* Op. cit., pp. 746 and 747.

been observed to pass through these successive evolutionary stages in sundry sponges, cœlenterates, worms, echinoderms, tunicates, arthropods, molluscs, and vertebrates; and there is valid reason for belief that all animals of higher organization than the protozoa agree in the general character of the early stages of their individual evolution. Each, starting from the condition of a simple nucleated cell, becomes a cell-aggregate, and then passes through a condition which represents the gastrula stage before taking in the features distinctive of the group to which it belongs. Stated in this form, the 'gastræa theory' of Haeckel appears to the present writer to be one of the most important and best-founded of recent generalizations. So far, therefore, as individual animals are concerned, Evolution is not a speculation, but a fact; and it takes place by epigenesis."

"Epigenesis," says G. H. Lewes,* "means not simply out-growth, but a growth upon growth; so that every additional or new part of an organism is the effect of a pre-existing part, and in turn the cause of a succeeding part." In these few words of Lewes, we see how largely Evolution depends upon the modern doctrine of causation for its explanation of vital phenomena. Everything that occurs in Nature has something going before it; and to say that this antecedent is the cause of what follows throws no light on the subject. Thus an animal, at every succeeding step in its development from its germ, is different from what it was previously, and to say that this difference is

* *The Physical Basis of Mind*, p. 88.

evolved by its precedent condition gives no reason for the change. The doctrine which I am advocating does give a reason for this differentiation. Vital power energises according to its specific plan, the law of its nature, and thus in the exercise of its formative property it gradually builds up the organs of the body; and accordingly the successive variations in the form of every part of its body during its growth to maturity correspond with the pattern of the design which it follows in its workings.

“The most important of the records relating to the origin of animals,” says Professor Haeckel,* “is without doubt embryology, the history of the development of organic individuals: it briefly repeats, in great and marked features, the series of forms which the ancestors of the individual have passed through from the beginning of the tribe or group. . . . If, then, we can trace all the varieties of animal forms to fundamental types or tribes, the next question is, Where did these tribes come from? Are they original independent forms, or are they all distantly related to one another by descent from a common root? The zoologist who has thoughtfully considered the history of individual development cannot but be convinced that they have all been derived from one source, that of the most ancient *monera*.”

The remarks of Huxley on embryology are more guarded than those of Haeckel; but when he speaks of one part *becoming* another part of the embryo, of a part originating from the *ingrowth* of another part, and of Evolution taking

* The History of Creation, vol. ii., pp. 122 and 123.

place by *epigenesis*—he implicitly means what the other explicitly asserts. Embryology, the history of the development of organic individuals, surely does not record the origin of animals? This origin is afterwards referred to in one of two questions asked, Are they [the tribes or groups of animals] original independent forms? but it receives no reply. The same author told us, when treating on the origin of matter, that we must take it for granted that matter is, for how it came into existence is beyond human ken. This is correct, and it equally applies to chemical substances and living organism; so we ought to remain content with these objects as facts to be studied. And if so, there is no ground for the assumption that all animals have been derived from one source, either by that of a spontaneous generation from a plasma of chemical substances, or by the spontaneous evolution of matter by its all-becoming potency.

11. Evolutionists, in substantiation of their doctrine, have adduced many instances of the supposed transformation of animals; but I must rest content, for want of space, with noticing a few instances. “It is probable,” says Haeckel,* “that the remarkable legion of whales originated out of hoofed animals which accustomed themselves exclusively to an aquatic life, and thereby became transformed into the shape of fish. Out of the order of herbivorous whales, to which the sea-cows, sirenias, belong, the other order of carnivorous whales, sarcoceta, appear to have been developed at a later period; but Huxley thinks

* Ibid, vol. ii., pp. 119, 122, and 123.

that these whales arose out of the carnaria through the seals; but in this case it would be difficult to understand the close anatomical relation between the herbivorous and carnivorous cetacea, if the former were derived from hoofed animals, and the latter from marine animals of prey. . . . We must probably look for the primary of the vertebrata in the unknown cœlomata, whose nearest kin of the present day are the sea-sacs, tunicata, which live in the sea, some adhering to the bottom, while others, the sea-barrels, thaliacea, swim about freely. No one would recognise in these barrel-shaped bodies, which generally possess no external appendages, a trace of relationship to vertebral animals. And yet this can be no longer doubted, for recent investigations have shown that the individual development of the adherent ascidian phallusia agrees in most points with that of the lancelet, amphioxus lanceolata, the lowest of the vertebrates. In the earliest stages of its development, the germ of this ascidian possesses beginnings of the spinal marrow, and of the spinal column lying beneath it, which are the two most characteristic organs of the vertebrates, and the nearest relations to those worms out of which the vertebrate tribe was developed. . . . The small fish lancelet is the last surviving representative of a lower class of vertebrates which existed during the primordial period, but which unfortunately could leave no fossil remains for want of a solid skeleton. The lancelet lies in our seas, where it generally burrows in the sand near the shore; its body is pointed at both extremities; and it has neither head, skull, nor brain. Externally the fore end of the body is

distinguished from the hinder end only by its open mouth : internally it possesses the spinal rod and spinal marrow. The rod, *chorda dorsalis*, is a straight cylindrical cartilaginous staff, pointed at both ends, forming the internal skeleton : directly above the spinal rod, on its dorsal side, lies the spinal marrow, likewise a straight hollow cord ; the primary piece and centre of its nervous system. In all vertebrates the embryo, during its development, begins in the same simple form ; and the hags and lampreys, the lowest of fishes, were developed out of scull-less animals like the lancelet."

It is only during the last fifty years that several eminent anatomists examined the internal structure of the lancelet, and the result of their labours induced the zoologist to place this little fish-like animal in the lowest class of the vertebrates. This seems a strange proceeding, for the most important characteristic in the definition of a vertebrate animal is its possession of a spinal axis crowned by a skull containing a brain, both of which are wanting in the lancelet. The development of the nervous system of the vertebrates does, indeed, begin with the simple form of a spinal rod and spinal marrow, but it does not end there, as in the case of the lancelet, but proceeds until sensory ganglia are formed ; and finally the development ends in the formation of the cerebrum and cerebellum. In lacking the sensory ganglia, the lancelet ought to be placed below insects in the scale of the animal kingdom ; and being destitute of a brain, the organ of consciousness, it is far beneath the vertebrates, which are intelligent animals. If the possession of the primary form of a spinal rod

and marrow entitles the lancelet to a place among the vertebrates, then the ascidian phallusia has an equal claim to this distinction: so that the lancelet ought to be relegated to the tunicata, where it may occupy the highest place; or the definition of the vertebrata must be altered so as to comprise the tunicata. The external fish-like form of this amphioxus is of little importance in classification; for a whale is much more like a fish, and yet it is not placed in the class of fishes, but in that of the mammalia.

12. Darwin, in his "Origin of Species," states that one possible mode of the transformation of animals might be brought about by their frequenting a medium different from that of their normal abode; for by so doing their organs might become gradually changed into those requisite for an aquatic life: but for such metamorphoses very long periods of time are necessary. Suppositions of this kind, with such a saving clause, might be advanced on any subject; for there is no dealing with such "airy nothings of the fancy." If animals frequent various media, it is a proof that it is their nature so to do; and we know that they do this all their life without undergoing any change; and that the descendants of such animals may, from generation to generation, pursue the same mode of life without altering their condition. We know that this is the case with existing amphibious animals; and there is no good reason to doubt that what has, in the present era of our planet, continued for thousands of years, has run the same course in all previous eras.

Evolutionists, however, are of a different opinion. At the recent Jubilee Meeting of the British Association,

Professor Seeley described the skeleton of a simosaurus, a recently discovered species of land animal, supposed to be in progress of adaptation for a natatory condition, the ancestor of the plesiosaurus and allied types of amphibious triassic reptiles. Repudiating the idea that this was an example of creative design, he maintained that the adoption of such a view would put an end to philosophical anatomy, and cause the stagnation of research. "The progress of Evolution," he says, "was due, in his opinion, to the discarding of the old doctrine of design." Professor Huxley, on the other hand, has told us* that "the doctrine of the unity of plan is the expression of deep-seated natural facts," and that "every animal is organized upon one or other of the five or more plans on which they are classified." Whether this plan, on which the animal kingdom was constructed, be "an example of creative design" or not, cannot in any way "cause a stagnation of research;" for it cannot interfere with the anatomist in his practical examination of fossil skeletons: but when he speculates on the descent of a plesiosaurus from a simosaurus he is not then engaged in anatomical research, but in a philosophical conjecture, the truth of which is very questionable. If "the progress of Evolution be due to the discarding of the old idea of design," it must sooner or later be arrested; for this idea is the legitimate expression of deep-seated natural facts, which cannot be discarded: it will intrude itself, *nolens volens*, into discourses on Evolution as pertinaciously as the ideas of force and cause

* Chap. vi., par. 7.

do into those on science ; it is, therefore, our wisdom to submit to the inevitable.

13. "The most important laws of organization," says Haeckel,* "had to take refuge in mystical ideas of plans of structure, that were incapable of arriving at a true and clear perception of effective mechanical causes. This most difficult and grandest problem Charles Darwin was the first to solve in 1859, by setting Lamarck's theory of descent on a firm footing by his theory of selection. . . . So far as the facts of selection can be proved by experiment, this has long since been done in the completest manner. For what are the numberless artificial selections for breeding purposes, which have been practised for thousands of years? For example, the different kinds of horses—the race-horse, the pack-horse, the carriage-horse, the dray-horse, and the pony—these, and many other kinds of horses, are so different that if we found them wild they would certainly be described as different species ; for they differ from each other in a much greater degree than the zebra and the quagga, which zoologists regard as true species. And yet all these varieties of horses, designedly produced by artificial selection, are descendants from a single common parent form."

Both animals and plants by cultivation assume a variety of forms, different from the original parental form : but even when greatly metamorphosed their nature is unchanged ; and even their external appearance generally bears the characteristic features of their parents. Many

* *Freedom in Science and Teaching*, pp. 23 and 24

as are the varieties of horses, no one, looking at them attentively, can fail to recognise in all of them the horse type; and the same holds good in the case of pigeons, though they are far more modified; so also in the case of the different races of mankind: they all have the same human nature; and, various as they are in appearance, no one can doubt that they are our fellows, however low they may be in the scale of human beings. Every kind of animal may be capable of variation under the influence of different conditions of life: but none can transcend its nature; for such changes are not the effects of mechanical but of vital causes, which act designedly in their production.

“How far ‘natural selection’ suffices for the production of species,” says Professor Huxley,* “remains to be seen. Few can doubt that, if not the sole cause, it is a very important factor in that operation: that it must play a great part in sorting out varieties into those that are transitory, and those which are permanent. But the causes and conditions of variations have yet to be thoroughly explored; and the importance of natural selection will not be impaired, even if further enquiries should prove that variability is definite, and is determined in certain directions rather than in others by conditions inherent in that which is varied. It is quite conceivable that every species tends to produce varieties of a limited number and kind; and that the effect of natural selection is to favour some of these, whilst it opposes the

* *Encyclo. Britan.*, vol. viii., p. 751.

development of others along their predetermined lines of modification."

This statement is very instructive, and enables me to strengthen my case. It admits that the causes of variation have not been discovered, and, therefore, my attempt to explore this subject in a direction different from that followed by Evolutionists, is not "to take refuge in mystical ideas of a plan of structure." It may be my "confusion of ideas," but I cannot conceive how "selection," an *act* of choosing or taking one thing out of many, can be a *factor* or *cause* in the production of species. On my view, every species of animal has its own specific vital power, which "tends to produce varieties of a limited number and kind," along "predetermined lines of modification:" and it is this power, and not natural selection, that by its formative faculty "plays a great part in sorting out" its transitory and permanent varieties; but it has no concern with the supposed production of species, for it cannot transcend its nature.

14. Charles Darwin, in "The Origin of Species," and in his subsequent works, has accumulated a vast store of important facts concerning the variations and functions of organisms, collected from the recorded researches of others, but largely due to his own skilful and successful investigations: and for this he justly holds a high rank as a biologist. I cannot, however, render a like tribute of praise to his philosophical speculations; for I do not think, as Haeckel says, that he has solved the grand problem of the laws of organization by his theory of selection. I have given my reasons for not accepting the most important points of his

doctrine, believing them to be too fanciful for philosophical assumptions ; and his minor speculations are very frivolous. For instance, he says,* “ As far as the extreme intricacy of the subject permits us to judge, it appears that our male ape-like progenitors *acquired* their beards as an ornament to charm or excite the opposite sex, and *transmitted* them to man as he now exists. The females *apparently* were first denuded of hair in like manner as a sexual ornament ; but they transmitted this character almost equally to both sexes. It is not improbable that the females were modified in other respects for the same purpose and through the same means ; so that women have acquired sweeter voices and more beauty than men. . . . For my own part, I conclude that of all the causes which have led to the differences in external appearance between the races of men, and to a certain extent between man and the lower animals, sexual selection has been the most efficient. . . . The main conclusion arrived at in this work—and now held by many who are competent to form a sound judgment—is that man is descended from some less organized form. The grounds upon which this conclusion rests will never be shaken ; for the close similarity between man and the lower animals in embryonic development, as well as in innumerable points of structure and constitution, are facts which cannot be disputed. The great principle of Evolution stands up clear and firm when these groups of facts are considered in connection with others. It is incredible that all the facts should speak falsely. He who is not

* The Descent of Man, vol. ii., pp. 383 and 385,

content to look at the phenomena of Nature, like a savage, as disconnected, cannot any longer believe that man is the work of a separate act of creation."

What has science or philosophy to do with the belief of men concerning acts of creation? The province of the former is restricted to natural phenomena, and that of the latter to the realities which underlie these phenomena: neither of them can attain to any knowledge of the origin of things; and they ought to remember the good advice of old, *Ne sutor ultra crepidam*. The doctrine of Evolution is still *sub judice*; so that neither litigant has a right to assume the office of judge, and to decide the cause in his own favour. The facts adduced as witnesses on behalf of Evolution cannot, it is said, speak falsely: this is true, for, as Burns says, "facts are chiels that winna ding;" but they must be well scrutinised by cross-examination to ascertain what it is that they do testify. I maintain that these facts have not been rightly interpreted; and I have, in detail, passed a great many of them under this examination, and given reasons for my judgments. I refrain from making any other comment on the origin of man's beard and woman's beauty, than to say that they are on a par with many other supposed causes of vital phenomena: such, for instance, as the ascription of the stripes on the tiger's skin to its living among jungle grasses, and of the spots of the leopard to the sun's rays glancing between the leaves of the forest: overlooking the fact that all animals that lead similar lives are not striped and spotted. And it is to be regretted that a President of the British Association should be so biased in his judgment as to

mention in his Address such trivialities, as evidence that Evolution can even explain the minutest particulars of organic development.*

* Since this was written, the death of Mr Charles Darwin has deprived Science of one of her ablest biologists ; and as some may deem my having sent the above remarks to press to be a sad breach of the maxim, *De mortuis nil nisi bonum*, I beg to state that they were solely directed against his published doctrine, which is fairly open to criticism.

CHAPTER VII.

The Vital Powers of Animals—The Cause of their Development.

The Soul, the Vital Power of Man.—2. Its Nature discussed.—3. The Development of the Human Germ.—4. Sketch of the Nervous System.—5. What is Instinct?—6. The Brain and its Functions.—7. What is the Mind?—8. Sensation, a Motive soliciting the Attention of the Mind.—9. Perception, Intuitive Knowledge.—10. What is the Memory?—11. The Instinctive and Conscious Faculties of Vital Power.—12. Knowledge, the Law of Volition, may be latent, but never lost.—13. All Vertebrate Animals have Minds.

It would require space beyond my limits to describe the nature of even a single species of each animal group. I purpose, therefore, restricting my subject to that of Man: and as human nature comprises the essential faculties of all other natures, in tracing its development some general notion will be obtained of all other animal natures. The term faculty is usually only applied to the mental activities, but I extend it to all the modes of vital power, by which it performs its various functions, mental as well as corporeal.

1. The nature of each animal type consists of a peculiar cluster of faculties which distinguishes it from all other species. This nature is the attribute of vital power, which each species possesses; and that of man is so superior to all others that it has been distinguished by the exclusive

name of Soul. The body—the visible and tangible part of man—is ever changing by the addition of new materials from without, and by the discharge of old materials from within; so that its substance is totally renovated at short intervals during life: whereas the soul is ever one and the same during the whole course of man's existence; it regulates the action of the corporeal forces in the formation of its organs, and it utilises these organs as the instruments by which it holds intercourse with the outer world. The body is not a human person, but the personification of the soul, the inner living man, who denotes himself by the personal pronoun I—the *Ego* of psychologists.

Evolutionists reject this twofold nature of man, maintaining that he is, like all other animals, merely a protoplasmic organism, which has no need of a vital power, since its molecular forces give rise to all its vital phenomena. "The whole body wastes," says Professor Tyndall,* "so that after a certain number of years it is entirely renewed. How, then, is the sense of personal identity maintained across this flight of molecules? Matter at any period of man's life may be changed, while consciousness exhibits no solution of continuity. Like changing sentinels, the oxygen, hydrogen, and carbon that depart seem to whisper their secret to their comrades that arrive, and thus, while the *Non-ego* shifts, the *Ego* remains the same. Constancy of form in the grouping of the molecules, and not constancy of the molecules themselves, is the correlative of this constancy of perception. . . . The

* Fragments of Science, vol. ii., pp. 50—72.

physical philosopher, as such, must be a pure materialist : his inquiries deal with matter and force, and with them alone."

What is here said of the function of the physical philosopher is strictly true ; for physical phenomena—the various modes of motion—constitute the sole subject of his inquiries : so that when he attempts to explain chemical and vital phenomena on materialistic principles, it is not surprising that he is compelled to attribute the mental phenomena of consciousness and perception to molecules ; and to pronounce their explanation to be an insoluble mystery. The Professor himself admits this ; for, in his Address to the British Association at Norwich, he stated "that a definite thought and a definite molecular action in the brain occur simultaneously ; they appear together, but we do not know why. . . . We are as far as ever from the solution of the problem, how these physical processes are connected with the fact of consciousness."

2. The advocates of the Positive Philosophy and those of Evolution ignore the idea of a Soul, regarding it as a doctrine which has been completely refuted ; and as their views on this subject were lately set forth in an article* on "The Soul and Future Life," I will quote a few passages from the discussion thereon, in order to contrast the new and old views of the nature of the soul.

"The consensus of the human faculties," says Mr Harrison, "which we call the Soul, comprises all sides of human nature according to one homogeneous theory. But

* *The Nineteenth Century*, vol. i., p. 628, *et seq.*

the intuitional method asks us to insert into the midst of this harmonious system of parts an underlying explanation of it, an indescribable entity ; and to this hypothesis the word Soul has been usually restricted. . . . How or when this entity, the soul, ever got into the organism, how it abides in it, what are its relations to it, how it acts on it, why and when it goes out of it—all is mystery. . . . If we ask why we are to assume the existence of something of which we have certainly no distinct evidence, and which is so wrapped in mystery that for practical purposes it becomes a nonentity, we are told that we need to conceive it, because a mere organism cannot act as we see the human organism act. Why not ? They say there must be a principle within as a cause of life. But what do we gain by supposing a principle ? The principle only adds a fresh difficulty. Why should a principle, or an entity, be more capable of possessing these marvellous human powers than the human organism ? . . . Nay, we shall have to go on to invent a principle to account for a tree growing, a thunderstorm roaring, and for every force of Nature.”

This special pleading may have led some to believe that the doctrine of the Soul has been satisfactorily disproved ; but there is in this, as in other cases, two sides of the question ; and it is requisite to hear both, before passing judgment. To call “the consensus of the human faculties” the Soul, is a strange notion : I would rather say that it is human nature, which is an abstract or general expression which comprises all the faculties of man. The soul and human nature are not one and the same thing :

on my view, the former is the vital power of man, and the latter is the attribute of the former, which, in the exercise of its various faculties, performs all the functions of man ; which I hope to show in the sequel. In the doctrine of the Soul there is no assumption of “something which is wrapped up in mystery :” for “the how and the when this entity got into the organism,” and made it a living organism, was when a living sperm entered into and was united to a protoplasmic germ by the act of generation. This germ is gradually developed into a material body, in which the sperm—the living entity, vital power—abides during the life of the human organism, directing and controlling its physical and chemical powers in building up and renovating the organs of the body ; and when it ceases to do so, the body is no longer a *living* organism, but is a mere mass of chemical substances, which are speedily resolved into ordinary compounds, such as occur in the earth. And, if this be so, it is evident that the soul is indeed a peculiar entity, the cause of life, an energising principle that is needed to enable an “organism to act as we see the human organism act.” The admission of such a principle of activity, it is said, requires other principles to explain the various phenomena of Nature. Decidedly so ; and this is the very doctrine which I am advocating, viz., that all Nature is a system of physical, chemical, and vital powers, which variously interacting, according to law, produce all the different physical, chemical, and vital phenomena.

“We say,” continues Mr Harrison, “the immaterial entity is something which we cannot grasp, and which

explains nothing which has a shadow of evidence. We are determined to treat man as a human organism, just as we treat a dog as a canine organism; and we know no ground for saying, and no good to be got by pretending that man is a human organism *plus* an indescribable entity. . . . We say the human organism is a marvellous thing, sublime if you will, of subtlest faculty and sensibility; but we, at anyrate, can find nothing in man which is not an organic part of this organism; we find the faculties of mind, feeling, and will directly dependent on physical organs; and to talk to us of these continuing their functions in the absence of such organs, and visible organisms, is to use language which, to us at least, is pure nonsense. . . . The method of treating man as man, insists, as much as any other method, that man has a moral, emotional, religious life, different in kind from his material and practical life; and to be studied on similar scientific methods. The spiritual sympathies of man are undoubtedly the highest part of human nature; and our method condemns as loudly as any other system physical explanations of spiritual life."

I am not aware that the advocates of vitality pretend "that man is a human organism *plus* an indescribable entity;" at all events, if any one does, I do not. What I say is, that man is not a *human* organism *plus* a specific vital power or soul, but a *material* organism *plus* soul, which is requisite to make the organism *human*; for it alone possesses the attributes of human nature. There is certainly "nothing in man which is not an organic part of his organism;" but the parts of this organism are not all

of them physical and chemical; for one of them is "a marvellous thing of subtlest faculty and sensibility," and this is "the highest part of human nature," which qualifies man for a "moral and religious life," which cannot be explained on physical principles. Feeling, knowing, and willing are acts which are performed by the faculties of the mind; and these, and all other faculties of vital power, are not dependent on physical organs, which are the appointed instruments whereby vital power performs its various functions. Where the soul goes, or what becomes of it, is a problem in the solution of which neither science nor natural philosophy has any concern.

Mr Harrison's doctrine comes perilously near to that of an immaterial soul: and has been aptly described by Professor Huxley as "a soulless spirituality." This eminent Evolutionist is more consistent in his materialism than the Positive philosopher. "I understand," he says,* "and I respect the meaning which others attach to the word Soul. But, in the interest of scientific clearness, I object to say that I have a Soul, when I mean, all the while, that my organism has certain mental functions, which, like the rest, are dependent upon its molecular composition, and come to an end when I die."

Truly, death puts an end to all the vital functions, corporeal as well as mental, that are manifested by the human organism during life; and this, too, in some cases, whilst "the molecular composition" of the body is still unchanged. This fact indicates that before death there

* Ibid, vol. ii., p. 340.

was a special factor co-operating with the molecular forces of the body, that enabled them to perform functions which they cannot do without such a co-operation. This is illustrated by the analogy of a machine, an artificial organism, which can only do its appointed work whilst a moving force co-operates therewith: by accident, or wear and tear, the machine may come to a stand-still; it, as it were, dies: but the moving power does not come to an end, it may be removed to another machine and cause it to work. And vital power, for a season, may be said to run a similar course, for it actuates a succession of renovated organic machines.

These eminent men agree "that every mental and moral fact is in functional relation with some molecular fact:" and yet, starting from the same point of departure, they arrive at diverse conclusions. Huxley says, "If I can trace the molecular facts which are the antecedents of the mental and moral facts, I have explained these facts; when I have traced out the molecular facts, I have built up a physical theory of moral phenomena." To this Harrison replies that "there is no such thing, no rational thing, that can be called a physical theory of moral phenomena; any more than there is a moral theory of physical phenomena." The physical doctrine, he says, does not meet all the requirements of vital phenomena. "It does not satisfy me, I call it materialism; for it exaggerates the importance of physical facts, and ignores that of spiritual facts. I deny that mental and moral facts are explained, when their antecedents are traced to molecular facts. I condemn the fancying that

one science can do the work of another; and that any molecular discovery can dispense with the study of organisms in their organic, mental, and moral aspects." This argument against materialism is satisfactory: but its author, in his anxiety to refute his adversary, has at the same time greatly damaged his own position.

3. To return from this long discussion about the Soul, let us now trace the development of man's vital faculties. Man, like all other animals, commences his existence as a living germ, formed by the process of generation, as already described.* During embryonic development, the human foetus is an organism of no higher degree than that of the inferior animals; for vital power then only exercises its formative and organizing faculties, according to the special type of the organism. These faculties—the lowest of vital power, but the most persistent, for they are active during the whole course of life—are moved to energise in response to impressions made on the general organ of the tactual sense—the *sensus communis*—which is diffused throughout the epidermic integument of the body, and in the membranes that line the cavities of the viscera; and on this account the energy of vital power concerned therewith may be called its organic faculty, which is the sole principle of vital activity in animals below the articulata.

When the new-born babe enters on an individual state of existence, it no longer receives its nourishment by organic connection with its mother's body: and its lungs, so long passive in the womb, are now inflated by air

* Chap. vi., par. 6.

rushing into them, and thus the function of respiration commences, commonly accompanied by crying, caused by a forced expiration of the air. At the same time a different circulation of the blood is induced; before birth it was single, but now it is duplex, owing to the closing of the communication between the ventricles of the double heart, which brings into play separate organs for arterial and venous blood; and these functions of respiration and circulation continue unceasingly in operation during the normal state of life. Soon after birth the babe searches for food by moving its head about; and, guided by the sense of touch, it seizes with its lips any prominent object that comes within its reach; and when it finds the right one it sucks and is satisfied. These actions of the babe, common to all newly-born mammals, are instinctively performed. Here, then, a question arises, What is instinct? Before this can be satisfactorily answered, it is requisite to say a few words about the nervous system, which was expressly formed during the embryonic development, as the means whereby vital power is enabled to superintend the movements of the corporeal organs.

4. In man the nervous system is so intimately connected with every part of his body, that abstracted therefrom—as depicted in anatomical plates—it represents the entire outline of the human form: and thus it is that vital power, which also pervades the body, has the instruments ever at hand by which it performs its functions in stimulating and directing the action of the muscles. In contemplating this system, exclusive of the brain, it is seen to consist of two kinds of nervous tissue: one appears as

masses of various size, called nerve-centres or ganglia; the other as strings or fibres, called nerves. The substance of the ganglia consists of nucleated cells or vesicles, lying somewhat loosely in the midst of minute blood vessels; and it is in the vesicular portion of these centres that nerve force—somewhat resembling electricity—seems to be originated. The nerves have a distinctly tubular structure, consisting of an external membranous sheath, within which there is a peculiar nervous matter, pellucid and of a semi-fluid consistence: the office of the nerves is internuncial. The nerves which connect an organ of sense with the ganglia are termed ingoing or afferent nerves; and those which lead from the ganglia to the muscles are outgoing or efferent nerves. The sensorial ganglia and their appendages form an intermediate portion of the nervous system, and are possessed not only by man and other vertebrates, but also by the higher invertebrates, more especially by the social insects, which manifest wonderful instincts.

5. We are now in a position to suggest an answer to the question concerning instinct. In illustration of this subject, let us consider what takes place in the case of locomotion in response to an impression made on the organ of sight by an external object. Various conditions of this object produce ethereal vibrations, which, impinging on the eye, occasion an impression, which is transmitted by its afferent nerve to the sensory ganglia, where it effects a change in its vesicular structure, evolving nerve-force, which causes a reflex current to be conveyed by its efferent nerve and discharged on the muscles of the legs, thereby stimulating them to contract and perform the

function of locomotion. This is not, however, all that takes place during the action and reaction of these nerve-currents; for, if it were, the process would be purely physical: but it is not so; for something very peculiar occurs at the ganglia, which cannot be ascribed to nervous energy. In short, the process of locomotion is not simply that of moving the legs, but also of determining in what direction the body is to be moved, in order to fulfil what is needed to be done in respect to the external object, as indicated by the organ of sight. The body by the movement of the legs may go forward to the object, or sideways to let it pass clear, or it may turn round and retreat from the object. What is it, then, that enables the unconscious creature to act rightly according to the intimation of the senses? May not the nervation excited in the ganglia by the ingoing current move vital power to use its instinctive faculty in determining and directing the outgoing current so as to produce the required movement of the body? And, if so, then *instinct* is the regulative principle or law, according to which vital power performs its *unconscious* actions: and this it does necessarily and undeviatingly, as physical powers do when acting according to the laws of motion.

Dr Carpenter in some measure admits that the impressions made upon the organs of sense, when transmitted to the sensory ganglia, result in something more than reflex actions that stimulate the muscles to move. "We know," he says,* "that impressions made upon the organs of

* Principles of Human Physiology. Fourth Edition, pp. 664, 729, and 740.

sight, hearing, &c., produce no further change unless we become conscious of them ; and as the invertebrata possess no distinct ganglionic centres of a higher character than the sensory ganglia, it seems to be a legitimate inference that these centres are the instruments by which animals, furnished with them, are rendered *cognisant* of such impressions, and through which the sensations thus called into existence serve to prompt and direct their movements.

. . . We are led by the very cogent evidence which Comparative Anatomy supplies, to regard the ganglionic centres as constituting the real *Sensorium*. If this position be denied, we must either refuse the attribute of consciousness to such animals as possess no other encephalic centres than these ; or we must believe that the addition of the cerebral hemispheres, in the vertebrata, alters the endowments of the sensory ganglia, an idea which is contrary to all analogy. . . . We have seen reason to conclude that, in their independent capacity, these ganglia are to be regarded as the true centres of sensations—*i.e.*, of the consciousness of external impressions—and as the instrument, in virtue of their own reflex power, of that class of instinctive or automatic movements which require to be prompted and guided by sensations.”

All animals, from the lowest to the highest, are *sensitive*—that is, parts or the whole of their bodies move in response to impressions on the organs of sense ; but those animals only which have brains are conscious of these impressions, and consciously direct their movements. In the latter case, the effects resulting from sense-impressions are evidently so peculiar that they have been expressly

termed *sensations*; whereas those of the former are so obscure, that as yet they have not received a distinctive name, and in default of this, I venture to call them *sensitions*: the difference between them is well marked: sensations are conscious, and sensitions instinctive nervations. When the brain is injured by accident or disease, we are for a time, as it were, virtually reduced to the condition of invertebrates; for we have no sensations, but our bodies are still instinctively sensitive to impressions on the organs of sense. The possession of brains by animals does not “alter the endowment of the sensory ganglia;” for their respective functions are perfectly distinct: the one consciously directs, and the other instinctively executes the required movements. “Sensations” do not “prompt and guide,” they only move, or rather solicit the mind to direct the actions of the sensory ganglia; and it is this co-ordinated connection of the various nerve-centres that affords vital power, the instrumental means of superintending and directing the complicated functions of the organism, in all its various phases of development.

6. The new-born babe is merely an instinctive creature, but the day at length comes when it gazes on surrounding objects, more especially on its mother's face; and then, as nurses say, it begins to take notice. This consciousness—the state of being conscious, or of knowing—is at first indistinct, but after frequently-repeated observation, the babe acquires a clear perception of the object at which it looks: it now knows its mother, and returns her smiles; and from this time it learns to know other persons, and to

recollect them, as indicated by its turning away from strangers.

As the instinctive faculty of vital power is intimately associated with the various ganglia of the nervous system, so is its conscious faculty exclusively connected with the *brain*, the highest nerve-centre, which crowns the cranio-spinal axis, and which is only possessed by vertebrate animals. The brain has no continuous connection with the organs of sense by distinct ingoing nerves, or with the muscular system by distinct outgoing nerves: these communications are effected through the medium of the sensory ganglia by the two pair of commissural bodies, called Thalimi Optici and Corpora Striata. "The brain," says Dr Carpenter,* "forms an exception to the general plan on which the elements of the ganglionic centres are arranged, in having its vesicular substance on the *exterior* instead of in the *interior* of the organ. The purpose of this is probably to allow the vesicular matter to present a very large surface, and by this means to admit, on the one side, the more ready access of blood vessels which are so essential to its functional operations and, on the other, to admit more ready communication with the vast number of fibres by which its influence is propagated: but there is no reason to believe that the relative functions of its vesicular and fibrous tissues are in the least altered by this change in their usual position. . . . With regard to the radiating fibres which connect the Thalimi Optici and Corpora Striata with the brain, no positive proof has

* Ibid, pp. 764 and 765.

yet been obtained, but they seem to be of a commissural nature only: on this view the brain would receive its *sensory* impressions by the commissural fibres that connect it with the ganglia, which are the real centres of the nerves: whilst it would call the *motor* trunks into action by exciting, through another set of fibres, the vesicular matter of the ganglionic centres from which they pass forth. Be this, however, as it may, there can be little doubt that sense impressions are transmitted from the sensory ganglia to the brain, and thence a nervous current descends to the same, which, in response thereto, perform the required voluntary motions."

7. We are now about to enter on the subject of mental phenomena, which have proved a stumbling-block to the doctrine of Evolution; but which, I hope to show, are at least plausibly explained by the doctrine which I am advocating. As a preliminary, however, it may be well to ascertain, if possible, the nature of the mind, and of its phenomena. The mind is generally defined to be *that* which feels, thinks, and wills: but this does not tell us what the nature of this *that* is, which is so bountifully endowed.

"It is needful," says Dr Maudsley,* "to apprehend exactly what is understood by the common and vague use of the word *mind*. It is really a general term acquired by observation of the manifold variety of mental phenomena—an abstract conception, an idea which has no more existence out of the mind than any other abstract term.

* The Physiology of the Mind, pp. 82, 125 to 127.

Because we can form such a conception, it does not follow that the mind can exist apart from the complex organization of the brain. Instead of the mind being a wondrous spiritual entity, the independent source of power and self-sufficient cause of causes, observation proves that it is the most dependent of all forces. But what is it that thinks, reasons, and wills, that of which consciousness is the phenomenon? The physiologist answers that it is the brain, not any supposititious entity, for the existence of which he has no evidence whatever. . . . The brain is not a dead instrument, but a living organ, with functions of a higher kind than those of any other bodily organ, insomuch as its structure far surpasses that of any other organ."

The passages which I have selected from this able work are in accord with the current science and philosophy of the day, and, therefore, serve for contrasting my views therewith. The word mind is not an abstract term for "the manifold variety of mental phenomena;" it has no such meaning, nor can have, for things of or belonging to another thing cannot be defined by the thing itself: the word mind is a definite expression for something that exists, though it is not an object of sense: this something is not, indeed, a "self-sufficient cause of causes," but the sole cause of peculiar phenomena, the phenomena of this something, which is called mind. The mind does not "exist apart from the brain," for this organ is the appointed instrument by means of which it is enabled to perform its voluntary actions. The physiologists who maintain that the brain is "that of which consciousness is the phenomenon," cannot have arrived at such a con-

clusion by inductive science, but by means of an unverified philosophy which assumes that all natural forces are merely the abstract terms of the manifold variety of phenomena. Consciousness is not a phenomenon of the brain, nor is it a faculty ; but it is, as Hamilton pointed out long ago, the conscious condition of the mind, a state of being conscious. There is no consciousness unless there be attention, which is an act of the will : and it is on this account that I conceive mind to be the free conscious energy of vital power. On this view, the conscious faculty of vital power energises freely in every mental action : and thus knowledge is obtained, which becomes, as it were, the law by which the mind freely regulates its conduct. I say freely, because the mind may act or refuse to act according to the dictates of knowledge. Mental, like social laws, may be metaphorically termed *dictates*, but, strictly speaking, they are the dictates of a lawgiver : and thus it is that the mind is said to be a law unto itself.

I am inclined to think that the mind, mental force, is one of the modes of vital power, precisely as heat is a mode of the physical power, repulsion : and, if so, then the word mind denotes the peculiar energy by which vital power, in the exercise of its free conscious faculty, feels, knows, and wills. And as the word *mind* conveniently expresses this condition of vital power, I intend to use it in this sense for the sake of brevity.

Evolutionists maintain that every feeling, thought, and volition, that is all the mental functions, are not only connected with, but dependent on a corresponding nervation of the brain ; or, as Professor Huxley has tersely

expressed it, "psychosis is invariably associated with neurosis." "That psychical phenomena," says Romanes,* "are very intimately associated with physical phenomena is a fact which does not admit of one moment's dispute: but concerning the nature of this association science must declare not merely that it is at present unknown, but, as far as she is at present able to discern, it must ever remain unknowable." "Do states of consciousness," asks Professor Tyndall,† "enter as links in the chain of antecedence and sequence, which give rise to bodily actions? . . . Is the causal connection between the objective and subjective, between molecular motions and states of consciousness? My answer is, I do not see the connection, nor am I acquainted with anybody who does. It is no explanation to say that the objective and the subjective are two sides of one and the same phenomenon. Why should the phenomenon have two sides? This is the very core of the difficulty. There are plenty of molecular motions which do not exhibit this two-sidedness. Why should the molecular motion of the brain be yoked to this mysterious companion, consciousness? The mechanical philosopher, *as such*, will never place a state of consciousness and a group of molecules in the relation of mover and moved. Observation proves them to interact; but, in passing from one to the other, we meet a blank which the logic of deduction is unable to fill." "The futility of all attempts," says T. H. Herbert,‡ "to explain the connection between

* *The Nineteenth Century*, vol. iv., p. 658.

† *Ibid*, pp. 827 and 828.

‡ *The Realistic Assumptions of Modern Science*, p. 285.

brain changes and thoughts follows as a matter of course ; for no ingenuity can discover the way in which two factors, neurosis and psychosis, co-operate, when there is but one factor, molecular changes."

Thus we see that it is admitted that there is an impassable gulf between matter and mind: 'since, then, this problem has been abandoned by Evolutionists, they ought not to stigmatize, as an insufferable presumption, the efforts of others to throw light on this subject. I admit that originally, at the outset, the mind is dependent on the co-operation of the brain ; and always on it for making the sensory ganglia subservient to its performance of voluntary actions: but I hope to show that the mind, in the exercise of its highest faculties, is, in *some* measure, independent of the brain when engaged in the development of pure rational knowledge. Only give me your undistracted attention, and, on my part, I will try not to overtax your patience.

8. When an impression on an organ of sense is transmitted by the sensory ganglia to the brain a nervation, neurosis, is produced, the import of which the mind—the conscious faculty of vital power—presiding at the brain, recognises as a sensation, that solicits attention to the object that produced the nervation. Sensation is, therefore, the dawn of consciousness, a conscious state of the mind induced by the infant intently gazing on an object of sense ; and it is only after repeated attention—an act of the will, the free conscious energy of the mind—that a perception of the object is attained.

This view of the genesis of the mind is in some

measure consistent with that of several able psychologists. "Sensation," says G. H. Lewes,* "avowedly lies at the basis of mental manifestations. Rightly or wrongly, it is viewed alternately as a pure subjective fact—a psychological process—and as a purely objective fact—the physiological reaction of a sense-organ. The physiologist describes how a stimulus excites the brain, and declares its reaction to be a sensation. Thus expressed in the terms of matter and motion, there is nothing of that subjective quality which characterises sensation; yet without this quality the objective process cannot be a sensation." "The nearest thing," says Dr Maudsley,† "with which we can compare the pure sensation, free from admixture with perception, is probably the so-called organic sense through which the brain is affected by the special stimuli of the internal organs, such organs being in intimate relation with the brain through internuncial nerve-fibres, having, so to speak, a special correspondence therewith. . . . Sensation expresses merely the state of simple feeling without reference to an external cause; it is wholly within and subjective: perception includes not only the internal feeling, but the reference of it to an external cause; it is the synthesis of subject and object."

9. The perception of objects of sense is intuitive knowledge, an ultimate or fundamental principle, which is like instinct, incapable of demonstration, and must therefore be accepted as a self-evident truth. It is possessed by all

* *The Physical Basis of Mind*, p. 335.

† *The Physiology of the Mind*, pp. 206 and 221.

intelligent beings, by the unlearned as well as the learned ; so that all are equally qualified to understand its testimony. Ask any one what it is that he sees ; and he will answer without hesitation, if his sight and mind be sound, that he perceives the object at which he is looking. Indeed, it has become a proverb, Shall I not believe my own senses ? And certainly, according to Vincent of Lirens' criterion of truth, it deserves our confidence ; for its testimony is the same to all men everywhere : had it been otherwise, there could not have been that common ground of agreement between man and man, which is indispensable for social intercourse.

It may be objected that the senses are not perfectly trustworthy, for both man and animals are occasionally deceived by relying thereon. For instance, Zeuxis painted grapes so naturally, that birds came and pecked at them ; and he himself was in turn deceived by his competitor, whom he challenged, saying, " Now, Parrhasius, draw aside the curtain, and let us see what you have painted." This, and like cases, do not prove that the senses are at fault ; for they only testify as to the appearances of things : it is the reliance on the acquired knowledge of things that causes the deception ; Nature herself is trustworthy, but she provides no safeguard against artificial imitations. Sense-perceptions, therefore, are unjustly blamed for such occurrences ; and also for errors of judgment. Thus, when travelling rapidly, houses and other stationary objects seem to be running away from us, whereas it is we ourselves who leave them behind by swiftly moving past them : so when the sun rises and sets, the senses testify

rightly as to what appears to take place; but it is our judgment that errs, in not making allowance, through ignorance or forgetfulness, for our participation in the earth's rotation.

Bishop Berkeley and his followers maintain that the immediate perception of the objects of sense is fallacious; that we can only know things, they say, as groups of sensations. Hume, legitimately carrying out the same argument, denied the existence of the mind itself; but he candidly admitted that this conclusion conveyed no conviction of its truth. This surely betrays a lurking defect in the doctrine of idealism; and, if I mistake not, it is owing to a misapprehension of the nature of sensations: for these are merely feelings—they convey no knowledge of the objects of sense, but only serve to elicit the attention of the mind to the impressions made on the brain, whereby an intuitive or *à priori* knowledge of objects is obtained. The infant notices and perceives objects before it can make any practical use of this knowledge; but as soon as it has learnt to use its hands, it grasps at everything that it sees: thus showing that it is the things themselves that it knows, and not its sensations. So that it might be said to the idealist, Go to the young child, and observe its actions, and you will learn that perception is a knowledge of things themselves, which carries a conviction to the mind that they are present, and capable of being handled and utilised in various ways.

10. In describing the genesis of knowledge, it was stated that a child came in time to know those persons with whom it was familiar, and remembering them would

cordially go to them, but turns away from strangers; this act of recognition is ascribed to memory, which, in after life, plays an important part in mental phenomena. Memory is the term by which we express the fact that *acquired* knowledge is appropriated and stored up in the mind, ready to be *utilised* as circumstances require. All this seems to be very simple, but when it is asked, What is the nature of memory? the question is by no means easy to answer. Some think that it is a function of the brain: for if this organ be injured by accident or disease it fails, or is even altogether lost; this dependence of the memory on the brain has been ascribed to impressions made on it during the acquisition of knowledge, and some facts seem to point in this direction. For instance, the memory undergoes a great alteration in old age, when passing events are soon forgotten, whilst those that occurred in youth and early manhood are vividly remembered: the defect of memory in old age is attributed to events making but feeble impressions on the brain, on account of the little interest they then excite; whereas in youth there is a continual novelty in passing events, which make deep impressions not easily obliterated. "It is not to be doubted," said Professor Huxley, in his Belfast Address, "that those motions which give rise to sensations leave on the brain changes which answer to what Haller called *vestigia rerum*. The sensation that has passed away leaves behind molecules of the brain competent to its reproduction—'sensigenous molecules,' so to speak—which constitute the physical foundation of memory."

We do not know that the motions which act on the

brain and produce nervations also make impressions on its molecules that become permanently marked molecules by a successive process of renovation. But if so, as a large proportion of impressions on the brain never give rise to sensations, all of these cannot be sensigenous molecules. What is it, then, that determines this difference? This is not simply a physical problem: psychosis, as well as neurosis, is concerned therein. Unless the mind is conscious of the neurosis, there is no sensation; so that the supposed impressions made on the molecules of the brain, having been made before sensation, they cannot represent that which was subsequently produced by the interaction of an additional factor. And the same holds good in respect to the supposed relation of sensations to the memory: thus the recollection of acquired knowledge is removed a step further from molecular impressions; for a sensation only serves to direct the mind's attention to the objects of sense, which then become perceptions or sense-knowledge. Sensations are only the means to an end, the genesis of knowledge; and having done their part they for ever pass away: it is knowledge thus acquired, and not sensations, with which memory is concerned. I am inclined to think that it is vital power that in the exercise of its conscious faculty, as mind, acquires, appropriates, and utilises knowledge, as the means of regulating its volitions. On this view, the word memory expresses the capacity of the mind for retaining its acquired property, knowledge, and using it as the means of directing its actions; and thus memory is an enlargement of the law, by which the mind is regulated in the production of its phenomena.

The memory is a provision of Nature, by which the mind is relieved from repeated acts of acquisition, by having its knowledge ready at hand to act promptly in cases of emergency. The laws of instinct and of knowledge are different in their origin; the one is innate, the other is acquired; but as the regulative principles of different faculties of vital power they subserve the same purpose.

11. Vital power may act at one time according to instinct, and at another according to knowledge; or it may simultaneously perform both kinds of actions: and this throws light on some curious occurrences in which knowledge seems to be reduced to the state of instinct: and in which the same individual seems to possess a two-fold personality.

In early childhood we learn to walk, talk, and read, and if we do not remember our own efforts in acquiring these attainments, we cannot fail to have observed how long and laboriously they engage the attention of children; and yet, when once acquired, they may be almost, if not altogether, unconsciously performed. Thus in reading an interesting book, its subject absorbs the attention of the mind; whilst the words, once so difficult to learn, are now understood at a glance, as it were instinctively; and so it is with the gymnast and the musician: their arts must be thoroughly learnt, and then the artist may perform his work so easily that he may do so whilst his mind is occupied in thinking about another subject. So likewise, persons who are in the habit of taking the same daily walk may, at setting out, have consciously directed their steps, but, falling into a reverie on the way, they uncon-

sciously continue their walk, and start with surprise, as one waking out of sleep, when they find themselves at their destination. By these and similar facts we learn that man can act both consciously and instinctively at the same time. On my view, the soul or vital power of the man who does these things performs them by its various faculties co-operating with the forces of different organs, acting in the one case consciously, and in the other unconsciously; though the actions are diverse, the agent is the same in both cases. There is nothing extraordinary in this, for at the same time vital power, in the exercise of its organizing faculty, is directing the growth and renovation of all the corporeal organs: so that vital power is ever active—it neither slumbers nor sleeps, but is ever ready to superintend and direct all the functions, both of body and mind, being only limited in its actions by the capabilities of its corporeal powers.

The limitation of these capabilities is manifested by a feeling of fatigue and exhaustion, which is produced by the excessive exertion both of body and mind. In the former case, the force that moves the limbs is supplied by the consumption of the muscular molecules; and if this takes place faster than these molecules can be replaced by the organic process of renovation, the strength fails; and if exertion be continued, a feeling of exhaustion ensues. So also in the latter case, when the attention of the mind—an act of the will—is engaged in thought, the nervous energy of the brain co-operating therewith is evolved by the molecules of the brain's vesicular tissue undergoing destruction; and should their renovation fail to

keep pace with the consumption, a sense of languor and weariness supervenes. At first sight, this statement may seem to justify the doctrine that mind is a function of the brain; but it only shows the close connection subsisting between this organ and vital power, which the doctrine of the twofold nature of man requires: it holds that there are two factors concerned in every vital phenomenon, consequently mental phenomena can only be explained by the co-operation of physical and vital powers, which are respectively the causes of neurosis and psychosis.

12. There is reason to believe that knowledge, when perfectly acquired and appropriated by the mind, is ever retained; though, for lack of the association of ideas, or other necessary means, it may never be recalled to mind. Two remarkable instances of this are recorded by Hamilton,* which he regarded as cases of latent consciousness. The Comtesse de Laval, in one of her confinements at Paris, talked Breton in her sleep, of which she did not understand a single word when the nurse, in the morning, repeated what she had said; but on being told that it was Breton, she remembered that her early childhood was passed at nurse in a family that spoke no other language. It is possible that the dress of the Breton nurse, or words spoken by her, may have led, by the association of ideas, to the unconscious utterance of words long forgotten. Again, a maid-servant who had learnt by rote several Hebrew, Greek, and Latin sentences, from hearing her master—a Swiss minister—frequently repeat them during

* Lectures on Metaphysics, vol. i., pp. 344 and 345.

his habitual walk in the veranda near the kitchen, repeated them in the delirium of fever at a German hospital. The doctors in consultation by her bedside may have made use of words of classical origin, and this might have suggested to her mind the sayings of her old master.

These facts show that knowledge long latent is not lost, but under favourable conditions may be recalled to mind, and actively used in directing the sensory ganglia to give it utterance. The mind is capable of acting according to knowledge in two different ways at the same time: for whilst consciously engaged in thought, it may direct the performance of voluntary actions; in both cases it acts only as a superintending authority issuing its commands; and much less time than the twinkling of an eye would suffice for the mind to revert from one to the other office. If we call to mind how simultaneously responses are instinctively given to impressions made on two or more organs of sense, we cannot be surprised that the mind is able to discharge various offices at the same time, in response to different impressions made on the brain. When the mind wills to do a thing which is known to it by memory, it cannot do so without the aid of the brain, to furnish the reflex current that excites the sensory ganglia to perform the action. And so when the mind thinks, it deals with its acquired knowledge, in which it is independent of the sensory ganglia, but not of the brain; for even when the mind is absorbed in dealing logically with conceptions according to the laws of thought, its attention is most intently fixed on its occupation, and this attention requires the co-operation of the nervous energy

of the brain; and if this be overwrought, other bodily functions besides that of the brain may be seriously injured.

13. Since the brain is a special organ of the mind, it might be expected, *à priori*, since all vertebrate animals have brains, that they also possess minds, that is, some degree of intelligence, though inferior to that of man in his lowest estate. Formerly it was supposed that brute animals were mere creatures of instinct; indeed, even at the present day many are of the same opinion, and even go farther, in maintaining that all animals, including man himself, are mere automatons; and that all their actions are capable of being explained on mechanical principles. An automaton is a self-moving machine; but an animal is a self-moving organism, which is a very different thing. An animal develops its own organism and keeps it in repair during its workings; and also produces another organism of the same kind to take its place when worn out; but a machine can do none of these things: it is not, therefore, reasonable to place things so totally different in the same category.

Anecdotes illustrative of animal intelligence are very numerous, and so familiar to most persons that little need be said on the subject. All will readily admit that the dog, horse, elephant, and others of the higher animals, are intelligent creatures; for they not only know and remember many things, but also rightly apply their experience: in short, they feel, know, and will, which are the characteristic properties of mind; and this, on my view, is vital power when in the exercise of its conscious

faculty ; so that every vertebrate animal, as well as man, has intelligence which distinguishes it from all other kinds of animals.

If the higher animals were not intelligent creatures, capable of receiving instruction, and of using such acquired knowledge in the voluntary regulation of their conduct, there could not have been that relation between them and man on which domestication depends. Gregarious brute animals, in a state of nature, fear and shun man ; but when captured and trained they become docile and submissive to his will, as useful and profitable servants. The obedience which domestic animals render to the commands of man opens up an entirely new field of research, very different from that which has hitherto engaged our attention : the phenomena which now present themselves do not result from the interaction of physical and chemical forces on each other, or from these under the direction of vital powers ; but are the result of the interaction of wills, belonging to different kinds of creatures. And here the idea of authority, which I have ascribed to vital powers as their means of action, comes clearly and prominently forward in its true character. Will, the conscious energy of vital power, does not merely direct, it authoritatively, as it were, commands : and the submission of will to will—of subjects to the powers that be—brings us into contact with the principle of dominion, a subject which will be considered hereafter.

Mr Alfred Smee* has given an interesting account of a

* Instinct and Reason, p. 9.

mouse which shows that brute animals, like man, do use their acquired knowledge for the regulation of their actions. He caught one in his study, and wishing to ascertain if there were any access to it besides the door, he allowed it to escape, set the trap again, and retired. Day after day he found no mouse in the trap, and the bait untouched: at length, after several days, the mouse was caught again, but so emaciated that the skin hung loosely on its body. Hence we learn that this little intelligent creature, in the first instance, followed the dictates of its appetite; but when by experience it had learnt the consequence of so doing, it refrained from the enticing food as long as there was any chance of self-preservation.

The intelligence of the higher vertebrates may be readily admitted: but it may be said that no one can suppose that fishes, the lowest of animals that have brains, can have minds. We have not hitherto obtained much insight into their nature, owing to their living in a medium unfavourable for our studying their habits: but the little that we do know justifies the belief that they also have minds. Fishes have been trained to come, on the tinkling of a bell, to a particular part of the pond to be fed; just as fowls, in the poultry yard, do when called. An instructive experiment, made by Professor Möbius, is given by Mr Romanes,* in an Article on Animal Intelligence. A pike was placed in a tank with minnows, but separated from each other by a partition of plate glass. As soon as the pike spied its wonted prey it darted at

* *The Nineteenth Century*, vol. iv., p. 659.

them, but was repulsed by the glass: subsequently, after repeated failures, it ceased to take any notice of them; and then the partition was withdrawn; but the pike made no attempt to capture the minnows. This proves that fishes, like all other vertebrates, have minds; for they *acquire* knowledge by experience, remember, that is, *appropriate* it, and *utilize* it in the regulation of their actions.

The degree of intelligence to which brute animals are capable of attaining does not rise above the simple understanding of man, aptly called common-sense, which is sufficient for the ordinary purposes of life. In the young of the higher animals, consciousness gradually dawns, and goes through the same course of development as in the human child. For instance, puppies and kittens for a time after birth are simply creatures of instinct; but, after a while, they come to know their mothers, and also the persons by whom they had been daily handled: and when we see them turn away from strangers, this indicates that they have not only acquired sense-knowledge, but also remembered what they have learnt.

Much more might be said on this subject, but it is time to terminate our survey of what has been termed the "animal faculties of the mind," and turn to the consideration of concepts, rational ideas, which are developed by the higher faculties of the mind, which belong only to man.

CHAPTER VIII.

The Genesis of Abstract Ideas—And of the Pure Sciences.

The Simple Understanding, or Common-Sense.—2. The Faculty of Speech, and the Origin of Language.—3. Concepts the Ideal Forms of Things.—4. Their Classification.—5. Logic, the Pure Science of System.—6. Hypostatics, the Pure Statical Science of Substance.—7. The Dynamical Science of Cause.—8. Kinematics, the Pure Science of Motion.—9. Chemics, the Pure Science of Combination.—10. Organics, the Pure Science of Organization.—11. Conclusion.

1. As far as we have hitherto advanced in describing the development of human nature, we have seen that man has much in common with the higher animals, which are even capable of acquiring experience, and of using it for their safety and welfare : but there is in this respect a great difference between them ; for the brute remains in the same condition from generation to generation, whereas man hands down his experience to his descendants, and thus from age to age makes advances in knowledge. And by this knowledge he is enabled to construct many artificial contrivances for his security and welfare.

2. A higher understanding is not the only advantage that man has over the brute ; for he also possesses the faculty of speech, by which he can communicate his thoughts to his fellows ; and by means of this faculty he

can execute combined operations, which raises him above individual weakness, and makes him a mighty power in the world. Language, the handmaid of the mind, expresses what we feel, think, and will—a system of words conventionally adopted as the signs of things and of their phenomena. Some maintain that when we think, words are the things of which we are conscious ; but this confounds the sign with the thing signified, which is the object of thought : the mind only makes use of words to impart its thoughts to others ; just as I now do by writing them. We learn to speak our mother-tongue by imitating verbal sounds, which, indeed, some birds may be taught to do ; but the child can not only do this, but comes to know the meaning of the words, and rightly apply them to the things which they represent. Here a question arises, How was language originally acquired ? Did man develop it, step by step, from interjections which are instinctively uttered on various occasions ; or is it an endowment of his nature, which is capable of being enlarged by cultivation ? Young children are taught to speak the language of their parents ; but how the first parents of mankind obtained their language we do not know : the analogy, however, of what now obtains renders it not improbable that it also was by instruction. The various languages now spoken by civilized nations have been traced up to a few ancient types ; and this has been regarded by some as evidence of a plurality of the human species. On the other hand, Professor Max Muller,* a high authority on

* Lectures on the Science of Language. First Series, p. 333.

this subject, thinks it probable that all-existing dialects—reducible to a few classes—flowed from the same fountain, a primeval language now lost by the frequent repetition of its transformation ; and this corresponds with an old tradition that the human race originally sprang from one primeval species, which has subsequently developed itself into several varieties by the modifying influence of natural conditions.

3. The understanding and the rational intellect only differ as a lower and higher degree of intelligence. In both cases, the mind has advanced beyond purely sense-knowledge or intuition. When attentively observing the intuitions of sense, directly or reproduced by memory, it obtains the simple ideas, percepts : and when it contemplates its percepts, in the exercise of its rational faculty, it then attains a knowledge of abstract ideas, called *concepts*. Complex, or concrete knowledge, as originally given in percepts, is somewhat analogous to compound substances, which the chemist decomposes into their elements ; for, in like manner, by logical analysis, the mind resolves percepts into concepts : and as the chemist by the reunion of elements may regain the compounds, so by logical synthesis the concrete percept may be reproduced. The mind has now entered on its rational mode of working according to the laws of thought, and is capable of arriving, by induction, at the fundamental principles of the natural sciences, which form the basis on which philosophy is constructed.

4. The system of Nature is a classified arrangement of all things according to a rational plan : natural things

have two aspects according as they are regarded in relation to the system as *real forms*, visible and tangible; or in relation to the plan as *ideal forms*, discernible only by the intellect. On this view, the ideal forms of natural things are not, as Plato and others supposed, the realities themselves; but that which was aptly called by Oersted the reason in Nature. The very idea of system and all its subordinate parts—kingdoms, sub-kingdoms, classes, genera, and species—are all abstract ideas expressive of the co-ordinate relation of things. Every kind of thing has a peculiar cluster of properties, common to all the individuals of the same kind, called its *nature*, which is also a concept or abstract idea of these properties, and not of the thing itself to which these properties belong; and the disregarding of this difference has caused some confusion. Let us now turn our attention to the ideal forms of natural things—the fundamental principles of the abstract or pure sciences—which, being outside of and beyond the natural sciences, are rightly called Metaphysics.

5. Abstracting the idea of system from the System of Nature, and making it the subject of a pure science, we have the highest generalization of ideal forms. What, then, is this science that treats of systematic order? It is Logic, which underlies the other pure statical sciences—Geometry, Arithmetic, Morphology, and Statics—that treat of the magnitude, number, form, and equilibrium of things: all of which are related to Logic as species are to their genus; in short, Logic is the science of the pure sciences, as Philosophy is that of the natural sciences—Physics, Chemistry, and Biology. Some have asserted

that Logic is a superfluous science, as Geometry can alone enable any one to reason correctly; but, in so far as it does so, it is indebted to the higher science which underlies it, and is only modified by its union with the specific idea of magnitude.

In Logic, the mind is only conversant with those ideas that relate to order; and when its attention is fixed on these objects, it proceeds, according to the laws of thought, to their denomination, definition, and classification. Every genus or species, abstracted from all its relations, is a logical unit, or universal, consisting of, and capable of division into, all its parts; for by its constitution it is a co-ordination of all its subalterns. How many parts make up the whole is unknown; but this we know, that they must all possess the same characteristic properties. The highest universal is equal to, or comprehends all its parts; and the lowest possesses the properties of the highest, with one peculiarly its own. Or, as otherwise expressed by Archbishop Thomson,* “In the *summum genus* the intension is least, the extension greatest; in *infima species* the intension is greatest, and the extension least.” Thus we see that ideal forms in pure, as powers in natural science, are, at their opposite extremities, in an inverse ratio to each other.

Quantity in Logic is a definite degree of comprehension; and *quality* is the similarity or dissimilarity which makes or excludes the subject from a given class: and when similarity is affirmed or denied of any member, it is a

*The Laws of Thought, p. 104.

categorical proposition. The constituent parts of a proposition are called its terms: the term affirmed or denied is the *predicate*; and that of which the predicate is affirmed or denied is the subject of the proposition. If the predicate affects the whole subject it is a universal proposition; if only a part of the subject, then it is a particular proposition. There are four distinct kinds of propositions, as was pointed out by Aristotle, which accord well with the essential ideal forms of realities. Other kinds have been suggested; but these four cardinal ones are practically the most useful.

Having thus briefly stated the definitions of Logic, it remains to say a few words about its axioms and postulates. *Axioms* are usually regarded as self-evident truths, and on this account have been undervalued. The first axiom is, "A universal comprises all its particulars:" this is a mode of expressing the nature of system; and with modifications is applicable to the other pure sciences. For instance, its equivalent in the axiom of Geometry is, "The whole is equal to all its parts." The second axiom is, "Terms which agree with a third term, agree with one another:" and, simple as this axiom is, it forms the basis of the syllogism, which in all its legitimate moods uses the middle term for ascertaining the relation of the major and minor terms of the proposition. *Postulates* relate to the processes of the mind when it energises according to the laws of thought. How the mind performs these logical processes we cannot tell; we, therefore, assume its possibility, and provisionally postulate that which, as yet, has not been demonstrated. What has been now said of

Logic may be applied to the other pure sciences above-mentioned, by making the requisite allowances for the difference of their respective ideal forms.

6. Here the question arises, Do these sciences represent the ideal forms of all things in a state of rest? I think not, for they do not treat of *substance*, the ideal form of matter. Matter has two statical properties, weight and volume; and correspondingly substance has the ideal forms of quantity and quality: and in the description of natural things these abstract terms frequently occur as their representatives. If this be a correct view of the subject, it ought to be possible to construct a pure science of substance, which might be called Hypostatics. There are several kinds of substance, distinguished from each other as chemical and vital substances. Chemical substances are something more than simple substance, as the adjective denotes: and accordingly they have two kinds of properties, the physical and the chemical; the former appertaining solely to substance, and the latter to something *sui generis*, that makes the compound a chemical substance. And so, in like manner, vital substances are another kind of specific compounds, which possesses vital as well as chemical and physical properties. Chemical and vital substances are species of the genus substance; the former species being related to the quantitative, and the latter to the qualitative property of substance.

7. When the powers or forces which produce natural phenomena are viewed on the ideal side, they are presented to the mind as correlative *causes*, which as agent and reagent co-exist and are concerned in the production

of every effect. The idea of such causes is ridiculed as an old metaphysical notion; but unjustly so, since the pure sciences, the highest development of the intellect, are founded on the ideal forms of things: in the face of such contempt I do not, therefore, hesitate to suggest the construction of a pure science or philosophy of causation. The late Macquorn Rankine long ago proposed a science of Energetics, "a science which, if constituted," it is said,* "would be the highest generalization attainable in physical research."

The First Axiom of Causation is that "Every effect has its cause; and consequently every cause may be known by its effect." This may seem to convey the notion that there is but one cause concerned in causation, which would be in accord with the doctrine that there is but one force in Nature; whereas I maintain that there are at least two causes, correlative and antagonistic, interacting in the production of every effect, as set forth in the Second Axiom, viz., that "Every effect is the result of the interaction of opposite causes." The predominant or dynamic cause is the one that immediately produces the effect; and in this sense it may be accepted as an abbreviated expression of what takes place in causation: there is no such thing in Nature as an insulated independent cause. The Third Axiom is that "Every effect partakes of the character of the dynamic cause by which it is produced;" and thus it comes to pass that the nature of the cause is manifested by its effect. These axioms,

* Nichol's Cyclopædia of the Physical Sciences. Article, "Energy."

modified by the ideal forms of specific causes, give the laws of motion, combination and organization.

8. The pure science of motion, Kinematics, is the only one of the specific causal sciences which has been well developed. "The three axioms [those of motion] now stated," says Whewell,* "are the fundamental maxims of all reasoning concerning causes, as to their quantities; and it will be shown in the sequel that these axioms form the basis of mechanics, determining its form, extent, and certainty." The statical state of substance gives a point of departure of motions: we do not know the quantities of the correlative causes when in equilibrio; but we can ascertain how much of the dynamic cause is required to put a substance at rest into a state of motion, or to bring one in motion into a state of rest. The statical state is very generally attributed to inertia. "According to the hypothesis of inertia, all external nature is inert, motionless, and can be moved solely by external forces. But this is physically untrue, for not an atom exists which is not the centre and source of manifold activities. The hypothesis is, however, convenient, and even necessary for the development of the science of motion; for an inert point is theoretically required whereon forces may act and produce motion."† On my view, there are two co-existing and antagonistic causes concerned in every case of causation; and it is the quantitative cause of statical substance that performs the function attributed to inertia, and it is the action of the qualitative cause that produces motion.

* The Philosophy of the Inductive Sciences, vol. i., p. 177.

† Cyclop. cit., p. 389.

9. The pure science of combination, *Chemics*, treats of the changes which take place when two or more chemical causes interact and form compounds. The possibility of such a science engaged Comte's attention, and he clearly indicated that the success of such an attempt must depend on correctly apprehending the nature of combination. Some of his remarks, at first sight, seem startling, but they deserve consideration. "If," he says,* "we could not hold, at once, the grand principle of dualism, and the doctrine of definite proportions, I should not hesitate to sacrifice the latter; for it is more important for chemical progress to grasp the principle of systematic dualism, than to advance our investigations by the use of numerical rule. But there is not, in fact, any incompatibility between these two means of progress. . . . Even after this clearing of the field, we could not accomplish the desired generalisation, if we had not taken a new stand in regard to the ternary and quaternary compounds. The rigorous dualism which I have before, in a higher view, shown to be necessary, seems to supply the needs of the doctrine of definite proportions. . . . Berzelius appears to have felt this connection, and he would probably have erected dualism into a fundamental principle, but for his subjection to the old division into organic and inorganic compounds. For a chemical philosophy we do not want new materials so much as the rational disposition of the details which already abound, by reducing all combinations, according to the principle

* *The Positive Philosophy*, vol. i., pp. 306, 331, and 332.

of dualism, into one body of homogeneous doctrine." Combination, resulting from the interaction of chemical causes, is very different from that of motion, which is the effect of a dynamical cause; for it is the union of two or more specific quantitative causes, the ideal forms of chemical powers. Every compound chemical substance consists of antagonistic causes, either or both of which may be simple or very complex; but, however complex they may be, they ought, theoretically, to form, as Comte says, a dualism, or union of two co-existing and opposite constituents.

10. The science of Organics treats of the changes which living things undergo; but it is, as yet, in a state of undeveloped infancy. Every kind of organism has a specific vital cause, which is endowed with a peculiar group of properties, called its nature; and within the limits of its nature it is capable of gradually developing all its properties: and in effecting these changes, vital causes proceed by the methods of acquisition, appropriation, and utilization.

11. It is probable that I have failed to make myself intelligible on the subject of the formation and development of the pure or abstract sciences; for it is not easy to express oneself distinctly on a subject which the mind is, as yet, only in the act of striving to master. What I have advanced is confessedly *very imperfect*, but I did not withhold it, in the hope that it may assist others, more competent than myself, to engage in the work of constructing a system of the pure sciences.

To some of my readers the contents of this chapter may

seem to have no bearing on the subject of Evolution, for it is only connected therewith mediately through its dependence on scientific dogmas: but they will perceive the connection if they call to mind how frequently, in the preceding chapters, I have had occasion to point out the reliance of Evolutionists on these dogmas, as if they were legitimate inductions from facts, whereas they are merely philosophical assumptions. For instance, resting on the truth of the modern doctrine of causation, they have rejected, as absurd, the idea of the various forces or activities of Nature being the causes of phenomena; and have, in their discourses, repeatedly cautioned their hearers against applying such a meaning to the words, physical, chemical, and vital forces; and yet continue to use them in such a manner as imply the very thing which they repudiate. They have striven, but failed, to avoid doing so, for these words expressly signify what they are intended to represent. Some light, I think, is thrown on this confusion by taking into account the twofold aspect—the real and ideal—of natural things, which has been the principal subject of this chapter; for it gives a reason for the intimate blending of facts and abstract ideas in all scientific discourses. When attention is first fixed on natural things, we are intuitively conscious of them as objects of sense; and such intuitive knowledge furnishes the data, which the mind, by its logical processes, gradually develops into scientific knowledge. At the very dawn of this knowledge, the mind, in contemplating the objects of sense and their differences—which are given by intuition as facts—becomes conscious of their ideal aspect, which it

denotes as *substances* possessing various *properties*; and as the knowledge of facts increases, that of their ideal forms—cause, effect, law, and the like—successively obtrude themselves among the objective facts manifested to the mind as phenomena. And thus it comes to pass that science and philosophy are indissolubly associated together, though in different degrees of perfection, corresponding to their respective success in the interpretation of Nature. Intimately, however, as they are connected together, they should not be confounded; for they treat of totally different subjects: so that the mind may abstract either of them, and make it a distinct investigation.

The Principal of the University of Glasgow, Dr Caird, arrived at a somewhat similar conclusion from a different point of view; and I will quote a few passages on this subject. “The tendency of modern materialistic speculation,” he says,* “is to reduce mind to a mode, and mental activity to a function of matter. . . . You cannot get mind as an ultimate product of matter, for in the very attempt to do so you have already begun with mind. The earliest step in any such inquiry involves categories of thought; and it is in terms of thought that the very problem you are investigating can be so much as stated. You cannot start in your investigations with bare, self-identical, objective facts, stript of every ideal element or contribution from thought. The least and lowest fact of outward observation is not an independent entity—fact *minus* mind—and out of which mind may, somehow or

* An Introduction to the Philosophy of Religion, pp. 94, 95, and 97.

other, be seen to emerge; but it is fact or object as it appears to an observing mind, in the medium of thought, having mind or thought as an inseparable factor of it. . . . The materialist, while supposing himself to be dealing with hard material facts and experiences, is found employing such abstractions as *force, law, matter*, as if they were on the same level with sensuous things, and treating them in his investigations and reasonings as real entities, immediately given, apart from the activity of thought to which they really belong. Or again, while contemning all that is supersensible, he is continually using, and cannot advance a single step without using, such categories as *identity, difference, cause, effect, substance, properties, &c.*, which are pure metaphysical forms, unconsciously adopted, without warrant or justification, from that realm of ideas which he ignores or denies."

CHAPTER IX.

The Nature of Conscience—And of Moral Phenomena.

Introduction.—2. Discussion on the Nature of the Will.—3. The Natural Conscience.—4. The Acquired Conscience.—5. Man Responsible for his Conduct.—6. The Relation of Will to Will in Society.—7. The Principle of Dominion.—8. The Difficulty of Forming a Science of Morals.—9. Whewell's Attempt to Construct One.—10. The Reason of this Failure.—11. The Relation of Different Kinds of Wills.—12. Recapitulation of the Doctrine of Powers.

1. The knowledge of natural phenomena, the subject of the preceding chapters, is based on the primary knowledge which is imparted to the mind by the intuition of sense: there now remains to be considered another kind of knowledge relating to moral phenomena, which is also obtained by a different intuition of the mind. By the former intuition the mind is informed as to whether the objects of sense are like or unlike; by the latter, as to whether human conduct is right or wrong, which is the basis of all moral knowledge.

2. The subject on which we are about to enter is very different from that which has hitherto engaged our attention: it has no concern with the material things around us, but solely with the relation of will to will. And since many scientists and philosophers, as in the case of the

soul, hold that there is no such thing as the will, whilst others maintain that man has a will, but do not agree as to its nature: it is, therefore, a needful preliminary that these points should be discussed before entering on the subject of morals.

“It is strange,” says Dr Maudsley,* “to see how some are content, in their zeal for freewill, to speak of the will as if it were self-determined, and had no cause. As thus commonly used, the term *will* has no definite meaning, and certainly is not applicable to any concrete reality in Nature. . . . To one of common-sense, it would appear that the term free, if properly used, should be used of the man, and not of his will. . . . If a man is hindered from doing something by internal or external causes, or is obliged to do something else, he is not free: a will free to will itself strikes one as simple nonsense. The advocates of the freedom of the will—for animals are excluded from the benefit of it—declare that a man can choose to will or to refrain from doing so. Their opponents retort, in an equally dogmatic way, that there is a uniform conjunction between motive and act, that the will follows the strongest motive; and that human actions, like all other natural phenomena, conform to constant laws: wherefore they maintain that the word free-will is an unmeaning absurdity. . . . The plain design of social enactments is to constrain people to act in a certain way, by supplying the motives which shall determine the will: and the result of experience proves that they are effica-

* *The Philosophy of the Mind*, pp. 409 to 411.

cious ; for the world goes on making systematic use of such enactments, which they would not do if they were liable to be interrupted by arbitrary free-wills."

How different things look from different points of view ! I do not think that the word free-will is absurd ; but that it is a needless pleonasm, for the word *will* sufficiently expresses the idea of its freedom without any adjunct. The will, on my view, is the energy which vital power—the inner man or *ego*—puts forth to perform its voluntary actions ; so that, strictly speaking, as Dr Maudsley says, the term free is more applicable to man than to his will ; for man is a free intelligent being. The design of social laws is not to supply "the motives which shall determine the will," for such laws frequently fail to constrain the obedience of people against their will, as the daily reports of the police testify : all vertebrate animals, as well as man, have wills, as they are free to respond to man's laws or not as they feel disposed ; penalties are attached to laws not to constrain obedience, for that they cannot do, but to incline voluntary creatures to submit to law.

"That every one," says Herbert Spencer,* "is at liberty to do what he desires to do (supposing that there are no external hindrances), all admit ; though people of confused conceptions commonly suppose this to be the thing denied. But that every one is at liberty to desire or not to desire, which is the real proposition involved in the dogma of free-will, is negatived by the internal perception of every one. . . . Considered as an internal percep-

* The Principles of Psychology, pp. 617 and 618.

tion, the illusion appears chiefly to consist in supposing that at each moment the *ego* is something more than the composite state of consciousness which then exists. A man—who, after being subject to an impulse consisting of a group of psychical states, positive and nascent, performs a certain action—usually asserts that he *determined* to perform the action, and performed it under the influence of this impulse: and by speaking of himself as having been something separate from the group of psychical states constituting the impulse, he falls into the error of supposing that it was not the impulse alone which determined the action. The entire group of psychical states which constituted the antecedent of the action also constituted himself at that moment—constituted his psychical self, that is, as distinguished from his physical state. It is alike true that he determined the action, and that the impulse determined it; seeing that, during its existence, the impulse constituted his then state of consciousness, that is himself. Either the *ego*, which is supposed to determine or will the action, is some state of consciousness, simple or composite, or it is not. If it is not some state of consciousness, it is something of which we are unconscious—something, therefore, that is unknown to us—something of whose existence we neither have nor can have any evidence—something, therefore, which it is absurd to suppose existing. If, on the other hand, the *ego* is some state of consciousness, then, as it is ever present, it can be, at each moment, nothing else than the state of consciousness present at that moment. . . . It is natural enough that the subject of such psychical changes

should say that he willed the action ; seeing that, psychically considered, he is at that moment nothing more than the composite state of consciousness by which the action is excited. But to say that the performance of the action is, therefore, the result of his free-will, is to say that he determines the cohesions of the psychical states by which the action is aroused ; and as these psychical states constitute himself at that moment, this is to say that these psychical states determine their own cohesions, which is absurd.”

It is certainly not true that the “liberty to desire, or not to desire, is negatived by the internal perception of every one :” on the contrary, every one, who attentively considers the matter, is conscious that he is perfectly free to desire those things that please him, and that he can cease to desire them, and regard them with aversion. When a man says that he did a thing intentionally, he speaks the truth : his voluntary act, indeed, may be in response to some mental motive, which solicited his attention ; but he is free to disregard the motive, and then it becomes abortive. The man, the personal man or *ego* that wills to act, is “something more than the composite state of consciousness ;” such a state is only one of the many conditions in which man may be, but neither nor all of these states can constitute the man himself. I am inclined to think, but of course my thoughts will be regarded as confused conceptions, that faith in the modern doctrine of causation has led our author to “fall into the error of supposing” that impulse alone determines action, and that impulse—the psychical state—constitutes the man himself at each moment of action ; but motives do

not make the man, they only suggest certain actions, which man may do or not, as he feels disposed ; or, in other words, it is man, not motives, that determines the performance of his voluntary actions.

“ A body moving in space,” says Spencer, “ under the influence of many surrounding bodies, will move in some ‘ indefinable line that appears to be free.’ In like manner, volitions are only apparently free ; for, if they conform to law, there cannot be any such thing as free-will.” *If* human actions conform to law, in like manner as physical phenomena, then, of course, it follows that they are not free : but this is the point at issue between us, which cannot be determined by such a postulate. This is on a par with an argument adduced in the last quotation—“ *If* the *ego* is some state of consciousness, then it can be, at each moment, nothing else than the state of consciousness present at that moment.” Such remarks are worthless ; for the opponent may say, *If* I am right you are wrong. The varying course of a planet is made known to us by the astronomer, to whom it certainly does not seem to be free ; for he knows that it is effected by the approximation of other celestial bodies, and he is able to calculate the amount of deviations in the planet’s course, which these bodies are capable of producing. On the other hand, volitions are not apparently but actually free ; for they are beyond the control of all external powers ; each man knows that he is free to will.

Enough, perhaps, has been said concerning the freedom of the will ; but it is a subject of such importance, that it may be well to consider what John Stuart Mill has

advanced thereon. "Are the actions of human beings," he asks,* "like all other events, subject to invariable laws? Does that constancy of causation, which is the foundation of every scientific theory of successive phenomena, really obtain among them? . . . The question whether the law of causality applies in the same strict sense to human actions as to other phenomena, is the celebrated controversy concerning the freedom of the will. The affirmative opinion is commonly called the doctrine of Necessity, as asserting human volitions and actions to be necessary and inevitable. The negative maintains that the will is not determined, like other phenomena, by antecedents, but determines itself; that our volitions are not, properly speaking, the effects of causes, or at least have no causes which they uniformly and implicitly obey. I have already made it sufficiently apparent that the former of these opinions is that which I consider to be the true one. . . . Correctly conceived, the doctrine of Necessity is simply this: that given the motives which are present in an individual's mind, and given likewise the character and disposition of the individual, the manner in which he will act may be unerringly inferred; and if we knew the person thoroughly, and knew all the inducements which are acting upon him, we could foretell his conduct with as much certainty as we can predict physical events. This proposition I take to be a mere interpretation of universal experience, a statement in words of what every one is internally conscious of."

* *A System of Logic.* Fourth Edition. Vol. ii., pp. 408 to 410.

This proposition may be in accord with the experience of Necessitarians, but this cannot be termed a universal experience, since that of the advocates of the will's freedom is totally different. So far from the ordinary experience of mankind sanctioning such a proposition, it points rather in the opposite direction. How common is the remark, Who would have thought that the man who was so generally respected could have done such a thing? indeed, examples of unexpected conduct are of frequent occurrence. But it may be said that the public err in judgment from not having a perfect knowledge of the individual's character and disposition. Very true; and it must ever err in this respect; for men will never be known, in this world, so thoroughly as postulated. The words, "given the motives," "if we knew," beg the whole question; for such things are utterly beyond human ken, and cannot, therefore, be made available for predicting human conduct: in short, it is an unjustifiable attempt to bring volitions into conformity with the theory of successive phenomena, the modern doctrine of causality. According to this doctrine, that "phenomena are determined by their antecedents," it follows that conduct is the cause that determines subsequent conduct, which is contrary to experience; for man knows that his conduct is his own voluntary act and deed. Of what avail would it be if, in a trial for theft, an advocate pleaded that his client did not commit the act, for it was the consequent of a precedent theft, which necessarily and invariably follows according to the law of causality, and consequently he had been unjustly accused: this might amuse, but it

would not convince a jury of the prisoner's innocence. Social laws are not addressed to conduct for its regulation ; but to men, who are required to regulate their conduct according to law, or be liable to penalties if they wilfully act contrary thereto. Does not the very imposition of penalties imply the freedom of the will over which the powers that be have no control ? Mill, in the above quotation, does not correctly state the doctrine of free-will, when he says that "our volitions are not, properly speaking, the effects of causes:" for the will—the conscious energy of man's vital power—is the cause of all his volitions, effects which man freely determines according to his inclination, the only law of voluntary actions.

3. Having now discussed the nature of the will, and given my reasons for adhering to the old doctrine of the freedom of the will, we are in a better position for entering on the consideration of moral phenomena, which are the effects of the will when regulated by moral knowledge. The natural conscience, which is given by the intuition of right and wrong, is sometimes called the "moral sense;" but this does not seem to be quite correct ; for the conscience is not a sensation or feeling—a motive to action—but rather an intuitive or acquired knowledge of right and wrong, by means of which man is enabled to act morally. Much has been written concerning the nature of conscience which is more fanciful than correct. For instance, it has been extolled as "a supreme authority, sitting in judgment over all our thoughts and deeds—a despotic but rightful sovereign, from whose decrees there is no appeal." So far from this being the case, it is the man himself,

informed by conscience, that is in authority ; and who can, if he chooses, act wrongfully in despite of conscience ; it is the free conscious soul, or self, that feels shame when detected in the violation of the law ; and that, if not detected, may ultimately feel remorse. The natural conscience, the moral intuition, is invariably truthful and trustworthy, like the sense intuition ; and accordingly it affords a secure point of departure in the development of higher moral knowledge : and thence has arisen the uniformity of principles in the legislative acts of all civilised people.

4. How, then, it may be asked, has it come to pass that there is such a diversity of opinion in the world on moral subjects ? The answer is obvious. The general accord, as in the intuition of sense, is only at the outset, when the natural conscience has not been perverted by other notions of right and wrong which have been adopted ; for then this acquired conscience supersedes the natural conscience—the innate law—and becomes the rule of social conduct. Thus the child is taught at an early age to regulate its actions according to the acquired conscience of its parents, and consequently the correctness of its judgment depends on the soundness of its instruction. This holds good in religious, as well as in social morals. For instance, when the Hindoo immolates himself under the carriage-wheels of his idol ; or when the Thug insidiously strangles his sleeping victim ; or, to come nearer home, when professing Christians torment and even inflict martyrdom on their fellow-men—they all act according to the dictates of their acquired consciences, which over-ride the law of the natural conscience, written in the hearts of mankind.

5. Man has to learn social laws, for without such knowledge he cannot regulate his conduct in conformity thereto, as in duty he is bound to do: it is his wisdom to be obedient to the powers that be, for by disobedience he subjects himself to the penalty of the laws. If man stood alone in the world he would be free to follow his own devices, and do as he pleased: but in society he comes into contact with his fellows, who are voluntary beings as well as himself, and have also their own desires, which, being different, may bring them into conflict: hence the necessity of social laws, in order to preserve the common weal; for otherwise will would clash with will, and produce anarchy. Social laws may be more or less unjust, for expediency rather than equity has too often prevailed in legislation; still, whatever may be their imperfection, the infringement of them is not only criminal, but also immoral, for it is resistance to the powers that be. The conscientious observance of law secures its own reward; for then the grievances arising from defects in the code may be more readily amended, as the liberty of the subject may be more safely extended: as witness our own country, which has made no mean progress in attaining reasonable liberty. Many may scout such an idea of freedom, considering it as a perfect bondage to law: but if a willing obedience be rendered to law, from a conviction that it alone can secure the wellbeing of the community, such a voluntary submission to law cannot surely detract from the liberty of the subject.

6. From the very nature of society there arises various grades in the relation of will to will, the lower being in

subjection to the higher. In illustration of this subject let us begin with the relation that subsists between parent and child, the family, which is the social germ that has been gradually developed into communities of various magnitudes. Parents, whether human or bestial, have instinctively an affection for their offspring, an emotion which prompts them, even at the peril of their own existence, to provide for and protect their helpless ones ; who for a while are unconscious of this care and love : but in process of time the babe becomes conscious, and learns to know its mother, and to reciprocate her love with responding smiles. A mutual love being thus established, the child gradually comes to look up to its parent for aid and protection ; and thus a sense of dependence is gradually developed into submission to its mother's will : and in time this first lesson in morals is learnt, and ripens into a filial reverence for both parents.

The family relation being established, the father, instructed by long experience gained in social intercourse, is prepared for the discharge of his duty ; but the child, on the other hand, has to be taught by its parents what he ought to do, and the consequence of disobedience. The father, the head of the family, has the right of making rules for the regulation of his household, and to exact obedience thereto : and this authority may be arbitrarily exercised within the limits of social and moral laws ; and thus the child comes to know, at an early period of his life, that, though free to do what he pleases, if he does what is forbidden, he makes himself liable to the threatened punishment. For a while the child lovingly obeys his

parent's commands ; and peace and joy attend this happy period of his life : but, as knowledge increases, and the example of bad companions tempts him to do what he ought not to do, it very generally comes to pass that he, sooner or later, wilfully departs from the path of rectitude, and then, in the expectation of being chastised, he strives to hide his fault from his parent : and, when at length detected, a feeling of helplessness fills him with fear and shame, and thus he stands before his judge, conscious-smitten and self-condemned. And, should punishment be inflicted, there is no questioning of the parent's justice, for the child is conscious that he has justly suffered.

In process of time the child successively attains to youth and manhood ; and then, departing from his father's house, and entering into the world, he becomes a member of a wider family : he is not, however, rendered more independent by this change, for he has incurred a new kind of responsibility. Parental authority is now transferred to the powers that be ; and domestic rules are superseded by the laws of the land. In every form of commonwealth it is requisite that each member should respect the rights of others, and this is provided for by social laws, and an executive power for their administration, in order to secure the safety of person, family, and property. Whatever be the form of government under which we live—whether patriarchal, monarchical, or republican—its authority is in principle like that which is originally and spontaneously manifested in the family. It is a natural necessity that every community should be

presided over by a chieftain : and the character of this social arrangement, like most things human, is subject to the law of progression, according as it advances in civilization. In a great empire, the most complicated form of society, there is a great variety of subordinate organizations, consisting of several degrees of rank, the lower being successively subject to the higher—the whole of the vast national organization being under the dominion of the monarch. Emperors, kings, and other supreme governors may inherit power by prescriptive right ; but they cannot justly claim to reign by divine right, for, in this latter age of the world, none have been so appointed.

7. In contemplating the development of the social germ, the question naturally arises, Whence does man derive the authority that lies at the root of all social dominion ? I know no better answer than that it is the essential property of his vital power, which presides over and directs all his actions during every phase of his existence. At the very dawn of life, the vital power of the germ superintends the construction of its corporeal organs according to a special design, and continues during life to regulate their functions ; and all this it accomplishes by dominating over and directing the physical and chemical forces of its protoplasmic body. This is, indeed, unconsciously performed, for, on this lower phase, vital power necessarily follows its laws, like physical powers ; so that its authority can only be inferred from various indications of a directing and controlling influence. In its higher phase of existence, when vital power is in the exercise of its conscious faculty, as mind, then it knows that it possesses this authority,

for it issues its directions, which are conveyed by nerve-currents from the brain to the sensory ganglia, which, in conformity thereto, stimulate the appropriate muscles to perform the required motions. Man is not conscious of all this detail, but has learnt it by observation: he knows, however, that he willed certain movements, and that they were done: just as a commander issues his orders, and they are executed by his subordinates. The vital power of man is not singular in this respect; for other vital and chemical powers exercise some degree of control, according to their position in the system of Nature.

8. People in every land appeal to the authority of their own moral code, believing it to be the criterion of moral truth. Shall we, then, say that this diversity of opinion shows that there are no correct moral principles, on which morality, the science of morals, can be constructed? Several attempts have been made to form such a science, but it has been found to be no easy task to accomplish: that of the late Dr Whewell has done more, perhaps, than any other; and I will quote what he has advanced on this subject.

9. "We may, I hope, reasonably attempt," he says,* "to construct a system of morality, meaning thereby, a body of moral truths definitely expressed, and arranged according to their rational connection. What is duty? It is what we *ought* to do. But what is that which we ought to do? It is that which is right to do; and this adjective *right*, with its opposite *wrong*, expresses that quality of

* Lectures on Systematic Morality, pp. 77 to 85.

actions, in virtue of which they are the subject of moral consideration. . . . It is right that every man should have his *rights*. Rights the substantive includes rights the adjective, referred to each man, and made his possession. Each man has a right to his own person, to his family, and to his property: and these rights have been made realities among men. . . . Rights and obligations are corresponding terms: we ought to regard the rights of others as established by social law. It is right to do this, and our duty to do so: but this is only a small part of our duty; for duty is far wider than social law. . . . In determining social rights men have selected only that which bears upon visible and tangible things; and upon such actions relative to these as are of an external character. They do not deal with the affections and thoughts of the mind; they regulate only external conduct, but do not reach the internal principles of action. This is all social law can do; it satisfies such laws, but it does not satisfy the higher and purer laws of morality, which have to do with the intentions as well as with the acts of man, for they, too, may be right or wrong. . . . I find that the mainsprings of moral actions are the appetites, affections, and desires: these may be summed up and included in certain desires of a more abstract and general kind—viz., the desire of personal safety and wellbeing, of family, and of property; other desires exist, but these occupy a primary place in man's nature. . . . The system of morals now set forth ought to enable us to give an answer to the question, What is my duty? And if we act according to this knowledge we fulfil all the requirements of the

moral law as regards the relation of man to man in society.”

Some moralists have attached such importance to the state of enjoyment which attends the gratification of our desires, that they have been led to regard it as the aim and end of a moral life: and accordingly have adopted it as the regulative principle of human conduct; thus pleasure and happiness have been severally advanced as the rule of life. Others, again, condemn such principles, as tending to selfishness and sensuality: they maintain that right reason, the fitness of things, duty and the like, are the true moral principles. Both schools of morals have long prevailed: the former from the time of Epicurus, who taught that pleasure is the supreme good; and the latter from that of Plato, who advocated the subordination of the desires to reason. It is fit and right that man should do his duty, and that, by so doing, he should secure his wellbeing and happiness: but it is a very narrow view of morals to make such an inducement the main end of conduct. The object aimed at ought to be a strict obedience to law; for then only can conduct be correct: and this will bring in its train a sure reward, by enabling mankind to live in peace and good fellowship.

10. It was said above that it is not easy to construct a science of morals. I ought rather to have said that it is not possible to form such a science that would be analogous to physics and chemistry, the sciences of natural phenomena. The reason of this difficulty is, that conduct is not, like phenomena, perfectly conformable to law. The powers which produce phenomena must necessarily act

according to their respective laws; and so also ought human conduct to conform to law; but man being free to obey or not, as he may be disposed, his conduct is so capriciously uncertain that it affords no correct data for the construction of morality.

Is there, then, no moral knowledge, no principles for the regulation of man's conduct? Most assuredly there is such knowledge, but, strictly speaking, it is not scientific but philosophical. Moral laws are of various kinds, both human and divine; they are "positive laws," enacted by different dominant powers for the government of their subordinates: such laws are not compulsory, but permissive; for subjects can choose between obedience thereto, or their liability to the penalty of disobedience. Positive laws, therefore, are arbitrary enactments of lawgivers, the powers that be—whether parents, patriarchs, or sovereigns—who promulgate them in the same way as tutors diffuse the principles of philosophy: principles which are applied in explaining phenomena, as those of moral laws are in determining the character of conduct.

11. There remains to notice another relation of man's will, viz., that which obtains between wills of different natures, when man holds rule over the lower animals that are capable of domestication; a relation which throws additional light on the nature of voluntary beings. This dominion of man over the beasts of the field has been exercised from the earliest times on record: and is so familiar to us that it has not arrested the attention which its importance deserves. There is an innate fear of man in these animals, which induces them when brought within

his power to submit to training, by which they are taught what is required of them, and the penalty of disobedience. When wild beasts were first caught, the taming and training them must have been more difficult than at present; but now, having been born for many generations in a state of domestication, and being from their birth as familiar with man as with their parents, they have become much more docile, and soon learn to be obedient to the commands of their masters. In no animal is this quality so highly developed as in the dog, more particularly when it has been made the companion of a kind master; for then it returns his affection with a most devoted love, ever striving to anticipate his wishes; and when it distinctly knows what is required, is promptly obedient, and evidently takes pleasure in doing its duty. I will not now say more on the subject of domestication; but hereafter I shall have occasion to refer to it, as illustrating several important events in connection with the higher development of human nature.

12. Having now finished the first part of my subject, I deem it expedient, before entering on the second part, to gather together the leading points of the previous discussion, in order to give a connected view of my hypothesis; and as I proceed, to contrast it with that of Evolution.

I conceive that the world, originally, was solely an Ethereal Orb filling all space; and that ether is pure matter: consequently the world then was, in the strictest sense of the word, a material world. My reason for so thinking is because ether has no other properties than those usually ascribed to matter, viz., weight and volume,

and the capacity of moving and being moved. The property of *weight* is due to gravity, a mode of attraction, and that of *volume* to a mode of repulsion: hence I infer that matter is a binary compound of the physical powers, attraction and repulsion. Each atom of matter consists of a unit of these correlative powers, which by their interaction produce tangential currents of these forces that rotate around a common centre. The ethereal orb, an aggregate of all these atoms, rotates on its axis by the co-operation of their united powers, which as centripetal and centrifugal forces, in the existing state of the world, "hold in their grasp not only our solar system, but also the innumerable systems of the heavens themselves," causing them all to rotate on the same plane, and in the same direction from west to east.

On this view there is no assumption of an unknown matter endowed with an imaginary all-becoming potency, for matter is a recognised constituent of Nature, which either simple or in combination occurs in every part of the world; and its attractive and repulsive powers by their interaction produce only physical phenomena, which are manifested as various modes of motion. The ethereal orb is the source whence all the celestial bodies have derived their matter, and consequently their physical forces: this, at first sight, may seem to be very improbable; but when the total volume of these bodies is compared with that of the ether that fills all space, there is reason to believe that its weight far exceeds that of all the bodies that revolve therein. Neither science nor philosophy can tell us anything about the origin of matter;

for it confessedly is beyond human ken : so we must rest content with the knowledge of its existence, and occupy ourselves in the investigation of its nature.

Evolutionists have given us no account of simple or pure matter : their matter is molecular, commonly called gross matter, which can be seen and handled, whereas pure matter, ether, is not an object of sense. They tell us that the world, living and not-living, is the result of the mutual interaction of the forces possessed by the molecules of which the primitive nebulosity of the universe is composed. By spectrum-analysis, however, we learn that nebulæ, and the stellar bodies derived therefrom, are composed of chemical elements, similar to those that constitute the lifeless things of our Earth. Are, then, molecules and chemical elements one and the same thing ? I think not ; but Evolutionists answer the question affirmatively, regarding the elements, obtained by the analysis of gross matter, as merely the various groupings of matter into molecules : but the thing analysed is not matter but a chemical compound ; and the products obtained are not diverse kinds of matter, but those of various elements, the constituents of this compound. The elements have chemical as well as physical properties, which indicate that they are something more than matter : and as surely as the presence of matter in the elements is manifested by their physical properties, so certainly is that of some other thing made evident by their chemical properties, for things are only known by their properties. The properties of matter, *ex hypothesi*, are due to its constituents, the physical powers of attraction and repulsion ; and guided by this analogy I ascribe

the peculiar properties of the elements to chemical powers : and accordingly conclude that the elements are compounds of matter and chemical powers ; the former being the quantitative basis, and the latter the qualitative specific types of the elements. The basis of each element is a molecular mass of matter of a definite weight ; so that there are as many kinds of molecules as there are elements, which are distinguished from one another by their peculiarly definite weight. When different elements act and react on each other, both physical and chemical phenomena are produced, which are of a totally different character ; the one giving rise only to various modes of motion, and the other to those of combination : and bearing this distinction in mind, in the explanation of these phenomena, there will be no difficulty in attributing all motions to the interaction of physical, and combinations to that of chemical powers. Both these powers, though thus intimately associated in the elements, are different, and the laws by which their operations are regulated, in the production of phenomena, are different : both may be developed within the limits of their respective natures ; but neither of them can pass their appointed bounds, for they are not mutually convertible. When heat, for instance, is applied to a mixture of solid elements, and they combine, it does not act by becoming a chemical power or affinity ; but by overcoming the cohesion of the solids their molecules are set free, which facilitates the interaction of the chemical powers ; so that whenever physical forces occasion chemical action to take place, they do so by producing molecular conditions favourable to

bringing chemical powers within the range of their mutual interaction.

There can, then, be little doubt that the chemical elements, like matter, are also constituents of Nature, which first made their appearance in the world as gases and vapours, the component parts of the universal nebula. If it be asked how they came there, we answer that no one can tell, any more than how matter came into the world and filled all space ; we can only surmise that the origin of both is due to the same external cause. Let it, then, be granted that the chemical powers were introduced, in some such way, into the midst of the ethereal orb, and then it is very conceivable that they would severally combine definite quantities of ethereal atoms to form their respective molecular bodies, with which we now find them indissolubly united. Such an origin of the elements is a more intelligible conjecture than that of Evolution, which ascribes it to a differentiation of matter, assigning no sufficient reason for the one thing, matter, becoming various other things of a different nature, and yet still being only kinds of matter. Such an insertion of an insoluble mystery into Nature is inconsistent with man's office, as the rational interpreter of her constitution.

Lastly, it remains to say a few words about living organisms, which, together with chemical substances and matter, comprise the three grand classes under which heads all the multitudinous things of the natural world may be arranged ; and which form the subjects of the natural sciences, Physics, Chemistry, and Biology. Evolutionists maintain that the simplest and lowest of living

things were formed from a complex chemical substance, called protoplasm, by a process of spontaneous generation : and that from these protozoa all the higher organisms were successively evolved ; or, as some say, by a process of differentiation the lower becomes the higher organism, which immediately succeeds it in the ascending scale of Nature. It is admitted that vital phenomena are peculiar, quite distinct from physical and chemical phenomena ; but this peculiarity is attributed, not to *vital power*, which is rejected as an absurdity, but to heat, especially that of the sun, which is supposed to be converted into vital force, as manifested by the subsequent occurrence of vital phenomena. Thus life is regarded as a mechanical problem : and the difference between vegetable and animal life is explained on the principle of the rising and falling of a weight.

Late researches, however, have satisfactorily shown that the idea of spontaneous generation is untenable ; for if living germs be perfectly excluded, no living organisms can be evolved from chemical substances, not even from the complex compound, protoplasm, which is only produced by vital processes in that “singular laboratory,” a living organism. Again, the evolution of higher from lower organisms by differentiation can only be justified by the modern doctrine of causation, which makes an antecedent the cause of the immediate sequent ; but such an explanation of phenomena is utterly worthless : it gives no reason for the different natures of the organisms in the sequence ; this cannot be ascribed to development, for then human nature, the highest, would be the only

nature in the animal kingdom ; and all animals would only be the successive stages of man's development. And, lastly, heat, when it acts on an organism, is not converted into vital force, nor does it occasion the subsequent phenomena of the organism : for unless it acts on a living organism—which stands in no need of such a conversion, as it already possesses the principle of life—no vital phenomena attend its action. For instance, seeds and eggs, unless exposed to a suitable warmth, will remain for a time unchanged, but when brought under the influence of heat, they will then, if they contain living germs, be gradually developed into forms of the same type as the parent plant and animal ; but if such germs be wanting, then heat will only hasten the decay and putrefaction of the organism. These are well-known facts, which clearly demonstrate that heat when it acts on an organism is not the cause, but only the condition, or rather one of the conditions, which enables living germs to pass from a dormant into an active state : and subsequently, during the continuance of life, heat only facilitates the performance of vital functions.

Evolution seems to attach little importance to the difference of things, which others regard as the pole-star of philosophy that directs them in the interpretation of Nature : and it is by this guidance that I was led to conclude that her various phenomena result from the operation of correspondingly different powers, energising according to their respective laws ; or, in other words, that physical, chemical, and vital phenomena are the effects of corresponding causes, the physical, chemical, and vital

powers: and on this view of Nature, the problem of life receives, I think, a better solution than that given by Evolution. Every living germ is not merely a protoplasmic body, actuated by physical forces, but is also actuated by a living principle, as the adjective living implies "a subtile influence," which I, in common with other opponents of Evolution, call vitality or vital power: so that every living germ, on this view, is a binary compound of a protoplasmic body and a specific vital power. Each kind of germ develops its own type and no other, and has continued to do so from the earliest time on record; and it is, therefore, reasonable to infer that it has done so from the beginning of existence, and will continue to do so until it becomes extinct: and there is good reason to believe that what has obtained in the existing era of our earth also held good in former eras; so that the various kinds of extinct animals, whose remains lie buried in the strata of the earth, probably ran the same course of development from special germs. There is not a single known instance of a lower animal transgressing the limits of its nature, its peculiar cluster of faculties, and becoming an animal of a higher nature; nor of a higher animal stopping short at an inferior stage of its development, and becoming a lower kind of animal. The vital power of every kind of animal, in the exercise of its formative faculty, constructs its body according to the designed pattern of its type, and this plan is the law of its organization, by which the formative energy of vital power is regulated: and it continues to perform this function during its existence, in effecting the growth and renova-

tion of the organs. These organs are the instrumental means by which vital power is enabled to perform its functions ; and of all these organs the nervous system is the most generally useful ; for it is intimately associated with every part of the organism : by it vital power holds communion with its entire body, receiving intimation of all its needs, and transmitting the necessary directions for supplying all its wants. For this purpose there are several distinct kinds of nerve-centres, or ganglia, where vital power presides and exercises its corresponding faculties : to these centres afferent nerves transmit the impressions made on them from within or without, which produce there a nervous effect or neurosis ; and this causes a reflex current, which is conveyed by efferent nerves, to be discharged on muscles to excite their movements ; but this reflex action is under the direction of vital power, which instinctively or consciously apprehends the purport of the neurosis at the nerve-centres, and regulates accordingly the action of the organs of motion, in order to fulfil the requirements indicated by the organs of sense. The tactual nerves of sense and their appendages—the *sensus communis*—suffice for the service of vital power, when exercising its formative faculty ; but in the higher animals, which possess special organs of sense, its instinctive faculty comes prominently into play, regulating the corporeal movements in their intercourse with the outer world : all the functions of the formative and instinctive faculties of vital power are necessarily performed according to law, like physical phenomena ; and as the former are incessantly carried on during life, it follows

that the latter, when they do occur, are simultaneously performed. But when vital power exercises its conscious faculty, then it acts according to knowledge, the law of all volitions; and thus vital power becomes free, being a law unto itself. The free conscious energy of vital power is called *mind*, that which feels, knows, and wills: and all animals that have brains have minds, and a degree of freedom according to their knowledge; this freedom cannot be controlled, if the creature, despite of all consequences, is resolved not to submit to dictation. The vital power of man, on account of its pre-eminence, is called the *soul*, which is the inner true man, a person, whereas the body—ever changeable and frequently renewed during life, whilst the soul is permanently persistent—is only a personification of the inner man. The soul is a personal being, as denoted by the personal pronoun I—the *Ego* of psychologists. When impressions, made on the sensory ganglia, are transmitted to the brain—the special organ of the conscious faculty of vital power—they produce a physical nervation which, by the concurrence of vital power, is recognised as a conscious feeling or sensation, which solicits the attention of the mind to the object which it represents; the mind, being a free energy, may consent to do so, or will to take no notice of the appeal; but, if it does consent, it intuitively knows the object, and such intuition, or sense-knowledge, is, as it were, the raw material, which the mind, by its logical method of operation, gradually develops into percepts and concepts, and ultimately into science and philosophy.

As soon as an advancement in science was made,

philosophical speculations were suggested to the mind, and accompanied its progress ; thus it came to pass that science and philosophy became so intermixed that inductive and deductive knowledge have been occasionally confounded. I am inclined to think that science, even in our day, has thus been led astray, by placing reliance on two very questionable assumptions of philosophy ; viz., the doctrine of sequent causation, and that of the mutual convertibility of natural forces. And in its turn philosophy, especially that of Evolution, in accepting these illegitimate doctrines as the verified outcome of scientific research, has founded its doctrine on a very insecure basis. The reason of this intimate association of science and philosophy seems to be due to the essence of natural objects, which present to the mind a twofold aspect of real and ideal : so that during their investigation the mind is apt to pass from one to the other, and thus the two kinds of knowledge become intermixed, and even sometimes confounded, which ought not to happen, for, though they are correlative, they are not identical.

CHAPTER X.

Man's Moral Relation to Deity—The Supreme Power of the Universe.

Introduction.—2. Scientists reject the Doctrine of Creation.—
 3. A Plea for its Acceptance.—4. Man by Nature knows a
 Higher Power than himself.—5. Revelation a Rational Mode
 of imparting Knowledge.—6. God reveals to Moses the Origin of
 the World.—7. The Record of the Creation.—8. The Formation
 of the First Man.—9. Adam placed in the Garden of Eden.—
 10. The Forbidden Fruit, a test of Obedience.—11. The Origin
 of Natural Knowledge.—12. The Formation of Eve.—13. The
 Fall.

1. Having concluded what I had to say concerning the doctrine of Evolution, I now proceed to the consideration of the doctrine of Creation, the second part of my subject. This doctrine treats of the origin of things, the discovery of which is confessedly beyond human ken : and if this be the case, why should we be content to abide in a state of ignorance, rather than accept another source of knowledge ?

2. At the present day there is a wide-spreading disbelief in Scripture, because its record of the Creation, it is said, cannot be reconciled with the principles of science : this is to be regretted, for it has led to recrimination on the part of theologians which is equally unjustifiable. “ Though we are unable,” says Professor Tyndall,* “ to trace the course

* The Nineteenth Century, vol. iv., p. 831.

of things from the nebula, where there was no life in our sense, to the present earth where life abounds, the spirit and practice of science pronounce against the intrusion of an anthropomorphic Creator. Theologians must liberate and refine their conceptions, or be prepared for the rejection of them by thoughtful minds. It is they, not we, who lay claim to knowledge never given to man. 'Our refusal of the creative hypothesis is less an assertion of knowledge than a protest against the assumption of knowledge which must long, if not always, lie beyond us, and the claim to which is a source of perpetual confusion.' At the same time, when I look with strenuous gaze into the whole problem, as far as my capacities allow, overwhelming wonder is the predominant feeling. This wonder has come to me from the ages, just as much as my understanding, and it has an equal right to satisfaction. Hence I say, if, abandoning your illegitimate claim to knowledge, you place, with Job, your forehead in the dust, and acknowledge the authorship of this universe to be past finding out—if having made this confession, and relinquished the views of the mechanical theologian, you desire for the satisfaction of your feelings, which I admit to be in great part those of humanity at large, to give ideal form to the Power that moves all things—it is not by me that you will find objections raised to this exercise of ideality, when consciously and worthily carried out."

3. There have been various cosmogonies, or "creative hypotheses," both ancient and modern, which are indeed mere myths; but the Mosaic account of the Creation ought not to be classed with such human inventions, for

it was professedly revealed by the Creator Himself, who is the only One competent to describe the origin of the world; and it contains internal evidence of its truth, for it displays a depth of knowledge far surpassing that of man, at the time Moses recorded this revelation: and they who humbly have faith therein make no assumption of knowledge, but are ever ready to confess that they only repeat what they were taught by the Word of God. They who assert that there is no knowledge but what science teaches, may, like the Positivist, exercise ideality "in giving form to the Power that moves all things"; but they who believe in a Creator cannot avail themselves of the gracious permission to idealise, for by so doing they would commit an act of idolatry.

I am inclined to think that the refusal of scientists to accept the doctrine of Creation—on the ground that it makes an "illegitimate claim to knowledge"—is attributable to their dogma "that there is but one kind of knowledge, and but one method of acquiring it, viz., by induction." This is, indeed, the true method of attaining natural science; but this is not the only kind of knowledge. For instance, the sense-perception of natural objects, and of their relation to each other as to likeness and difference, comes to us by intuition, which is, as it were, a natural revelation to the mind: and it is this peculiar knowledge that furnishes the primary data, which by the logical process of induction are developed into the sciences, and through them into philosophy. This development has been the work of many successive generations; and the knowledge thus gradually acquired has been handed

down to us by oral and written traditions : and thus tutors have been qualified to teach their pupils, who, having faith in their teaching, implicitly believe what they are taught. By this method the advancement of knowledge has made good progress, which could not have happened if every one began *de novo* to interpret Nature for himself. And there is also another kind of knowledge, which comes to us by a supernatural revelation ; it is a Divine philosophy or theology, and God is its teacher, who in times past has imparted it to mankind by His prophets, and in these last days by His Son ; and thus He has gradually unfolded the depth of its wisdom, as man was prepared for its reception. So faith in this peculiar knowledge comes also by hearing, and hearing by the Word of God.

4. Theology—like philosophy—must, in the first instance, be received and believed, nothing doubting ; but when man is well-instructed therein, then he may compare Scripture with Scripture, and strive to prove all things, and hold fast that which is good. This is the task which is about to engage our attention ; but before entering on the subject of the Creation, let us inquire whether man has any means of knowing, besides that of revelation, that there is a higher power than himself in the world. Cicero has recorded in his work "*De Natura Deorum*," the current belief of his time, "that there are no people—not even savages—who have not some notion of Deity:" and this has been confirmed by modern travellers and missionaries with few exceptions, and these probably failed by their not making their enquiry intelligible to the savages. Among civilised people such a difficulty does not exist,

so that Balbus, the Stoic, was able to assert "that all nations agree that there are gods, for it is engraven in the minds of men ; the only point to determine is, what are they ?" It was, therefore, acknowledged at this early period, that man had by nature an innate intuition of the supernatural, which in our day has been termed "God-consciousness"—a fear of something unknown which arrests the attention of the mind, and bewilders it with a perplexing expectation of evil. For instance, children, ay and even adults, when alone in utter darkness, especially if ignorant of their whereabouts, will shudder at any doubtful sound or suspicious gleam of light, fearing they know not what. And this is still more manifest when man during tempests, earthquakes, or other convulsions of Nature, finds himself in jeopardy, and utterly helpless ; for then he quails under the dread of impending destruction : and this has led him to ascribe these awful occurrences to supernatural powers. This intuition of the supernatural has been the foundation of a great variety of idols, the adopted representatives of the unknown Power : these vary from the fetich of the savage to human statues of exquisite workmanship, the gods of ancient Greece. The wonderful Greek Mythology taught that its gods were divine persons, who were to be worshipped, and supplicated for aid in times of adversity : and to them were ascribed the attributes of human nature ; and on the analogy of social dominion, they formed a hierarchy, of which Jupiter, the father of the gods and men, was the supreme head ; but this natural theology was marred by a great imperfection, in that its gods were addicted to the

sensual vices of mankind. Plato's conception of Deity was free from this defect: and it has been lauded as the nearest approach to the true God that has been attained by the unaided intellect of man; but perhaps undeservedly so, for when in Egypt, he may have seen the Hebrew Scriptures, and derived from them his idea of moral perfection.

5. Let it, then, be granted that there is in the universe a higher Power than that of man; and it follows, according to the principle of dominion, that the relation of man thereto is that of subject to his sovereign Lord, whose laws he is in duty bound to obey, or render himself liable to the penalty of disobedience. Scientists will, of course, refuse to grant this, on the plea that they have no knowledge of such a God, whom no man hath seen or can see, or of laws which are past finding out. Such objections, however, have no place in the doctrine which I am advocating. It is very conceivable that the universe comprises a spiritual and unseen, as well as a natural and visible world, over which God, the Lord over all, presides: and that man, the highest natural power, is the connecting link between these worlds; and thus he is enabled to look from Nature up to Nature's God. According to Scripture, God has revealed Himself and His laws to man: and by the light of Nature we learn that such a revelation is both a necessary and reasonable method of imparting knowledge to an inferior power, which it cannot otherwise attain. For example, the relation of man to God is analogous to that of domesticated animals to man, who is their lord and master; and during training—the only practical mode of teaching these creatures—man, as it

were, reveals himself, his laws, and his power of chastising them if they do not submit thereto; a knowledge perfectly different from that which they are capable of acquiring by the intuition of sense.

6. The description of the Creation—recorded in the book Genesis—was probably revealed to Moses on Mount Sinai, where he abode forty days and forty nights in the presence of the Lord God, who spake unto him face to face, as a man speaketh to his friend; that is, God talked with him, not mediately by the mouth of a representative, but directly out of the midst of a cloud, as He did once before when He called unto Moses out of a flame of fire in the midst of a bush: by face to face we must not understand an intercourse with a visible person; for God expressly told Moses, “Thou canst not see My face, for there shall no man see Me and live.” God has revealed Himself to man by various theophanies, and imparted to him spiritual knowledge by various modes; and that on Sinai may have been by a vision, whilst Moses was in the spirit, as the Apostle John was in the isle of Patmos: such a mode of instruction, accompanied by explanations in answer to questions of the seer, is recorded on several occasions. Let it, then, be assumed that the revelation to Moses took place in a vision, and we shall have a better meaning of the word *saw* in the sentence, “And God saw that it was good,” which occurs several times in the narrative; for this word might have been rendered *showed*, as stated by R. S. Poole,* who adds that “the Hebrew word

* The Genesis of the Earth and of Man, p. 20.

to see, is the root of a derivative signifying *to cause to see*, and hence to *show*, which often occurs in the description of dreams and visions." On reading the account of Creation, the repetition of what God created, with occasional variations, seems to indicate that this is an interpolation of Moses, such as St. John has made in his Gospel. These repetitions begin with the word "And," on every day except the sixth, where it is written "So," which more clearly denotes that what follows is a remark of Moses. The object of this revelation was to teach the Israelites that God is the Creator of the world, and that all that is therein was not made simultaneously, but during distinct intervals of time: and for this purpose it needed to be expressed in terms adapted to the understanding of the people to whom it was addressed. This being the case, any attempt to reconcile the verbal details of the Creation with modern science must be labour lost; we shall, however, have occasion to point out that there is displayed therein a depth of knowledge far surpassing that of man at the time when Moses wrote.

7. The opening words of Genesis state that "In the beginning God created the heavens and the earth;" that is, the whole world: and brief as the sentence is, it reveals to us the origin of all things, a problem which science has been unable to solve. The words, "in the beginning," refer to that period in eternity when the world was not, when God was about to commence the work of Creation. An attempt has been lately made to reconcile Scripture and Evolution, by maintaining that matter, as well as Deity, is eternal: and that, by the energising potency of

the latter, the world was developed out of matter. This pantheism is another illustration of Haeckel's method of constructing an hypothesis, viz., by adapting it to the requirements of Evolution: but this assumption of two correlative eternals, instead of one self-existent eternal, only makes the origin of the world a more complex problem. When God entered on His work, matter was not. According to my hypothesis, this was the first of the three things which He created to be the basis of chemical substances and living organisms, of which collectively the world consists: "so things which are seen were not made of things which do appear." Thus, by the light of science, we may read between the lines of the grand and comprehensive announcement that in the beginning God created the heavens and the earth. Formerly it was thought that in these words we had a summary of the six days' work of Creation; but now it is very generally admitted that they refer to the entire material world, of which our earth forms but a very minute part.

"And the earth was without form and void, and darkness was upon the face of the deep: and the Spirit of God moved upon the face of the waters." This condition of the earth, before the beginning of the existing state of things in our little planetary world, seems to be similar to that which, according to geology, has frequently occurred during its history. The earth is composed of several distinct rock-formations, the oldest of which is of igneous origin, resulting from the cooling of its intensely-heated nebula; they are destitute of organic remains, not as some suppose by the destruction of organisms, but because

the earth as yet was too hot for the existence of living creatures : the more recent formations consist principally of rocks of aqueous origin, abounding in organic remains, but much changed and elevated by the intrusion of volcanic rocks ; there are several formations of these fossiliferous rocks distinguished from each other by containing the remains of peculiar séries of plants and animals now extinct. There is reason to believe that the destruction of these organisms was occasioned by changes of the sea-level, produced by elevations and depressions of the land by volcanic convulsions. At all events, such a cause would satisfactorily account for the condition of the earth, when covered by the deep, and void of living creatures. The earth was now about to become the abode of man, a new inhabitant superior to any that existed during the previous geological eras. Such a mode of terminating each formation, has been denounced as an "imaginary assumption of cataclysmic energy," of which science can find no record in the book of Nature ; but, on the contrary, has found graven in the rocks sufficient evidence to prove that no breaks occur between the series of organisms of adjacent formations. Evolutionists interpret this geological fact so as to favour their doctrine, that all the ancient and modern organisms form one connected series by gradual transitions. On the other hand, from my point of view, the occurrence of some of the same kinds of organisms in the rocks of adjoining formations may arise from the remains of the older rocks being transported into the newer formation, or from the older organisms being created anew as a part of the more

recent series. And, if so, then the series of organisms in each formation were adapted to the existing condition of the earth, and may have been a distinct creation like that described in Genesis. It may be here noticed that such an alternate destruction and reproduction of living creatures is set forth in the CIV. Psalm—"Thou takest away their breath, they die and return to their dust: Thou sendest forth Thy spirit, they are created; and Thou renewest the face of the earth." This verbal coincidence is curious, but, of course, it cannot be adduced to prove that the doctrine of Creation and science are in accord with one another.

What I am desirous of pointing out is that the doctrines of Evolution and Creation are two distinct kinds of philosophy, the natural and divine: both treat of the same subject, the formation of the world; one says this was effected by a gradual and spontaneous development of matter; and the other that it took place by several distinct commands of God—He spake and it was done. They cannot both be right: and we ought not to hesitate which to accept, as Evolution rests on the assumption of an imaginary matter, whereas Creation is a philosophy without assumption, for the Creator Himself, who alone can have a positive knowledge of the origin of the world, has revealed to us how it was made. Is the proof of such a Creation demanded? It is amply furnished by the reason in Nature that pervades all her works, as demonstrated by the researches of science: for these works, like those of man, clearly indicate that they have been formed by an intelligent Being operating according to a pre-

conceived rational design. And if so, God is the author of the Book of Nature, as well as that of revelation : so that if these books be rightly understood, they cannot be inconsistent with each other.

Let us now return, from these long introductory remarks, to the vision which was about to be displayed to Moses. All was shrouded by the darkness of the first day's evening, when "God said, Let there be light, and there was light;" and then Moses saw what was described in the second verse. This light was not, then, a special thing created on the first day, but probably represented the diffused light of the sun, which appeared on the dispersion of the dense clouds which previously covered the earth with darkness. The direct display of the sun, shining in all its glory, was reserved to the fourth day of the vision. The work of God on the first day is described in the third verse of Genesis, immediately after the words, "And God said :—" but as above stated, what follows in the fourth and fifth verses, beginning with the words—"And [so] God saw [showed]," I conceive to be the words of Moses. Now, if all the verses of the first chapter be read on the same principle, we find only ten which give God's own words ; and nineteen, those of Moses. On the sixth day, "God said, Let the earth bring forth the living creature after his kind, cattle, creeping thing, and beast after his kind : and it was so." And then follows a remarkable change in the diction. Now, instead of Let the earth bring forth, it is, "And God said, Let us make man in our image, after our likeness ; and let them have dominion over the fish of the sea, and over the fowl of the air, and over the

cattle, and over all the earth, and over every creeping thing that creepeth upon the earth."

The words—"Let us make"—are often adduced in support of the doctrine of the Trinity: this, I think, is a forced interpretation, and unnecessary, as it is sustained by much stronger evidence. The words imply that God addressed those around Him, who, elsewhere in Scripture, are called the angelic host: they are precisely such words as man uses in addressing an audience to call attention to what is about to be done. All God's revelations to man are recorded in language that may be understood; and man, in addressing God or speaking of Him, is obliged to express Himself in terms which correspond to the attributes of human nature. This adaptation of the higher to the capacity of the lower being, may be ridiculed as anthropomorphism; but it is the only means by which such intercourse could be maintained: and thus it is that scientists who desire to instruct the unlearned must discourse in popular language in order to be intelligible.

Moses' remarks on the sixth day's work run thus—"So God created man in His own image, in the image of God created He him, male and female created He them. And God blessed them, and said unto them, be fruitful and multiply and replenish the earth and subdue it. . . . And God saw [showed] every thing that He had made; and, behold, it was very good."

I have much to say on the subject of these latter verses; but, as the subject is more circumstantially detailed in the following chapters of Genesis, I will reserve my comments until then: but, before concluding the six days'

works of Creation, I will revert to that of the third day, which needs some notice. "And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after its kind, whose seed is in itself, upon the earth : and it was so." Thus, in the order of Creation, plants were made before animals, an order which accords with science, which teaches that plants derive sustenance from the chemical substances contained in earth, water, and air ; whereas animals obtain their food directly or indirectly from albuminoid substances, the products of vegetation. This order, therefore, indicates that the world was constructed by the Creator according to a preconceived teleological design, each part of which was executed at distinct periods of time.

8. The first chapter of Genesis gives a very general account of the world's origin ; the second chapter enters into detail concerning the nature of man and his relation to God : it does not seem to be a continuation of the vision, but rather explanations of it, probably in answer to questions of the seer, who records it in his own words. Be this, however, as it may, by it we learn that "The Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life ; and man became a living soul." "Living soul" is the rendering of the same Hebrew words which in the former chapter were translated "living creature," when applied to the beast of the field. This seems to have been done in order to avoid ascribing a soul to the beast, as this term is conventionally restricted to the living spirit or vital power of man. In another portion of the English version we read that

“They [men and beasts] have all one breath. . . . Who knoweth the spirit of a man that goeth upward, and the spirit of the beast that goeth downward to the earth?” According to the doctrine which I am advocating, every animal, including man, has a specific vital power, that which, by union with an organic body, constitutes a living creature. Man, that is the inner man or living spirit, is a personal being, who was made in the image of God; and it is to this spirit, or soul, that all the attributes of human nature belong: so that the human and divine natures are similar, though the attributes of the former are very inferior to those of the latter; just as bestial nature is inferior in degree to that of human nature. Has, then, God also got a soul? Scripture answers this question affirmatively; for we read that God is a spirit: and He Himself frequently speaks of His soul: and uses the personal pronoun in such a manner as makes the words *I* and *soul* convertible terms. So that the likeness of God, in which man was created, refers only to his soul, a free rational power, having a delegated authority over all natural powers, but subordinate to God, the supreme Power of the universe. This doctrine of powers maintains that there is an uninterrupted order of progression from the lowest to the highest; and such an order gives a more perfect idea of systematic continuity than the doctrine of Evolution, which boasts of its continuity, and yet is obliged to acknowledge at least one breach therein. The body of man, when first made of the dust of the ground, was a lifeless organism, prepared for the reception of his living soul: and, if so, Scripture, as well as the doctrine of

vital power, is opposed to the teaching of Evolutionists ; for man is something more than a protoplasmic body actuated by physical and chemical forces.

9. Although man at his creation had a mature body, his mind may have been like that of a young child ; and, if so, his intercourse with God would be analogous to that of a child with its parent. This seems to have been the relation between them ; for the sonship of man, and the fatherhood of God, are set forth in the subsequent Scriptures : thus, in the Gospel of St Luke, Adam is called the son of God—that is, a created, not a begotten son ; and the only begotten Son of God taught His disciples to address God as their Father in Heaven. Adam's divine Father, with providential care for His offspring, had planted a garden in Eden for his reception : “ and out of the ground made the Lord God to grow every tree that is pleasant to the sight, and good for food ; the tree of life also in the midst of the garden, and the tree of knowledge of good and evil.” And, doubtless, Adam was conscious of his dependence on God for this supply of all his wants, and loved Him for His kindness ; just as the young child becomes gradually conscious of its mother's care and protection, which it acknowledges with loving smiles. “ And the Lord God took the man, and put him in the garden of Eden to dress it and keep it.” Daily toil ought not, therefore, to be regarded as a curse, a weary penance for transgression, as some maintain ; for Adam as yet was in a state of innocence. Industrious occupation is, on the contrary, a blessing to man, for idleness is the parent of sin and misery ; and when in excess

it engenders ennui, a grievous affliction that makes life a burden.

10. "And the Lord God commanded the man, saying, Of every tree of the garden thou mayest freely eat; but of the tree of the knowledge of good and evil, thou shalt not eat of it, for in the day that thou eatest thereof thou shalt surely die." By this commandment was the will of God revealed to Adam, which instructed him what he might do, and what he must not do: and had he, as in duty bound, obeyed the voice of the Lord, he might have continued to eat freely of the sacramental tree of life and lived for ever.

Some have deemed it improbable that this commandment was of divine origin, on account of its great simplicity, but this is not a reasonable objection. God who made man knew what was in him, that is, all the capacities of his nature; and, in all His dealings with mankind, He ever "drew them with cords of a man, with bands of love;" precisely in the same manner as earthly parents instruct their young children before they are suffered to go alone, telling them that they must not do so and so, and if they disobey they will be punished. And so also in the training of animals, man stands in respect to them *in loco Dei*, and, by practical means which they understand, He teaches them what is required, and the penalty of disobedience. Thus, even by the light of Nature, it is manifest that the law given to Adam, simple as it is, was a sufficient test to determine whether he would voluntarily submit to the will of God.

Others, again, have attempted to throw discredit on this

commandment to Adam on the plea that it is derogatory to the goodness of God that He should have made such a law, knowing that it would be broken, and entail on Adam and his descendants such fearful consequences. “Nay but, O man, who art thou that repliest against God? Shall the thing formed say to him that formed it, Why hast thou made me thus? Hath not the potter power over the clay, of the same lump to make one vessel unto honour and another to dishonour?” It pleased God to make of the same earthy material different kinds of creatures; and to endow them with distinctively peculiar powers, or principles of activity. Some of them when they act cannot deviate from their appointed laws, for they *must* of necessity conform thereto; and accordingly their actions are perfect. On the other hand, God has chosen to diversify His works by endowing mankind with rational minds, so that they can understand what is said to them; and with wills, free to obey His laws or not as they feel disposed: they *ought* to obey His laws; for it is only by so doing that their conduct can be perfect, and thus fulfil the end of their being, by rendering to God a willing and reasonable service. God has pronounced all His works to be very good: so assuredly, as set forth in Scripture, man’s perfection, in the fulness of time, will be accomplished.

11. “And the Lord God brought every beast of the field and every fowl of the air unto Adam to see what he would call them: and whatsoever Adam called every living creature, that was the name thereof.” This review of the animal creation immediately after Adam’s instruction in

the Divine law, shows that natural knowledge, though secondary in importance to spiritual knowledge, is requisite in order to enable man to hold intercourse with the world which he now inhabits. It likewise indicates that whilst the latter knowledge can only be acquired by a special revelation of God, the former may be attained by the exercise of man's mental faculties, which are, as all man's other endowments, the gift of God. So that it is vanity of vanity for man in the pride of his scientific attainments, and the power which he obtains thereby, to be puffed up with self-conceit, and to glory, as if he had not received it as the gift of God. And it is also worth noting that man then as now obtains his primary knowledge of Nature by fixing his attention on objects; and having ascertained their peculiarities he then distinguishes them from each other by special names. This portion of the sacred narrative has also been pronounced to be improbable: but it may be that the words "every living creature" only apply to those of Eden with which Adam was associated; too much stress ought not to be laid on the literal construction, which has been liable to many alterations during its transmission to us. This review seems also to have been principally intended to point out to Adam that whilst each species of animals which came before him consisted of male and female, he alone was a solitary example of his kind: and it may also have served as an occasion for the important lesson, that the Lord God was the Creator of these living creatures, for immediately after this, God gave Adam a practical proof of His power to create a living being.

12. "And the Lord God said, It is not good that the man should be alone; I will make him a help meet for him. . . . And the Lord God caused a deep sleep to fall upon Adam, and he slept: and he took one of his ribs, and closed up the flesh instead thereof; and the rib, which he had taken from man, made he a woman, and brought her unto the man: and Adam said, This is now bone of my bones, and flesh of my flesh; she shall be called woman, because she was taken out of man." This account of woman's creation suggests several things worthy of remark. It makes us acquainted with one of the modes by which God imparts knowledge to man. The deep sleep was not a natural sleep, but a trance, during which voluntary motion is suspended, whilst the senses of sight and hearing are awake to what is going on around; and several instances of such a trance, in after ages, are recorded in the Scriptures. The words of Adam on awaking from this deep sleep, "This is now bone of my bones," clearly imply that he had witnessed what had taken place. This is the first miracle on record, wrought in confirmation of God's word that He is the Creator of all things. It was meet and right that Adam should have this testimony, to give him faith in God's teaching: for he was about to become the spiritual pastor of his wife and family, and it behoved him to be able to say, when inculcating the doctrine of creation, that he himself had been an eye-witness of God's wonderful work.

Miracles were of frequent occurrence in God's subsequent dealings with mankind: they formed the credentials of His servants, the prophets, to convince their hearers that

they were duly commissioned as ambassadors to deliver the messages of God. It is, therefore, probable that the mind naturally requires such evidence, to give confidence in the truth of revelation. There is in our day a disposition to place more reliance on the presumptuous assertion that the miracles recorded in Scripture cannot be true, because they are contrary to the laws of Nature. The word Nature, by a metonymy of the effect for the cause, is often used as if it were the author or producer of all things. Is it not more reasonable to believe that the Great First Cause is a Person, an omniscient and omnipotent Being, who made the whole natural organism, consisting of physical, chemical, and vital powers, which, interacting on each other according to their respective laws, produce all the phenomena of Nature? Such a Supreme Power, having a perfect knowledge of all His works would be far more able than scientists with their limited knowledge of natural laws, so to adjust the relation of things as to produce miracles, which appear to them to be contrary to law; just as wonderful experiments in the lecture room appear to the unlearned equally contrary to the laws of Nature.

The comment on the bringing together of the first man and woman, viz., "Therefore shall a man leave his father and mother, and shall cleave unto his wife: and they twain shall be one flesh,"—was probably that of Moses, the author of the book Genesis; for many instances of a similar interpolation occur in the books of Scripture, in order to point out to the reader the import of the passage, or to give an explanation of it, or otherwise to

impart instruction. The word “flesh” is often used by the sacred writers as a synonym for the natural man—the human species, which comprises both sexes, male and female, for neither of them apart can perform all the functions of human nature; and, therefore, cannot fulfil the Divine command, “Be fruitful, and multiply, and replenish the earth.” Marriage was ordained of God for the express purpose that a natural appetite might be purely gratified: it is, therefore, an honourable ordinance, and those Christians who deem it an unclean thing, and flock in multitudes into monasteries and nunneries in order to shun it, do despite to God’s commandment; for to obey is better than any sacrifice that man can devise. Doubtless there is good authority to justify those who voluntarily and in all sincerity refrain from family ties, for the kingdom of heaven’s sake; but this does not consist in seclusion and corporeal mortifications, but by mingling with the world, and engaging actively in the service of their Lord, by striving to convert their erring brethren from their evil ways.

13. How long Adam remained in a state of righteousness, and enjoyed sweet communion with his God, is not recorded: it would seem to have been of short duration, for God had blessed him and his wife in their generation, and yet Cain, their first child, was not born in Eden. It pleased God to submit them to temptation, as a test of their obedience; and to this end, Satan, in the guise of a serpent, was permitted to induce them by his seductive art to eat the forbidden fruit. “And he said unto the woman, Yea, hath God said, Ye shall not eat of every tree

of the garden? And the woman said unto the serpent, We may eat of the fruit of the trees of the garden; but of the fruit of the tree which is in the midst of the garden, God hath said, Ye shall not eat of it, lest ye die. And the serpent said unto the woman, Ye shall not surely die: for God doth know that in the day ye eat thereof, then your eyes shall be opened, and ye shall be as gods, knowing good and evil. And when the woman saw that the tree was good for food, and that it was pleasant to the eyes, and a tree to be desired to make one wise, she took of the tree thereof, and did eat: and she gave also to her husband, and he did eat. And the eyes of them both were opened, and they knew that they were naked; and they sewed fig leaves together, and made themselves aprons."

This graphic account of the temptation is a copious subject for reflection, but I must rest content with a few remarks. The serpent, the apparent agent in tempting Eve, was only the instrument of Satan: Eve was probably familiar with its presence in Eden; and its speaking to her, so limited was her experience, would not excite any alarm, or even suspicion: in her simplicity she was ignorant of guile; so that the serpent's speech must have seemed to her the words of truth. "The serpent," says Bishop Horsley,* "was no allegory; it was the tempter himself, in the form which he chose to assume." Others, again, have tried to set aside the narrative of the temptation as fabulous, boldly asserting that there is no such being as Satan; that which is so called, they say, is

* *Biblical Criticisms*, vol. i., p. 17.

the ideal personification of man's evil passions. They are not, however, qualified to sit in judgment on such a matter ; as men, they may know the things of a man by the spirit of man that is in them, but they cannot discern spiritual things unless they are revealed by the Spirit of God : information on this subject must be sought for in the Scriptures ; for science can give no insight into things appertaining to the supernatural world. Scripture tells us that the angelic host were, as well as man, subjected to temptation to test their obedience to the Most High : and that some of them maintained their integrity, whilst others were wilfully disobedient, and, forfeiting their high estate, became fallen angels. The chief of these evil angels is Satan, to whom authority has been delegated over all, both angels and men, who have thrown off their allegiance to God ; who, by so doing, have become the slaves of Satan. From the beginning, even until now, God has employed Satan as the means of proving man's faith by temptation ; but, in every case he limits his power by a definite permission—hitherto thou mayest go, but no further : as notably illustrated in the case of Job, when “ the Lord said unto Satan, Behold, he is in thine hand ; but save his life.” This doctrine of two masters must not be confounded with the Manichean heresy of the existence of a good and bad deity, who are ever contending with each other for authority over man. Satan cannot contend with God ; his authority is derived from God, who is able at any time to revoke it, and has from the beginning ordained so to do in the fulness of time.

It has not been revealed how it came to pass that

Satan was permitted to beguile Eve, and through her Adam also : but guided by the case of Job, it may have been somewhat on this wise. God may have said to Satan, Seest thou My children in Eden, how they love Me and keep My commandment ? And Satan may have answered, Hast thou not made a hedge about them ; and by Thy watchful care preserved them from disobedience ? But let them go alone, and be free to follow their heart's desire, and they will be easily tempted to eat the forbidden fruit. And the Lord may have answered, Thou mayest try to persuade them, and shalt prevail also : go forth and do so. And Satan went, and by enticing words accomplished his purpose, as already related. We do not realise as we ought our relation to and intimate connection with the spiritual world ; we little heed the declaration of Scripture that Satan, "going to and fro in the earth," "walketh about, as a roaring lion, seeking whom he may devour." Our Lord's miraculous works, when here on earth, were chiefly concerned with destroying the works of Satan. And He was tempted like as we are ; and by His example on that occasion He showed us how to resist the devil, and he would flee from us ; and remembering His bitter experience, He taught His disciples to pray, "Lead us not into temptation, but deliver us from the evil one : " and yet so little do Christians concern themselves about the power of darkness, the prince of this world, that it seems as if they also doubted the existence of such a person as Satan.

A brief suspense followed the transgression of our first parents, which must have seemed an age of anguish in

the fearful looking for the coming of the Lord. At length they hear His voice in the garden, and instead of going to meet Him as heretofore, they hid themselves from His presence amongst the trees: a delusive hope of safety, for they could not be concealed from God's all-seeing eye. "And the Lord God called to Adam, and said, Where art thou?" Heretofore Adam, having a conscience void of offence, would have cheerfully responded to this call: but now self-convicted he tries to excuse his withdrawal from God's presence, saying, "I heard thy voice in the garden, and I was afraid, because I was naked, and I hid myself." Thus he inadvertently proclaimed his guilt, and called forth the demand, "Who told thee that thou wast naked? Hast thou eaten of the tree, whereof I commanded thee that thou shouldest not eat? And the man said, The woman whom thou gavest to be with me, she gave me of the tree and I did eat."

Thus Adam, as his descendants do now when detected in a fault, strove to evade punishment by throwing the blame on others: his answer was in the main truthful, but there lurks in it an evil spirit; for his words seem to imply, I was tempted by my wife, and lovingly yielded to her allurements; and how could I resist charms which thou madest so fascinating? Such may have been the foolish and very natural thought of his heart, so like a child that catches at any excuse for its exculpation. Some think that Adam, being conscious of his guilt, ought to have prostrated himself before God and said, "Father I have sinned, and am no more worthy to be called Thy son;" but repentance cometh not so suddenly, and whilst

one is overwhelmed with a sense of shame ; for then pride, not humility fills the soul, and there is no disposition to kiss the rod.

“And the Lord God said unto the woman, What is this that thou hast done ? And the woman said, The serpent beguiled me, and I did eat. And the Lord God said unto the serpent, Because thou hast done this, thou art cursed above every beast of the field ; upon thy belly thou shalt go, and dust shalt thou eat all the days of thy life. And I will put enmity between thy seed and her seed, it shall bruise thy head, and thou shalt bruise his heel. And unto the woman he said, I will greatly multiply thy sorrow and thy conception ; in sorrow thou shalt bring forth children ; and thy desire shall be to thy husband, and he shall rule over thee. And unto Adam he said, Because thou hast hearkened unto the voice of thy wife, and hast eaten of the tree, of which I commanded thee, saying, Thou shalt not eat of it : cursed is the ground for thy sake ; in sorrow thou shalt eat of it all the days of thy life ; thorns also and thistles shall it bring forth to thee ; and thou shalt eat the herb of the field ; in the sweat of thy face shalt thou eat bread, till thou return unto the ground ; for out of it wast thou taken : for dust thou art, and unto dust shalt thou return.”

The visitation of punishment on the serpent, the unconscious instrument of Satan, has been too hastily condemned as unmerciful ; and also as untrue. *Untrue*, because the remains of serpents, similar to those now existing, have been found in rocks more ancient than Adam's appearance on earth : this, however, is nothing to

the purpose for which it is adduced ; for Scripture does not say that this was the origin of the serpent tribe ; but that a creature of a higher order was degraded into a lower order. And such a striking occurrence must have made a deep impression on the minds of our first parents ; and, being handed down by tradition, become a standing memorial of man's transgression. *Unmerciful*, because the innocent serpent was punished for the offence of another. If a desire of fault-finding had not blinded the judgment of such objectors, they would have perceived that the serpent, whether it were a dragon or even a quadruped, could have suffered no injury, for it must have been unconscious of the change, and would enjoy its new nature without any remembrance of its former condition. The vicarious vengeance inflicted on the serpent was manifestly addressed to Satan, and foreshadowed the awful but just doom that awaited him in the fulness of time, when the seed of the woman will bruise his head. Satan, doubtless, understood its import ; though Adam probably only saw in it a promise of revenge on the serpent, the apparent cause of his trouble.

All know how fully the sentence on the woman has been fulfilled ; for even at the present day it is a warning voice that cries aloud in every family. Remember that the pain of childbearing is the punishment of transgression, therefore repent and seek for forgiveness by the appointed means of grace. Adam's part in the transgression is clearly pointed out by the words, " Hast thou eaten of the tree, of which I commanded thee, saying, thou shalt not eat of it ? " The Lord is a just as well as a merciful God,

and He cannot overlook any wilful violation of even the least commandment, more especially of one directly delivered to an individual. We have another notable instance of this recorded in the case of the man of God from Judah, who, after he had delivered the Lord's message concerning the altar at Bethel, disobeyed the command—"Eat no bread nor drink water in that place, nor turn again by the same way that thou camest:" he hearkened unto the lying words of an old prophet and did eat in his house at Bethel, and returning home by the same way that he came, a lion met him, and slew him. Adam also had been fully instructed in his duty, and he ought to have obeyed the commandment of his heavenly Father. He did not, however, immediately suffer the penalty—"dust thou art, and unto dust thou shalt return"—but he underwent that of which it was typical, a spiritual death; for by his disobedience he forfeited his birthright, and fell, like Satan, from his high estate, and became an alien from his Father's house.

Since nothing takes place without God's permission—not even the fall of a sparrow, much less that of a man—it is not unscriptural to suppose that Satan's successful guile toward our first parents was ordained, and not as some say that Satan revengefully marred the work of God: for it manifestly was done according to the determinate counsel and foreknowledge of God, as testified by "the Lamb slain from the foundation of the world," for the redemption of man's transgression. It was God who endowed man's soul with a will to do as he pleased; and he knew that when man was left to follow his own desires

that he would be tempted to disobedience, and that it would require a long career of probation before mankind, like the prodigal son, having learnt by bitter experience the folly of their wilfulness, would humbly return to their Father's house, where alone peace and joy are to be found.

When Adam stood, as a condemned sinner, before his Judge, he may have cried out in his agony, "O wretched man that I am, who shall deliver me from the body of this death?" And God in His mercy had compassion on His creature, and appointed the means whereby he might have a hope of salvation, for He instituted the vicarious atonement of a bloody sacrifice, to which Adam could resort, and obtain his reconciliation with God. For we read, "Unto Adam and also to his wife did the Lord God make coats of skins, and clothed them." The brevity of sacred history in these early times makes it rather obscure; but later Scripture throws light on this subject: by it we learn that the animals which furnished the skins were slain as a sin-offering, prefiguring "the seed of the woman," who, in the fulness of time, was to be sacrificed on the Cross as a propitiation for the sins of the whole world. Thus God provides the means of grace, but man, thankfully accepting the same, and co-operating therewith, must strive to work out his salvation with fear and trembling. The teaching of Adam in Eden concerning spiritual things was adapted to his inexperience: it taught him that God is, and that He is the Creator of all things; and that, as his Lord, it was his duty to be obedient to His commandment, which was simply not to do that which

was forbidden : after the Fall he was taught the obligation of sacrifice to God ; and now the commandment is different from the former : it is—Do this, and thou shalt live, and be renewed in the image of God.

“ And the Lord God said, Behold, the man is become as one of us, to know good and evil ; and now, lest he put forth his hand, and take also of the tree of life, and eat and live for ever, He sent Adam forth from the garden of Eden to till the ground from whence he was taken. So He drove out the man ; and He placed at the east of the garden of Eden Cherubims, and a flaming sword, which turned every way to keep the way to the tree of life.” Some things in these concluding verses are hard to understand : it may be that marginal glosses, intended as explanations, have been interpolated, which have failed to enlighten the darkness ; for, as it now stands, it is not in keeping with the general tenor of Scripture. For instance, so far from God forbidding man, He invites him to eat of the tree of life ; for the partaking of this sacramental symbol in faith is the appointed means of obtaining everlasting life. The notion of forcibly preventing the doing of evil is not God's method of dealing with man, and would, indeed, be inefficient, as even the wilful desire to do evil, without its actual commission, is equally sinful in the sight of God. Is it not more probable that the Cherubims placed at the east of the garden were sacred emblems of the mercy-seat of God, where Adam was to offer the appointed sacrifice ? and the flaming sword may have been the sword-like appearance of the sacred flame—the symbol of the Divine presence—which

kept the way open for Adam's access to the bread of life, which sacrifice foreshadowed.

No small portion of the subsequent Scriptures is occupied in relating a long series of man's rebellions against Divine authority, and God's long-suffering and merciful compassion in pardoning their offences, and by sending a succession of prophets—His ambassadors—to reclaim them from their evil ways. The spiritual education of God's chosen people Israel was a preparatory instruction to qualify man for the reception of a higher standard of knowledge; and it has not been in vain; for since the Babylonian captivity, Israel finally abandoned idolatry, and stood as an ensign raised on high in the midst of heathendom, testifying that there is only one true God—the God of their fathers, Abraham, Isaac, and Jacob. So far well: but they were still a stiff-necked generation; they prided themselves that they were better than other men, being high-minded on account of their descent from Abraham. Israel has hitherto failed to fulfil the purpose for which they were set apart: but their failure has served to establish the great truth that man, even with Divine teaching, does not necessarily walk uprightly, being ever prone to wilfulness.

During the probation of Israel, the rest of the world being left to follow their own devices, the faculties of human nature were successively developed in the hope of attaining perfection, the absolute good, for which man has ever yearned: and each faculty has been tested by experience and found to be wanting. Thus, the dominant power of the will—which exists in every individual, and is first

manifested in the family—has been unsuccessfully exercised by all people: sensuality has been assayed in the luxury and voluptuousness of eastern empires; the cultivation of the intellectual faculties by the Greeks; and morality by the Romans in the institution of equitable laws. But neither of them has enabled man to attain perfection. In our day, the great development of natural knowledge, and the consequent enlargement of man's dominion over all inferior creatures, has a tendency to give him such an overweening idea of his dignity and self-sufficiency as is detrimental to his obtaining the only knowledge by which he can attain the long coveted perfection: for to this end man must be taught the revealed will of God, for it is only by regulating his conduct by Divine law, that his actions can be as perfect as the phenomena of the natural world.

In short, for the full development of human nature, there must needs have been a Divine revelation; for it is only by a knowledge of the law of God, and by a lively faith in that knowledge, that man can attain unto righteousness: happy are the people that are in such a case; yea blessed are the people who have the Lord for their God.