ON PROTOPLASM:

BEING

AN EXAMINATION OF
DR. JAMES HUTCHINSON STIRLING'S CRITICISM
OF PROFESSOR HUXLEY'S VIEWS.

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LONDON:
ROBERT HARDWICKE, 192, PICCADILLY, W.
1874.

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CHAPTER I.

DR. STIRLING'S DEFENCE OF THE LOGICAL CATEGORY OF DIFFERENCE.

THE first week of November of 1868 is a memorable one in the annals of philosophy in the city of Edinburgh. In that week the Archbishop of York delivered the introductory address of the winter session to the members of the Philosophical Institution. In this address his Grace attacked, as from his standpoint he might have been expected to do, the modern experimental school of philosophy, and traced its origin to Comte. It was not to be expected that the champions of what the Archbishop styled the "New Philosophy" would long remain silent. Professor Huxley had previously promised to deliver an evening address on the following Sunday in Edinburgh upon some non-theological subject; and his studies led him, as a matter of course, to choose some biological topic. But, as all inquiries into the nature of life unavoidably bring us face to face with the most perplexing philosophical problems, it was not strange that Professor Huxley took this opportunity to vindicate the

"New Philosophy" from the Archbishop's strictures. The title of this lecture, "Protoplasm, or the Physical Basis of Life," was in itself sufficiently suggestive; and after giving a plain statement of the interesting scientific questions involved in his subject, he proceeded to give his own solution of the philosophical problems which underlie all our knowledge; such as, the nature of matter, mind, causality, force, necessity, and law. He also took exception to the historical truth of the Archbishop in tracing the origin of the "New Philosophy" to Comte, and showed that its fundamental conceptions could be proved to have originated with Hume. So far we are dealing with historical facts, and have no wish to arbitrate between these two champions of rival schools of philosophical thought.

But soon after another opponent of the "New Philosophy" appeared on the scene. At a conversazione of the Royal College of Physicians of Edinburgh on the evening of the 30th April, 1869, Dr. James Hutchinson Stirling read a paper entitled "As Regards Protoplasm," in which be commented in very severe terms upon Professor Huxley's lecture.

This paper was published about six months afterwards as a pamphlet. Interested as we were in the subject, we soon obtained this pamphlet, expecting to find the battle of the philosophies continued; but to our disappointment, instead of finding a truly *philosophical* discussion, we either detected, or we supposed we detected, fundamental misconceptions and misrepresentations of Professor

Huxley's *scientific* opinions. Professor Huxley did not make a direct reply to this attack, but in an essay "On Yeast," which appeared in the December number of the *Contemporary Review* for 1871, he strengthened his former position by a short historical résumé of the development of our ideas regarding protoplasm; and in a few words at the close he charged Dr. Stirling with misrepresenting his views. We quote this passage at length, because it gives us a bird's-eye view of the whole controversy; and because it was this passage which occasioned the issue of a second edition of Dr. Stirling's pamphlet. It therefore forms a fitting introduction to its examination.

"Dr. Stirling," says Professor Huxley, "winds up his paper with the following paragraph:—'In short, the whole position of Mr. Huxley, (1) that all organisms consist alike of the same life-matter, (2) which life-matter is, for its part, due only to chemistry, must be pronounced untenable,—nor less untenable (3) the materialism he would found on it.'

"The paragraph contains three distinct assertions concerning my views, and just the same number of utter misrepresentations of them. That which I have numbered (1) turns on the ambiguity of the word 'same,' for a discussion of which I would refer Dr. Stirling to a great hero of 'Aufklärung,' Archbishop Whately. Statement (2) is, in my judgment absurd; and certainly I have never said anything resembling it; while as to number (3), one great object of my essay was to show that what is

called 'materialism' has no sound philosophical basis."*

We shall now proceed to inquire how far Professor Huxley is justified in asserting that Dr. Stirling has misrepresented his views; and this will lead us into a detailed examination of the second edition of his pamphlet; in which we not only find the original statements repeated, but a vindication of himself offered against Professor Huxley's charge. The main object which led Dr. Stirling to publish his paper is best stated in his own words. "I may now state," he says, "without any more particular reference to the motives, whether general or special, which gave rise to it, that this essay of mine had but one thing to do,—to protest, namely, against the thoughtless extinction of certain essential *differences* in a supposed *common identity*."† This being the main object of the essay, it is no wonder that the late Professor Ueberweg, who appears to have taken Professor Huxley's views upon trust from Dr. Stirling, should say that the "dialectical leading thought" of the essay is "the contention, namely, for the right of the logical Category of Difference, as against that of Identity, one-sidedly accentuated, as it seems, by Huxley." "My reply to this was," proceeds Dr. Stirling, "that he [Ueberweg] had hit the mark—that I had been simply laughing all through, and holding up to the Category of Identity, the *equally authentic* Category

* *Contemporary Review*, December, 1871, p. 35.

† "As Regards Protoplasm." By James Hutchinson Stirling. Second edition, p. 1. Longmans, Green, & Co.

of Difference—but *that it had taken a German to find me out.*" * We do not envy the mixture of self-complacency and conceit which dictated this reply. The thoughts of Dr. Stirling are so profound that we, "amusing Britons that we are"—the offspring of the "Aufklärung," and steeped in the philosophy of the "Revulsion," cannot detect him even in his laughter! We must bear our fate as we may; but as offspring of the "Aufklärung" it is only natural that we should ask how far this laughter is justified. And when we admit that the danger of the extinction of the Category of Difference is a subject sufficiently provocative of laughter, we are then entitled to ask whether this category is in any danger of extinction by Professor Huxley's essay. What are the particular passages of this essay which prove that he ignores the differences of protoplasm? "Consider," says Dr. Stirling, "one or two of Mr. Huxley's own phrases! 'There is such a thing as *a* physical basis or matter of life'—or '*the* physical basis or matter of life.' There is 'a single physical basis of life,' and through its unity 'the whole living world is pervaded by a threefold unity'—'namely, a unity of power or faculty, a unity of form, and a unity of substantial composition.'

"With such expressions ringing in our ears—and they occur on every page—which of us, Mr. Huxley or I, shall be said to be the one who rather *pushes* 'identity'?" †

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* *Ibid.* † *Ibid.*, p. 8.

Now if we take the first of these phrases, "there is such a thing as *a* physical basis or matter of life," it is manifest that Professor Huxley could not employ such language without believing that there is a certain material element common to all living things; and it is further manifest that he regards this common element as protoplasm, since he uses this term and "the physical basis of life" as equivalents. Is Professor Huxley warranted in asserting that there is a certain matter common to everything that lives? Dr. Stirling thinks that he is not, and adopts two lines of argument to prove the erroneousness of the conclusion. He first affirms that this conclusion is not accepted by the most innovating of the Germans, and secondly he advances a theory of his own which places the nucleus above the protoplasm in importance.

Before proceeding to estimate the value of Dr. Stirling's arguments under these heads, let us digress for a moment in order to notice the historical development of our present ideas regarding protoplasm. The historical facts, however, are of little use for our present purpose, except in so far as a survey of them will enable us to seize upon the mental operations concerned in interpreting them. We shall therefore start with the discovery of the cell by Schleiden and Schwann, and shall purposely avoid the mention of any other authorities, lest our main object be missed amongst a multiplicity of facts and statements. The typical cell at the time of its discovery was supposed to be a small sac consisting of an external membrane, with contents

of albuminoid character, afterwards called protoplasm, and a small central body of harder consistence called a nucleus. Further observation, however, showed that one or more of these elements might be absent, and the question arose, which of them is to be regarded as the fundamental, never-failing constituent of the morphological unit? Observation showed that a great many of the bodies called cells really possessed no distinct limiting membrane. The membrane, therefore, was found to be a special constituent, and could not be regarded as fundamental, hence the morphological unit was reduced to a bit of nucleated protoplasm. Can this unit be further simplified? Professor Huxley says it can. "But at the very bottom of the animal scale," he remarks, "even this simplicity becomes simplified, and all the phenomena of life are manifested by a particle of protoplasm without a nucleus."* Observation, therefore, shows that life may be present when there is no nucleus and no membrane; but no observation has ever shown, or is ever likely to show, that any matter is living in the absence of protoplasm. Protoplasm, therefore, is proved by a genuine induction to be the most fundamental and essential material of living organisms, and both the nucleus and the cell-membrane must be regarded as special modifications of the fundamental substance. The conclusion thus reached by the morphologist has been independently attained by the

* "Lay Sermons, Addresses, and Reviews," by T. H. Huxley, LL.D., F.R.S., p. 140.

physiologist; and although the observations of the latter were directed to function and not to structure, yet the method adopted by both was essentially the same, and need not be further particularized here. We are now in a better position to estimate the value of the arguments which Dr. Stirling directs against this inference. As already remarked he attacks it indirectly; (1) by the supposed aid of the German histologists, and (2) by a theory of his own advanced in opposition to it.

In reference to the German histologists he says:—"Whatever may be the opinion of the adherents of the molecular theory of generation (namely, that physical molecules combine of themselves into living organisms), it is certain that all the great German histologists still hold by the cell, and can hardly open their mouths without mention of it."*

But on the supposition that this statement is in great measure true, it is quite irrelevant to the point at issue. The question is, not whether histologists speak frequently of the cell, and still hold by it, but whether they regard the protoplasm as more fundamental and essential than either the nucleus or membrane. Several reasons might be given why not only German histologists, but histologists of all countries, should speak of the cell. But the frequency with which it is spoken of is no measure whatever of the relative importance attached to each of its three constituent elements. No one denies that by far the largest part of plants and

* "As Regards Protoplasm," p. 26.

animals are composed of cells and their modifications; hence histologists must necessarily speak more frequently of cells than of any other component; but the frequency with which the cell is mentioned affords no aid in determining the real question at issue, which is, the relative importance of the constituent parts of the cell. Another reason for the frequency with which the cell is mentioned by histologists is, that it was discovered and its significance recognized long before the question of the relative importance of its constituent parts had assumed such consequence. Therefore the whole of descriptive histology started from the cell, which was supposed to be common to all organisms and to all parts of organisms. There can at least be no doubt that the progress of discovery in this case was from the complex cell to the simple protoplasm; whereas the course of nature is from the simple to the complex. Hence it is that we frequently find histologists speak of a cell, even when both nucleus and membrane are absent. It is perfectly certain, therefore, that no argument can be founded upon the frequency with which the cell is mentioned by histologists, as against the importance which Professor Huxley attaches to protoplasm.

But it is not true that all German histologists regard the cell as the fundamental morphological unit. In order to avoid the difficulties which the use of the term cell involves, Haeckel, for instance, proposes to call the morphological individuals of the first order—Plastides. He divides the Plastides

into two kinds—Cytodæ and Cellulæ. The Cytodæ he subdivides into Gymnocytodæ, unnucleated lumps of plasma without membrane or shell; and Lepocytodæ, unnucleated lumps of plasma with membrane or shell. The Cellulæ he subdivides into Gymnocytæ, nucleated lumps of plasma without membrane or shell; and Lepocytæ, nucleated lumps of plasma with membrane or shell.* It is perfectly evident that in Haeckel's opinion the lump of plasma (plasmaklumpen), or as he afterwards calls it—the protoplasm—is the most essential part of the whole. It is present in all the divisions and subdivisions of his classification; and both the nucleus and membrane, when present, are regarded as special modifications of this fundamental substance. Since Professor Huxley's essay was delivered as a lecture to a popular audience, it would be quite out of place to give such an elaborate classification of protoplasm and of its modifications as that given by Haeckel; but he enunciates the whole substance of this classification in a single sentence when he says: "protoplasm, simple or nucleated, is the formal basis of all life."† But the similarity between the views of Professor Haeckel and of Professor Huxley does not stop here, since the former in 1866 used phrases in describing protoplasm almost the exact equivalents of those used by the latter in 1869. "According to the preceding," says Haeckel, "we call all those organic

* See "Generelle Morphologie der Organismen," von Erns Haeckel, B. 1, 1866, S. 274.

† "Lay Sermons, Addresses, and Reviews," p. 142.

materials which are the essential and never-failing media of the movement of life, plasma, cell-matter, or, better, formation-matter (Bildungsstoff): the active material substrate of life, and which can, therefore, be called, in a certain narrow sense, the matter of life (Lebensstoff), or the living matter."* And that there may be no mistake respecting the substance of which he is speaking, he proceeds to enumerate the names which have been applied to it by different authors, protoplasm being the first name mentioned. What now becomes of Dr. Stirling's insinuation that the most innovating of the Germans would not sanction the terms in which Professor Huxley describes protoplasm? The truth is, that not only is what Professor Huxley says about simple and nucleated protoplasm perfectly in accord with Haeckel's classification, but the very phrases adopted by the former might be accepted as good translations of those used by the latter; the "kernlose und kernhaltige Plasmaklumpen," "Bildungsstoff," "materielle substrate des Lebens," "Lebensstoff," of Haeckel, being respectively the equivalents of "simple and nucleated protoplasm," "the formal basis of life," "physical basis of life," and "matter of life," of Professor Huxley.

Let us now turn to Dr. Stirling's own theory, to see if it is sufficiently strong to upset a conclusion founded upon a genuine induction. After noticing the great importance which Goodsir, Schleiden, and Schwann attached to the nucleus, Dr. Stirling, in a

* "Generelle Morphologie," erster Band, S. 275.

burst of poetry which is surely beyond the occasion, proceeds to wish success to this view. "This universe," he says, "is not an accidental cavity, in which an accidental dust has been accidentally swept into heaps for the accidental evolution of the majestic spectacle of organic and inorganic life. That majestic spectacle is a spectacle as plainly for the eye of reason as any diagram of mathematics. That majestic spectacle could have been constructed, *was* constructed, only in reason, for reason, and by reason. From beyond Orion and the Pleiades, across the green hem of Earth, up to the imperial personality of man, all, the furthest, the deadest, the dustiest, is for fusion in the invisible point of the single Ego—*which alone glorifies it. For* the subject, and on the model of the subject, all is made. Therefore it is that—though precisely as there are acephalous monsters by way of exception and deformity, there may be also at the very extremity of animated existence cells without a nucleus, I cannot help believing that this nucleus itself, as analogue of the subject, will yet be proved the most important and indispensable part of all the normal cell-elements. Even the phenomena of the impregnated egg seem to me to support this view. In the egg, on impregnation, it seems to me natural (I say it with a smile) that the old sun that ruled it should go down, and that a new sun, stronger in the combination of the new and the old, should ascend into its place."* We have quoted

* "As Regards Protoplasm," p. 37.

this passage at length because no single extract from it would enable the reader to conceive how the facts of natural science are regarded by one who has "eaten the *historic pabulum* out of the vessel of Hegel." * We shall content ourselves with an endeavour to disentangle the scientific argument, which, as members of the "Aufklärung," we ought to be able to understand, from the mass of poetry and metaphysics, which are quite beyond our appreciation. The argument is that in reference to the cell the nucleus is a small central body, and therefore the analogue of the Ego in reference to the body. The Ego is an "invisible point," occupying a central position in the body; as, I presume, the soul of Descartes had in the pineal gland. But the Ego is the most important and indispensable part of man; hence its analogue, the nucleus, must be regarded as the most important and indispensable part of the cell. Dr. Stirling tells us in another place that "Analogy being never identity, is apt to betray. The difference it hides may be essential, that is, while the likeness it shows may be unessential—so far as the conclusion is concerned."† Did Dr. Stirling forget this rule when he drew the analogy between the nucleus and the Ego? Even were the similarity between them closer, were the Ego like the nucleus a small, spherical, central body, insoluble in acetic acid, it is difficult to perceive why such an analogy should

* See "Recent British Philosophy," by David Masson, second edition, p. 9.

† "As Regards Protoplasm," p. 39.

override a conclusion based upon an induction of facts, and therefore founded upon *identity*. Those who are satisfied with this argument in favour of the nucleus do not require to go further; the battle is lost and won, and Dr. Stirling must be proclaimed victor. Those, however, who prefer to rely upon a conclusion drawn from a careful observation and comparison of facts must acknowledge that Professor Huxley is perfectly justified in applying such phrases to protoplasm as "the physical basis of life," and "the matter of life," and may proceed with us to examine whether the existence of the Category of Difference is endangered by such statements. We have already seen that Dr. Stirling entered the list against Professor Huxley mainly in defence of this category; it is manifest, therefore, that we are approaching the discussion of the most vital part of the whole controversy.

Wherein consists the identity for which Professor Huxley contends? This identity is asserted when he says, that, "notwithstanding apparent difficulties, a threefold unity—namely, a unity of power or faculty, a unity of form, and a unity of substantial composition—does pervade the whole living world."* Let us now carefully follow him in tracing the different elements of which this unity, or, if Dr. Stirling prefers it, this identity, consists. Professor Huxley shows in the first place that "the powers or faculties of all kinds of living matter, diverse as they may be in degree, are substan-

* "Lay Sermons, Addresses, and Reviews," p. 134.

tially similar in kind." * The complicated activities of the higher animals—even mental manifestations in their objective aspect—may be comprised under three categories,—those which maintain the individual, those which maintain the species, and those which effect transitory changes in the relative position of parts of the body. But these modes of activity are not exclusively confined to the higher animals; but are common to every being that lives; from man and the oak, on the one hand, down to the protamœba of Haeckel, which merely consists of a speck of undifferentiated protoplasm, on the other. This, then, constitutes the first unity. The second unity is, in Professor Huxley's own language, that "protoplasm, simple or nucleated, is the formal basis of all life." † The third and last unity is, "that all the forms of protoplasm which have yet been examined contain the four elements, carbon, hydrogen, oxygen, and nitrogen, in very complex union, and that they behave similarly towards several reagents." ‡ Such, then, is the threefold unity which, according to Professor Huxley, pervades the living world. What are Dr. Stirling's objections to these unities? and how do they threaten the extinction of the Category of Difference?

And first with regard to the unity of chemical composition. In this reference, Dr. Stirling says:—"By substance, Mr. Huxley understands the internal or chemical composition; and with a mere

* *Ibid.*, p. 134. † *Ibid.*, p. 142. ‡ *Ibid.*, p. 143.

reference to the action of reagents, he asserts the protoplasm of all living beings to be an identical combination of carbon, hydrogen, oxygen, and nitrogen. It is for us to ask, then, are all samples of protoplasm identical, first, in their chemical composition, and, second, under the action of the various reagents?"* The reader has only to bring the passage already quoted, in which Professor Huxley declares the unity of composition of protoplasm, into juxtaposition with this quotation, to see how grossly he is misrepresented. His assertion "that all the forms of protoplasm which have yet been examined *contain* the four elements, carbon, hydrogen, oxygen, and nitrogen," is converted by Dr. Stirling into the proposition that "the protoplasm of living beings is an *identical* combination" of these elements; and his assertion that all the forms of protoplasm "behave *similarly* towards *several* reagents," into the proposition that their behaviour is "*identical* under the action of *the various* reagents." Having first misrepresented his opponent's views upon this point, Dr. Stirling has, of course, no difficulty in demolishing them. He can easily show that all the forms of protoplasm are not *identical* in composition nor in chemical constitution; and that they do not behave in an identical manner under the action of "the various reagents" which he enumerates; amongst which reagents not one of those which Professor Huxley would include in his "several reagents" is admitted.

* "As Regards Protoplasm," p. 28.

The whole of the argumentation upon this point is directed against an irrelevant issue. The commonplaces of vital chemistry, which no sane biologist would ever think of denying, are elaborately proved, and positions defended which were never assailed. Even Dr. Stirling himself ultimately obtains a glimpse of this truth. At the close of this part of the argument he says: "In such a state of the case we cannot wonder that Mr. Huxley's own conclusion here is: therefore 'all living matter is more or less albuminoid.' All living matter is more or less albuminoid! That, indeed, is the single conclusion of Mr. Huxley's whole industry; but it is a conclusion that, far from requiring the intervention of protoplasm, had been reached long before the word itself had been, in this connection, used." * This is, indeed, the main conclusion which Professor Huxley affirmed with regard to the chemical composition of protoplasm; and if Dr. Stirling accepts it as true, why all this elaborate argument to show that the different kinds of protoplasm are not identical in chemical composition? If the different kinds of protoplasm are more or less albuminoid, then they have *so* much identity; and the only further chemical identity which Professor Huxley affirmed of protoplasm was that which related to its behaviour under the action of *several* reagents. This conclusion may be very trifling; but, if so, why waste so much time and space in combating it? We would also remark that Professor Huxley never

* *Ibid.*, p. 34.

endeavoured to prove the albuminoid nature of living matter through the intervention of protoplasm. Indeed, he never attempted to *prove* its chemical composition at all. He accepted that as a conclusion from the chemists, and applied it to the special aim he had in view. That this conclusion was reached before the word protoplasm had been used in this connection, is no reason why Professor Huxley should not utilize it for this or for any other purpose. Surely the Category of Difference has nothing to fear from the inference that every kind of protoplasm is at one with every other kind, in so far as that all kinds are *albuminoid*, and that all behave similarly towards several reagents; such as alcohol, for instance, which checks its movements. Such a unity, however, is perfectly consonant with an indefinite amount of variety and difference in other respects.

What has Dr. Stirling to urge against Professor Huxley's unity of form? "What now," he asks, "of the unities of form and power in protoplasm? By form, Mr. Huxley will be found to mean the general appearance and structure; and by faculty or power, the action exhibited. Now it will be very easy to prove that, in neither respect, do all specimens of protoplasm agree." * By agreement it is evident that Dr. Stirling means complete congruity; since the only proof of non-agreement which he offers is an enumeration of various particulars, in which certain kinds of protoplasm dif-

* "As Regards Protoplasm," p. 30.

fer from each other. But would any sane man, not to speak of a distinguished biologist like Professor Huxley, maintain that there is a complete agreement in general appearance and structure between all the kinds of protoplasm? Were such a statement made, it would require no involved reasoning for its refutation. The perceptions received from the direct observation of tissues, like nerve and muscle, would suffice for this purpose. Yet we find Dr. Stirling putting himself to the trouble of quoting Stricker to show that "we have club-shaped protoplasm, globe-shaped protoplasm, cup-shaped protoplasm, &c. &c."* It never occurs to him to inquire whether Professor Huxley's language involves such an insane idea as he attributes to him. Professor Huxley's language does not of course bear such an interpretation, nor can we imagine how any one could so construe it. Dr. Stirling will himself admit that, for the vast majority of living beings and tissues the cell is the structural unit. But, as already pointed out, the cell is a complex body, and the question arose, which of its three constituent parts is the essential or fundamental one. At present biologists decide in favour of the protoplasm, and Professor Huxley's statement simply amounts to the old conclusion, that the cell is the structural unit; the mode of expression being modified in such a manner as to adapt this conclusion to the recent change in the theory of the cell. Instead of saying the cell, he says,

* *Ibid.*

"protoplasm, simple or nucleated, is the formal basis of life," or structural unit; and such being the case, every form of living thing is *so much* at one with every other living thing; while it is possible for them to possess every other imaginable structural variety and difference: Dr. Stirling may think this conclusion a very trifling one, and one that was known in every sense but a verbal one before the word protoplasm was invented; but whatever may be his opinion upon this point, it is perfectly certain that the Category of Difference was never denied, and has nothing to fear from the inference.

Dr. Stirling's objections to Professor Huxley's unity of power or faculty remain now to be considered. As already noticed, Professor Huxley asserts that all the activities of living beings may be comprised under three categories, namely, alimentation, reproduction, and contractility; and in these consists the unity of living beings as regards faculty. Dr. Stirling himself admits that all living beings, from the lowest to the highest, do feed and reproduce themselves. Nay! he has asserted much more than this with regard to reproduction. He says that, "from the very earliest moment—even literally *ab ovo*—brain-cells only generate brain-cells, bone-cells bone-cells, and so on." *

This appears to me to be one of the fundamental assumptions in Mr. Darwin's hypothesis of Pangenesis; and it is very curious to notice how substantially the same idea is reached by two men,

* "As Regards Protoplasm," p. 32.

whose entire mode of thinking is so unlike. We do not in the least quarrel with this assumption, for assumption we must still call it; but if Dr. Stirling believes it, he will not deny that all living beings are at one in the fact of reproduction. Of course no one is sufficiently insane to maintain that there is no difference between the mode in which this process is effected in the lower living beings and in the higher plants and animals. Beginning with the simple fission and budding processes, by which the lower forms of life multiply, difference accumulates upon difference, until the complicated mode in which the process is effected in the higher plants and animals is reached. Similar remarks apply to alimentation. That all living beings, and all parts of living beings endowed with life, feed themselves, is beyond question, and so far all are at *one;* but this is compatible with any amount of variability in the arrangements by which the process is effected. The unity which pervades the organic world, so far as alimentation and reproduction are concerned, does not, therefore, appear to threaten, in any particular manner, the Category of Difference. Indeed, Dr. Stirling himself makes no particular objection to Professor Huxley's statements respecting the activities directly involved in maintaining and developing the individual, and those directed to the continuance of the species. But we must now come to consider one of the main issues in the controversy.

The activities which are not included in alimentation and reproduction, may, Professor Huxley

thinks, be regarded as "effecting transitory changes in the relative position of parts of the body." Two questions present themselves, Is the category of contractility coextensive with living matter? Does this category include all living activities not included in the first two categories?

Let us attend at present to the first question. The answer Professor Huxley would give to it may be rendered in his own words: "The lowest plant, or animalcule, feeds, grows, and reproduces its kind. In addition, all animals manifest those transitory changes of form which we class under irritability and contractility; and it is more than probable, that when the vegetable world is thoroughly explored, we shall find all plants in possession of the same powers, at one time or other of their existence." * Glisson was the first physiologist who employed the term "Irritability" to designate the power of contraction possessed by muscular fibre, and which can be called forth by the application of what are called *stimuli*. This idea was more fully developed by Haller, who conducted a variety of experiments to determine the laws of the irritability or *vis insita*. But besides the *vis insita*, Haller supposed that muscle was possessed of two other powers. The second was the ordinary *elasticity* it possesses in common with other animal fibre, both dead and living; and the third was the *vis nervosa*, which was supposed by him to reside in the muscle: this latter force enabled the muscle to respond to

* "Lay Sermons, Addresses, and Reviews," p. 135.

the stimuli conveyed to it by the nervous fluid. *Sensibility*, or *vis nervosa*, came, however, afterwards to be applied to the power a nerve possesses of undergoing a physical change on the application of the stimuli which call forth its functional activity.

Further observations, however, have shown that irritability or contractility is by no means confined to muscular tissue. All young masses of protoplasm are now found to contract on the application of appropriate stimuli. Hence our ideas of irritability have extended in a corresponding degree. But having extended the bounds of irritability so far, is it not possible to extend it further? If, on comparison, a common bond of union were found between the behaviour of nerves and that of other tissues on the application of stimuli, it would be possible to define irritability so as to include the physical change undergone by both during functional activity. So far as we know, the latest attempt to effect this object has been made by Professor Rutherford. "I consider," he says, "that a tissue is irritable if, when irritated, it evolve energy." * It is obvious that the action of nerve on the application of a stimulus is quite as much included within this definition as that of muscular fibre, or that of white-blood corpuscles and other masses of protoplasm. But several objections could be urged against this definition. One objection is, indeed, stated by Professor Rutherford him-

* *Lancet*, Jun. 21, 1871, p. 76.

self, but he does not endeavour to obviate it. The evolution of energy which takes place in the head of a lucifer-match on the application of a stimulus is included in the definition quite as much as that which occurs in muscular fibre. But when the irritability of muscular fibre is called forth, it is accompanied by contraction. And this is equally true of white-blood corpuscles and of protoplasm generally. Were it true with regard to nerve, this would not only bring nerve and muscle, and other dynamical tissues to a fundamental community of faculty; but also serve to distinguish between vital irritability and the physical irritability displayed by a lucifer-match. Professor Huxley does not say that this is the case, but his language implies that it is his opinion that the physical change which the grey matter of the nerve undergoes in performing its function is accompanied by some degree of contraction. This is an idea which is particularly obnoxious to Dr. Stirling. "Where," he asks, "in relation to the protoplasm of the nervous system, is there evidence of its contractility? Has any one pretended that thought is but the contraction of the brain; or is it by contraction that the very nerves operate contraction—the nerves that supply muscles, namely?" * With regard to thought, we must say at once that it has no business here at all. It must be considered in the purely philosophical part of the essay; and the reasons for this opinion will be given hereafter. No one doubts that

* "As Regards Protoplasm," p. 33.

the brain undergoes physical and chemical changes as an accompaniment of thought; and it is with these changes only that we have to do at present. The question, therefore, is, are there any grounds for believing that the changes undergone by the brain during its activity are accompanied by some degree of contraction of its grey matter? Dr. Stirling thinks that he at once negatives such a supposition by a quotation from Professor's Huxley's Physiology. "Mr. Huxley himself," he says, "in his Physiology, describes nervous action very differently. There *conduction* is spoken of without a hint of contraction." * The power which a nerve possesses of conducting its energy from one end to another is termed its *conductivity*. But the term is used simply as expressive of a fact, and does not involve a theory of how the fact is accomplished. Dr. Stirling, however, appears to think that because the same word is employed to denote the transmission of heat and of nerve-force, that the mode in which the transmission is effected is the same in both cases. The majority of physiologists, however, do not believe that nerve-force is conducted like heat; that is, by a vibration communicated to one molecule being passed on in whole or in part to another, and so on. The conduction of nerve-force is supposed to be much more like the ignition of a train of gunpowder. A chemical change set a-going at one end sets sufficient energy free to effect a similar change in the next

* *Ibid.*

particle; and so on till the whole is changed. But the chemical change which takes place in nerve-fibre differs very considerably from that which takes place in gunpowder. It is supposed to be a change from a higher to a lower isomeric form of the protoplasm. If this is true, the molecules, in undergoing change, must pass from a comparatively unstable to a comparatively stable condition, wherein their polar affinities are more satisfied—in short the molecules must be in a more closely aggregated form after, than previous to, the change; and hence this chemical change must be accompanied by contraction. It is highly probable, therefore, that along with a chemical change a wave of contraction passes along the grey matter of the nerve when it is performing its functions. If this is the case, contractility is co-extensive with irritability; and irritability co-extensive with all the active functions of protoplasm. And similarly "in the case of pure sensation—smell, taste, touch, sound, colour;" * neither can occur without chemical change of the nerve concerned and its accompanying contraction. And so also "between the physical cause of heat without and the mental sensation of heat within," † contraction must be everywhere and at every time interpolated.

Our second question is, Does the category of contractility include all the activities not included in alimentation and reproduction? Professor Huxley is most emphatic upon this point. "Even those

* "As Regards Protoplasm," p. 33. † *Ibid.*

manifestations of intellect," he says, "of feeling, and of will, which we rightly name the higher faculties, are not excluded from this classification, inasmuch as to every *one but the subject of them*, they are known only as transitory changes in the relative positions of parts of the body. Speech, gesture, and every other form of human action are, in the long run, resolvable into muscular contraction, and muscular contraction is but a transitory change in the relative position of parts of a muscle." *

It was not to be expected that such a statement as this would pass unchallenged by Dr. Stirling. Accordingly we find that he takes great exception to it, and, as usual, he misconceives the import of the passage he criticises. He thinks that this passage affirms that our ideas are of the same nature as contractions; and that the proviso, "that the manifestations of intellect, of feeling, and of will are otherwise known to the subject of them," is not intended to modify the rest of the sentence, but is an unwilling concession which Professor Huxley would gladly suppress, were it possible to do so. Dr. Stirling has of course no difficulty in demolishing the whole of this argument, or rather his own interpretation of it. With this view, he quotes a passage from Professor Huxley's Physiology which expresses our absolute ignorance of how a state of consciousness comes about as a result of irritating nervous tissue; and employs the quotation to show

* "Lay Sermons, Addresses, and Reviews," p. 135.

how Professor Huxley contradicts himself, instead of using it to determine the real meaning of the passage which is the subject of criticism. But Dr. Stirling himself will not deny that Objective Psychology has to deal with a physical organism, and that what we infer to be states of consciousness in other beings are made known to us through the medium of physical changes in this organism. Objective Psychology has, quite as much as any other department of Physiology, to investigate the physical changes of a material organism; and any one who has attended to the recent extension of psychology, by Professor Ferrier's researches, will notice that the facts to be interpreted are definite muscular contractions excited by means of irritating definite tracts of the brain. But the provisional clause that the manifestations of intellect are otherwise known to the subject of them shows that Professor Huxley believes in the necessity of a Subjective Psychology. Were he a pure materialist, he must think that the whole of human knowledge is comprised in the study of the redistribution of matter and of motion, and would, like Comte, deny the utility of the subjective analysis of our ideas. It is perfectly evident, therefore, from the provisional clause of this sentence, as well as from the whole tenour of Professor Huxley's teachings elsewhere, that he does not deny the necessity of a subjective science of the mind. The whole of Dr. Stirling's argumentation upon this point, like his argumentation upon every other point yet examined, is therefore a mere *ignoratio elenchi*. Professor Huxley's opinions are

first misinterpreted, and consequently misrepresented; and then refuted,—the refutation being perfectly easy, and as perfectly worthless. We find, then, that when Professor Huxley's deliverances are rightly interpreted, he is perfectly justified in saying that there is a unity of power or faculty in protoplasm. And how far, we ask, does this unity threaten the extinction of the Category of Difference? We have already seen that this category is in no real danger from the affirmation that all living beings feed and reproduce themselves; nor do we now find that it is in any great danger from the assertion that protoplasm possesses the power of contractility; since there may be an endless variety in the manner in which contraction takes place.

We have now examined the different elements of which Professor Huxley's threefold unity consists, and, neither taken separately nor combined, do they afford any reason for saying that the Category of Difference is overlooked. The method which Professor Huxley adopts is simply to compare the most different kinds of protoplasm, and to seize upon the points which are common to every kind, and to neglect, for the time being, those which are special to certain kinds; and if this mode of procedure denies or overlooks the Category of Difference, the extinction of this category is equally threatened in every induction. The opinion of the late Professor Ueberweg in this reference will no doubt carry more weight with Dr. Stirling than anything we can say. "Since syllogistic procedure is *synthetic*, the inductive, in so far as it separates

the given object into its partly *common*, partly *special* elements, may be called *analytic*." * That this is the manner in which Professor Huxley meant us to understand the threefold unity which he proclaimed, is amply proved when he comes to sum up his conclusions in this reference. "Enough," he says, "has, perhaps, been said to prove the existence of a *general uniformity* in the character of the protoplasm, or physical basis of life, in whatever group of living beings it may be studied. But it will be understood that this *general uniformity* by no means excludes any amount of *special modifications* of the fundamental substance." † A *general uniformity* in the character of protoplasm is all he contends for—fundamental likeness in a few specified properties, and varying degrees of unlikeness in its other multitudinous properties. Where then is the danger to the Category of Difference? It is not only not denied, but it is distinctly acknowledged, that one kind of protoplasm may differ from another kind; inasmuch as there may be any amount of *special modifications*. In answer to this point, Dr. Stirling says, "The word modification can be regarded as but a cloak, under which identity is to be shuffled into difference, but remain identity all the same." ‡ It is not a cloak at all, but a distinct avowal of possible differences in all the properties, except those enumerated as common to all the

* "System of Logic," by Dr. F. Ueberweg, translated by T. M. Lindsay, M.A., p. 487.

† "Lay Sermons, Addresses, and Reviews," p. 144.

‡ "As Regards Protoplasm," p. 56.

varieties of protoplasm, and the other properties which directly depend upon these. Professor Huxley never did, and we are bound to say, never meant to assert that one kind of protoplasm is so perfectly identical with every other kind that there is no room for the Category of Difference. Let us now see if all Professor Huxley's other expressions are in perfect accord with this interpretation of his opinions. As he remarked in the *Contemporary Review*, almost the whole controversy turns upon "the ambiguity of the word 'same';" and as we have already seen, he referred Dr. Stirling to Archbishop Whately for its solution. Dr. Stirling accordingly consults Whately, and finds, or thinks he finds, that the latter endorses the mode in which he himself employs the term, and consequently he endeavours to turn the tables upon his opponent. Whately shows that the word is used in both a primary and a secondary sense. The primary Dr. Stirling appropriately denominates "numerical sameness"; as, when we say that a man is the same as himself. It is evident, however, that it is with the secondary use of the term that we have to do here; and with regard to this meaning Whately says: "When several objects are 'undistinguishably alike,' one *single description* will apply equally to any of them; and thence they are said to be all of one and the same nature, appearance, &c.; as, *e. g.*, when we say, this house is built of the same stone with such another, we only mean that the stones are undistinguishable in their qualities, not that the one building was pulled down, and

the other constructed with the materials." * It must be confessed that this passage really does appear to favour Dr. Stirling; since if "same" is only applicable to objects which are "*undistinguishably alike*" in every particular, this is exactly the sense in which Dr. Stirling uses the word, and in which he also uses the word "identity." If two objects are "undistinguishably alike" in all their qualities, there is no room for the Category of Difference, and consequently Dr. Stirling's criticisms are valid. Our critic is quite at home when dealing with this part of his subject. He has at last got a hold of one of those disputations about words in which be so much delights; and the reader may imagine how lofty and contemptuous he grows towards his opponent. But notwithstanding the apparent agreement between Dr. Stirling and Whately, we are persuaded that it is only apparent, and not real. Dr. Stirling allows that the context will show whether the word same is used in its primary or its secondary sense; and therefore we hope he will not object to our employing similar means to elicit the meaning which Whately attaches to "*undistinguishable in their qualities.*" Let us suppose that two houses are built of what is called the *same stone.* Nobody will maintain that each stone in both buildings is undistinguishable in every respect from every other stone. Each stone, however much alike it may be to every other, will

* "As Regards Protoplasm," p. 7. See also Whately's Logic, second edition, p. 107.

have certain peculiarities of its own. It will differ from every other in form and size, even if cut after the same model, in the mode of its stratification, in the direction of its cleavage, and in other innumerable ways; and the more minute the description is, the more will these differences accumulate. Whately merely says that they are "*undistinguishable in their qualities*" in so far that "one single description" will apply equally to any of them. The description in the case of the stone is required for the practical purpose of building; and so long as this purpose is kept in view, one description will serve for all, and the stones may be called the same. But let the purpose for which the stone is required be altered, and attend to the result. Let some of this stone be required for a geological museum, and see if two pieces which may be regarded as the "same" for building, can also be regarded in this light for geological purposes. In one piece a beautiful fossil is found, in a second, one of a different species, while in a third there is none. These stones may still be the same for building purposes; but are they so to the eye of the geologist? Certainly not. It may be objected that the geologist still regards the stones as the same; and that it is only the addition of the fossil that makes the difference. To obviate this difficulty, let us change the illustration and suppose that one of these stones is impressed with what a geologist recognizes as the foot-marks of the Cheirotherium, and another with the marks of rain-drops. These stones would be undistinguishable in their qualities

for building purposes, and consequently the same in Whately's sense; but for geological purposes they are widely different. It is only in this sense that the word "same" could possibly he applied to the stones in any one building, even if they were dug out of the same quarry, cut by the same hand, by the same tools, and after the same model. In short Whately does not deny the Category of Difference with regard to the "stones" of his illustration, and could not deny it with any show of reason.

We must now turn to Professor Huxley's essay in order to gather the meaning which he attaches to the word "same," and its cognates. Throughout the entire essay the word "same" is only used twice in connection with protoplasm. We have already quoted the passage in which Professor Huxley says that the only unity he contends for is a mere "general uniformity," which is compatible with "any amount of special modifications." He then adds, by way of illustration:—"The mineral, carbonate of lime, assumes an immense *diversity* of characters, though no one doubts that under all these Protean forms it is one and the same thing."* The *same thing* amidst immense *diversity* and *Protean forms!* Surely this cannot be held to mean that all the forms are "undistinguishably alike." All that is meant is that, amidst manifold differences between its varieties, it is constantly the same in the main elements of its chemical composition, and in certain fundamental

* "Lay Sermons, Addresses, and Reviews," p. 144.

physical characteristics. Amongst all its varieties it is the same in "fundamental substance." Or, slightly varying the mode of expression, carbonate of lime is *fundamentally the same*, notwithstanding its numerous varieties, an expression which is the exact equivalent of the one used by Dr. Stirling when he says that the history of protoplasm given in Stricker's "Handbuch" is *substantially the same* as that given by himself in the first edition of his pamphlet. Dr. Stirling is careful to *italicize* "*substantially*" in order to draw attention to the fact that although the two histories are at one with regard to the main facts, yet each presents *special* differences, which show that he was not a slavish copyist.* In short, he endeavours to show that the two histories present fundamental agreement along with a considerable amount of individual differences; or, in the language which Professor Huxley applies to protoplasm, he labours to show that although the two histories present a *general uniformity*, this by no means excludes a considerable degree of *special modifications*. The context, therefore, shows that Professor Huxley in this case means by the "*same thing*" exactly what Dr. Stirling means by "*substantially the same;*" and this mode of employing the word is perfectly in accord with the usages of common speech. It is in this sense that he uses the term when he says, "beast and fowl, reptile and fish, mollusk, worm, and polype, are all composed of structural units of

* See "As Regards Protoplasm," p. 13, *et seq.*

the *same* character, namely, masses of protoplasm with a nucleus." * The structural units are of the *same* character in so far as that they are all masses of protoplasm with a nucleus, and in all that this implies; but not necessarily further. That this is his meaning is rendered more evident when one looks a little further up the same page, and reads the question to which the sentence just quoted is the answer. The question is: "Does the formula which expresses the *essential* structural character of the highest animals cover all the rest?" † This shows that he is only in search of *sameness* in the *essential* structural characters; and when he asserts that structural units are of the *same character,* the word same must be taken along with the limitations imposed by the question he is answering; and it must therefore mean *essentially the same*—a qualification similar in every respect to Dr. Stirling's *substantially the same.* Strong corroborative evidence of this view is afforded a little further on, where Professor Huxley concludes "that all living powers are cognate, and that all living forms are *fundamentally of one* character." ‡ By no ingenuity can the term "cognate" here be held to mean that the powers are perfectly identical; and "fundamentally" limits the "one" here as "substantially" limits Dr. Stirling's "same." And if further evidence be necessary, it will be found a few pages further back, where Professor Huxley says "that

* "Lay Sermons, Addresses, and Reviews," p. 140.
† *Ibid.*, p. 140. ‡ *Ibid.*, p. 142.

the powers, or faculties, of all kinds of living matter, diverse as they may be in degree, are *substantially similar* in kind;" * and, again, when he says, corpuscles of *essentially similar* structure are to be found in the skin, &c." † "Fundamentally of one character," "substantially similar in kind," "of essentially similar structure;" these are the phrases employed by Professor Huxley, and they are the exact equivalents of Dr. Stirling's "substantially the same;" and yet we find the former phrases interpreted to mean complete identity; and the latter an identity compatible with a considerable amount of difference in the things compared. When Professor Huxley refers Dr. Stirling to Whately for a solution of the double meaning of the word same, the latter replies, "As for the word 'same,' I do not believe it to occur more than twice or thrice throughout the whole essay; identity is the term I use for the most part." ‡ But Dr. Stirling does not deny that when he does use the word "same," he uses it in the sense of identity, and therefore the reference which would enable him to solve the ambiguity of the one, ought to enable him to detect and solve the ambiguity in the other. But the main question for us to solve is, whether Dr. Stirling does justice to Professor Huxley's opinions in his use of the word identity. The fact is, the word occurs only twice in the whole of Professor Huxley's essay; and let

* *Ibid.*, p. 134. † *Ibid.*, p. 139.
‡ "As Regards Protoplasm," p. 7.

us now carefully examine how he employs it. It occurs first in the following connection: "Hence it appears to be a matter of no great moment what animal, or what plant, I lay under contribution for protoplasm, and the fact speaks volumes for the *general identity* of that substance in all living beings." * The second and last time it appears in the following passage:—"But if, as I have endeavoured to prove to you, their protoplasm is *essentially identical* with, and most readily converted into, that of any animal, &c." † In the first place all he claims for protoplasm is a "general identity," and in the second it is implied that different kinds of protoplasm are "*essentially identical;*" and will Dr. Stirling have the hardihood to assert that in either place Professor Huxley affirms such a complete identity in all respects as his argument assumes throughout? When it suits his purpose, Dr. Stirling identifies Professor Huxley with the philosophers of the Revulsion; and yet he will not avail himself of their writings in order to reach Professor Huxley's meaning. He will not deny that the late Mr. Mill was a recognized leader of the philosophy which he calls the Revulsion; and if he will refer to his writings, he will find that it is his opinion that the "essential properties" are merely those which analysis shows to be common to all the members of a naturally related group, and which are therefore included

* "Lay Sermons, Addresses, and Reviews," p. 147.
† *Ibid.*, p. 152.

in its definition. The question, what groups are naturally related, may be overlooked here, since no one doubts that all living beings are naturally related. If this is all that Professor Huxley means by "essential," his language simply means that protoplasm has an identity in so far as a certain number of properties, which are common to all kinds, are concerned; while there may be any amount of multiplicity in other respects. And even if we believe with the school of logicians with which Dr. Stirling allies himself, that analytic methods depend upon essentiality, and not the latter upon the former; yet the case is not different. However the essential attributes become known to us, whether by analysis or synthesis, it is perfectly certain that they must be found amongst the attributes which are common to the various members of the group of objects under consideration. We cannot, therefore, understand Dr. Stirling when he says that his object is "to protest, namely, against the thoughtless extinction of certain *essential differences* in a supposed common identity." * It is perfectly certain that the essential attributes of life, considered either with regard to its matter or its function, cannot be found amongst those in which one kind of living thing differs from another; but must be found amongst those which are common to all forms of life. We do not say that because an attribute is common to all living beings, it is therefore essential; but we maintain that an attribute which

* "As Regards Protoplasm," p. 1.

differentiates one living being from another cannot be an essential attribute of life. When, therefore, Dr. Stirling speaks of the "*essential differences* of life," as he does several times, this shows his want of precision in the use of language; and what is worse, he shows the same incautiousness in making references to his opponent's words. "Nay," he says, "not only does he directly *say* that 'it is by no means his intention to suggest that there is no difference between the lowest plant and the highest, or between plants and animals,' but he directly proves what he says, for he demonstrates in plants and animals *an essential difference of power*. Plants *can* assimilate inorganic matters, animals can *not*, &c." * When we read this passage, we thought that Professor Huxley by some slip of language had made a direct acknowledgment that there was an *essential difference* between plants and animals. His language, however, is that there is a *striking* difference between them.† No doubt there are essential attributes which constitute the one plant and the other animal, and these attributes must differ from one another; but in so far as both plant and animal are living, their essential attributes must agree; and it is of the attributes which constitute them living beings that Professor Huxley asserts identity, while he admits that there may be any amount of diversity in other respects. Dr. Stirling labours to show that Professor Huxley is

* "As Regards Protoplasm," p. 34.

† See "Lay Sermons, Addresses, and Reviews," p. 138.

not at home with the notion of *substance* in the sense of *existence, thing, ens;* but it is very desirable that he should first put himself at home with this notion when it means *essence, essentiality, essentia;* and then perhaps we should not hear so much from him about "*essential differences* of life." These remarks then bring to a close our examination of what Dr. Stirling conceives to be the most important part of his criticism of Professor Huxley's essay. In summing up this part of his criticism, Dr. Stirling says: "We have now overwhelming evidence before us for concluding, with reference to Mr. Huxley's first proposition, that . . . . Mr. Huxley is not authorized to speak of a physical matter of life, which, for the rest, if granted, would, for innumerable and, as it appears to me, irrefragable reasons, be obliged to acknowledge for itself, not identity, but an infinite diversity in power, in form, and in substance."* In opposition to these positions, we have seen that Professor Huxley is perfectly justified in speaking of "a physical basis of life," and that in this respect he is at least at one with a great German authority, Haeckel: and we have also seen that this physical basis presents fundamental agreements as regards power, form, and substance; and that this is perfectly congruous with an indefinite amount of special differences. The one great object for which Dr. Stirling wrote his pamphlet is, then, non-existent except in his own imagination. Professor Huxley never asserted that

* "As Regards Protoplasm," p. 37.

every kind of protoplasm was identical in every respect with every other kind; hence it was singularly unnecessary for the author of "The Secret of Hegel" to wade through page after page of controversy in defence of that which was never in any danger—the logical Category of Difference.

CHAPTER II.

ON VITALITY.

THE secondary issues which remain to be considered are not much less important than the main one which has just been discussed. Indeed, in our opinion, the subject-matter of the present chapter is not a whit less important than the previous defence of the Category of Difference, since it constitutes the transition between the purely physiological and the purely philosophical part of the essay; and if not that we have Dr. Stirling's own word to the contrary, we should have considered it the more important. But however this may be, we have now to undertake the examination of the second division of the physiological part of Dr. Stirling's criticism. The question is stated by Dr. Stirling in the following terms:— "For that is Mr. Huxley's second proposition namely, that all vital and intellectual functions are but the properties of the molecular disposition and changes of the material basis (protoplasm) of which the various animals and vegetables consist." * We have already had abundant evidence to show that Dr. Stirling's statements of his opponent's views are not to be trusted; and it will probably turn out that this statement is no ex-

* "As Regards Protoplasm," p. 38.

ception to the general rule. In the part of his essay which is being criticised at present, Professor Huxley is arguing against the existence of a *vital principle* or *vitality*. These terms, however, are employed in different meanings by different authors, so that, in order fully to comprehend the view which Professor Huxley is opposing, it is necessary to give a slight historical sketch of their genesis. We enter upon such a narrative with great diffidence, knowing how very much more competent the translator of that admirable work, Schwegler's "History of Philosophy," is to the task than we are; nevertheless a slight outline of the genesis of the conception of vitality is necessary in the interests of the general reader, and we will not shrink from it, even if we lay ourselves open to the retort of being a "conceited school-boy," an epithet which Dr. Stirling had already applied to a worthier man —the late Mr. Buckle.

The ancient philosophers held that there were two original principles in the universe—the one was matter, and the other an immaterial principle. The former was the substratum from which everything was made; it was formless, passive, and *received* the forms of things; the latter was the universal energy, the efficient, the moving power which *impressed* the forms of things upon matter. The term *nature* (φύσις) was sometimes used in a general sense to include the passive matter and the immaterial principle by which matter was impressed; but it was used by Hippocrates and his immediate predecessors to designate the spiritual essence

which was supposed to be diffused throughout the universe. In medicine, however, *nature* came to have a more technical meaning. The physician must constantly keep before his mind the correlative couple—health and disease. The former condition, because desirable, was regarded as according to, the latter, because undesirable, as contrary to nature, the term being used here in its general sense, with the addition that it was also the principle of order. The next step was that nature came to be regarded as an immaterial force which tended to maintain the body in health, and to correct its derangements when diseased. It will be noticed that the word "Nature" was employed by those who approached the phenomena of the universe mainly from the objective point of view; but another term was brought into use in this reference by those who viewed all phenomena from the subjective point of view. Originally the word ψυχή meant breath, and this was supposed to leave the body through the mouth at death, and to go to the place of the invisible (Ἀιδης). This term (ψυχή) afterwards came to mean the principle of life, as distinguished from the decaying body; and finally, the immaterial and immortal part of man. Plato—the idealist—saw movement and order everywhere, and assumed the existence of a universal soul which animated the universe, and of which the individual soul was an emanation. Aristotle, on the other hand, although employing the terms of his predecessor, approached the subject from a different standpoint. His close study of animated nature enabled him to

come to very wide generalizations. He noticed that both plants and animals were at one, inasmuch as both were possessed of life; but in addition to the faculties which are common to plants and animals, the latter possessed *sensibility;* and in addition to the faculties which are common to the lower animals and man, the latter also possessed *rationality.* These generalizations were the result of extensive observation and deep reflection, and, once formed, they must be brought into unison with the rest of his philosophy. He assumed the existence of three souls corresponding to these three distinctions. The vegetative soul existed in plants; animals possessed a vegetative and a sensitive soul; and man possessed a vegetative, sensitive, and rational soul. Aristotle's vegetative soul, therefore, corresponded in the main to the restricted sense of "nature" as employed by Hippocrates. Passing over the animal soul and natural faculties of Galen, and also the Archæus of Paracelsus and Van Helmont, we may come down at once to Descartes.

No one can doubt that living beings are to some extent at least subject to material laws; hence physical science is a necessary preliminary to the study of vital laws. On the other hand, the phenomena of voluntary motion and sensation in animals must have led biologists in all ages to take cognizance of mental science, even if they did not, as they do now, claim objective psychology as their province; and their contact with mental science would necessarily bring them face to face with the deeper problems of philosophy. The form which the bi-

ology of any age assumes will, therefore, be mainly determined by two factors—the one the state of the physical science, and the other that of the philosophy of the period. About the beginning of the seventeenth century, Bacon directed attention anew to the observation of nature by the method of experience; and it was about the same time that natural science may be said to have come into existence. The discovery of new processes in mathematics and geometry by Napier, Kepler, Cavalieri, and Descartes; of the law of virtual velocities in statics, and of accelerated and retarded motion in dynamics, by Galileo; of the planetary motions by Kepler; and the speculations of Descartes in celestial mechanics, combined to give an immense impulse to the development of physical science. These brilliant results produced an entire revolution in man's conceptions of the universe, and, as might have been expected, powerfully influenced the science of life. When about this time the circulation was discovered by Harvey, the union between physiology and physical science was rendered more definite and intimate. This discovery showed that the circulation could in great part be explained upon physical principles; and when this inference was generalized so as to include the other functions of the body, the belief arose that the body was a mere machine, and that its functions could be explained by mathematical and hydraulic laws. Thus arose the iatro-mathematical school of medicine, an art which even to the present day has maintained a close association with the

science of life, inasmuch as this science must always be one of its principal bases. The philosophy of Descartes readily lent itself to this mechanical view of life on the one hand, and to the doctrine of an immaterial principle on the other. But Professor Huxley has, in his beautiful essay on "Descartes' Discourse," so clearly traced the relation in which his philosophy stands to modern physiology, that I shall only glance at it here. The philosophy of Descartes was a dualism, without any inherent unity. He drew a sharp distinction between mind and matter, and regarded them as mutually exclusive principles, so that the great problem of philosophy was to show how two such heterogeneous principles could act on each other. The physiology of Descartes is thoroughgoing in its materialism. He regards the body as a completed machine, which acts and performs all the animal functions like a clock or automaton. The lower animals do not, in his opinion, possess thought and self-consciousness, and are therefore mere automata; but in man there is the indwelling thought which is the essence of spirit. But thought has no extension, and consequently mind can only come in contact with body at a single point; and as the pineal gland is the only single part of the brain, it was selected as its seat. But the question of how the one could act upon the other was still undetermined; and to solve the difficulty Descartes had recourse to the Divine assistance. The dualism of Descartes gave origin to two schools of philosophic thought—a one-sided *idealism* on the one hand, and an equally one-sided

realism on the other. The realism or sensualism of Descartes flowed on through the empiricism of Locke, who carried the Baconian principles into the domain of mind, founded the English school of psychology, and may be regarded as the father of modern materialism and empiricism. Locke held the opinion that all our knowledge springs from experience, and admitted two sources of knowledge —sensation and reflection. He brushed aside, as useless and unfruitful, all questions respecting essences and substances. Berkeley carried out the principles of Locke, and denied the existence of matter; while Hume on the same principles rejected mind also. The influence of this branch of philosophy upon medical doctrines may be traced principally through Cullen and Brown. The empiricism of Locke was carried in France to its extreme consequences in the sensualism of Condillac and the materialism of La Mettrie, the latter of whom gave the significant title of "L'Homme Machine" to one of his works. The influence of this branch may be traced into physiology through Hartley, Darwin, and Priestley. The philosophy of Locke also allied itself readily with the theories of the iatro-mathematical and iatro-chemical school of physicians. We find Boerhaave, for instance, rejecting all inquiries into *primary physical* and *metaphysical causes*; meaning by the former *transcendental*, and by the latter *final* causes;* and this view was adopted by his pupil Haller. The influence

* See "Institutes," section 28, Comment.

of these physiologists may be traced into modern doctrines, in this country at least, through Cullen and Brown.

Let us now turn for a moment to the idealistic branch of the Cartesian philosophy. We have already seen that Descartes, in order to explain how two such heterogeneous powers as he conceived mind and matter to be, could yet act upon each other, had recourse to the Divine assistance. This conception was further developed by De la Forge and Geulinx into the theory of occasional causes. Malebranche believed that the soul sees and knows all things in God; and Spinoza carried the doctrine to its logical consequences when he inferred that the finite is a mere accident, and that there is only one true being—God. From this position Leibnitz endeavoured to rescue philosophy by his theory of monads, to which he affiliated the well-known hypothesis of pre-established harmony. We have given this rapid and very imperfect sketch of the idealistic branch of the Cartesian philosophy because of the influence which it exercised upon physiological doctrines. We shall now for a moment attend to the prevailing theories of life as influenced by idealism. Stahl assumed a single immaterial essence as principle of life, which he called *anima*, and which corresponds to a great extent to the vegetative soul of Aristotle. He attributed all the functions of life to the *anima*, and indeed, according to him, it bestowed life upon the body. He also regarded the action of the mind upon the body as direct and immediate, and did not trouble himself

to supply any mechanism by which the former could be conceived as acting upon the latter. According to Hoffmann, "Man consists of an intelligent and freely-acting substance—mind, united with an organic most skilfully constructed living body."* If the mind is only united with the body, the former cannot confer life upon the latter; hence organization and life are independent of the soul. How then does the soul act upon the body? Descartes had recourse to the animal spirits of the ancients as a medium between soul and body in his physiology; but the mechanism supplied by Hoffmann was of a much more refined character. He still retained the soul, called by him the *rational soul*, on one hand; and the animal spirits, named *nervous fluid*, on the other, as the two terms of the antithesis. Between these he interposed a third substance—the *sensitive soul*, which he conceived to be of a nature intermediate between mind and matter. By this assumption, Hoffmann not only supposed that he could bridge the gulf which separated mind from matter; but he was also enabled to allow the existence of mind in the lower animals, and not to regard them, like Descartes, as simple automata. The nature of the sentient principle Hoffmann could not precisely determine; its investigation belonged to a higher species of metaphysics than medical inquiry could reach.†

Towards the latter half of the eighteenth century, there were on all sides manifest indications

* "Opera Omnia," vol. i. p. 26. † *Ibid.*, p. 96.

that the Cartesian philosophy was tending to dissolution. The materialistic branch ended in this country in the nihilism of Hume, and in France in the materialism of La Mettrie; while the idealistic branch terminated in the German illumination. And when the two branches into which the Cartesian philosophy had divided were again united by Kant, what was the result? In the second book of the "Transcendental Dialectic" Kant completely subverted the traditional psychology founded upon the doctrine of the soul as a thinking substance. He showed that substances (noumena) are beyond the limits of our knowledge, and directed attention to the practical field of phenomena.* "Thus," he says, "if materialism is inadequate to the explanation of my existence, so is spiritualism likewise insufficient; and the conclusion is, that we can know nothing respecting the constitution of the soul, in so far as relates to the possibility of its separate existence." The doctrine of the soul as a thinking substance could now no longer be placed at the foundation of the theory of life.

But the change which took place at this time in physical science was no less complete than that of philosophy. The grand generalization by which Newton identified the force by which an unsupported body falls to the ground with the central force of the sun, and the result to which it led in celestial mechanics, combined to give an undue authority to

* "Kant's Kritik der Reinen Vernunft," von G. Hartenstein, s. 272, *et seq.*

† *Ibid.*, s. 285.

his other opinions. Newton could not conceive the sun as acting upon the planets without some material connection; and he therefore endeavoured to supply a medium by which he supposed the influence to pass from the one to the other. He also supposed that luminous bodies emit infinitely small particles in straight lines, which, by penetrating the transparent parts of the eye and falling upon the nervous tissue, produce vision. When this doctrine was accepted, it gave origin to the idea that the physical forces—light, heat, and electricity—were material substances, but without weight: hence they were called the imponderable bodies. And when the philosophy of Kant had driven the physiologists, who were influenced by the Cartesian idealism, from the doctrine of the soul as a basis of a theory of life, they took refuge in a *vital principle* or a vital force, similar to, but distinct from, the physical forces. By some, the vital force was conceived as a subtle fluid similar to heat; by others, as an immaterial substance analogous to mind; but both regarded it as a distinct entity, which was superadded to ordinary, in order to constitute living matter. In this manner we can trace the transition from the *Nature* of Hippocrates, the *Vegetative Soul* of Aristotle, the *Natural Faculties* of Galen, the *Archæus* of Paracelsus and Van Helmont, to the *Anima* of Stahl and the *Sensitive Soul* of Hoffmann, and then to the *Vital Principle* of Barthez and Whytt, the *Nisus formativus* of Blumenbach, and the *Vital Force* and *Vitality* of some modern physiologists.

The whole historical genesis of the conception of

a vital force or vitality, therefore, shows that some at least of those who employ these terms have been of opinion that there is an entity which enters into, and takes possession of the matter of which living beings are composed; that this entity, indeed, bestows life, and that it can conceivably exist apart from matter.* It is perfectly evident that Professor Huxley is arguing against this conception. After noticing the great difference which exists between water at 32° Fahrenheit, and those of its component gases, he says: "We do not assume that a something called 'aquosity' entered into and took possession of the oxide of hydrogen as soon as it was formed," &c. † The whole of this illustration would be quite meaningless unless he were of opinion that some physiologists hold the view that a something called "vitality" enters into and takes possession of albuminoid matter at the moment it becomes living.

But although the historical development of the

* The language of one of the most disinguished physiologists of the present day, M. Claude Bernard, is very emphatic with regard to this point. "La méthode expérimentale à laquelle toutes les sciences sont redevables de leurs progrès actuels a rendu les plus éminents services à la physiologie. C'est elle qui nous apprend à ne considérer chez les animaux que les propriétés de la matière vivante, au lieu de les rapporter à l'action mystérieuse d'une force située en dehors de l'organisme, régissant tous ses actes et prenant le nom, dans le langage des anciens, *d'âme physiologique* ou de *force vitale*." ("Leçons de Pathologie Expérimentale," par M. Claude Bernard, p. 125.) Bernard does not even deign to refute the idea of a vital force; he simply alludes to it as a conception which has played a part in the history of the science of life; and which, in his opinion, every one now regards as antiquated, and thoroughly at variance with the results of modern experimental physiology.

† "Lay Sermons, Addresses, and Reviews," p. 150.

conception of "vitality" abundantly proves that some writers do employ the term in this sense, it is very difficult to convict any particular writer of having used it with such a signification. One, who does not wish to own to having used "vitality" in the sense already indicated, has a convenient way of escape, by passing from the abstract to the concrete mode of expression. Accuse him of having employed the word "vitality" to indicate an entity which confers life upon certain forms of matter, and he may say that he has merely employed it as an abstract expression for the living properties themselves. Tell him that he uses the word to indicate a power which is the cause of vital functions, and he may say that he merely uses it as an abstract statement of the fact that certain combinations of matter manifest vital functions. Between such and Professor Huxley there probably would be no fundamental difference; and certainly the argument of the latter against "vitality" would be irrelevant if directed against this meaning of the word. If any one, however, does use the word in this sense, he ought to be particularly careful to guard it, by the frequent use of the concrete mode of expression, lest both he and his readers be betrayed unconsciously into the first meaning. If we now turn to the phrase "vital force," it is equally equivocal in meaning. One who employs it may deny that he means to maintain that there is a distinct entity corresponding to it, and say that he simply employs it as a generic expression denoting the cause or causes of life; in the same manner as a geologist

might conveniently speak of "volcanic force" without thereby implying that it was a simple and unanalyzable power, and least of all that it was a special entity. In this sense "vital force" may merely be used as an abstract expression for an unknown collocation of physical forces; and the one who employs it may declare himself ready to abandon its use whenever the particular collocation of the forces which is the cause of the living functions is determined. Barthez, for instance, was quite cognizant that his "vital principle" might be a mere *mode* of the living body; although he inclined to the belief that it was a *substance.* Indeed the "vital principle" of Barthez, and the "vitality" of some other physiologists, may with the utmost propriety be described in the language used by Boerhaave when commenting upon the "Archæus" of Paracelsus and Van Helmont, as a substance, "quod nec mens esset cogitans, neque corpus crassum atque vulgare, sed aliquid medium, quod omnes functiones corporis sani dirigat,"—a third substance having a separate existence, and which bestows life on being superadded to certain combinations of matter. We hope the reader will pardon this somewhat lengthened digression. This historical outline was necessary in order to show that the word "vitality" and its cognates have been employed to denote a supposed entity which exists independently of matter, and that this is the sense in which Professor Huxley condemns those expressions. This was all the more necessary since these words may be used in other meanings, which

may be defended with plausibility. It is also right to state that Dr. Stirling confines himself to a criticism of Professor Huxley, without committing himself to the idea that "vitality" exists as a separate substance. To judge, indeed, from some of his writings, he does not concur in this idea. "For his part, indeed," he says, "Hegel is peculiarly opposed to the assumption of occult forces,"* and it is to be presumed that he himself is equally opposed to such assumptions. There are also indications that this is the case in the pamphlet before us; but it is not with Dr. Stirling's own opinions that we are here concerned but with his criticism of Professor Huxley; and we shall now proceed with its examination.

Professor Huxley does not pretend to enter upon an exhaustive treatment of this part of his subject. His essay was in the first instance delivered as a lecture to a popular audience, and to enter upon a full discussion of a topic so abstruse would be to court complete failure. He knew his work too well to commit that mistake. Instead, therefore, of offering systematic proof of his position, he simply, by one artistic stroke, places before his audience a bold figure which serves at one and the same time as an illustration of his meaning, and as an argument against the doctrine he is opposing. It is evident, indeed, that for his purpose the illustration is even of more consequence than the argument;

* "Schwegler's History of Philosophy," translated by J. H. Stirling, M.D., p. 459.

since, unless he succeeded in striking home to his audience the nature of the doctrine he is combating, the whole of this part of his lecture would be valueless for his purpose. We shall accept Dr. Stirling's statement of Professor Huxley's argument against "vitality." "This argument," he says, "is the simple chemical analogy that under stimulus of an electric spark, hydrogen and oxygen uniting into an equivalent weight of water, and, under stimulus of pre-existing protoplasm, carbon, hydrogen, oxygen, and nitrogen uniting into an equivalent weight of protoplasm, there is the same warrant for attributing the properties of the consequent to the properties of the antecedents in the latter case as in the former."* Dr. Stirling then notices the inconclusive nature of an argument from analogy and proceeds:—"The analogy to which Mr. Huxley trusts has two references: one to chemical composition, and one to a certain stimulus that determines it. As regards chemical composition, we are asked, by virtue of the analogy obtaining, to identify, as equally simple instances of it, protoplasm here, and water there; and, as regards the stimulus in question, we are asked to admit the action of the electric spark in the one case to be quite analogous to the action of pre-existing protoplasm in the other. In both references I shall endeavour to point out that the analogy fails; or, as we may say it also, that, even to Mr. Huxley, it can only seem to succeed by discounting the

* "As Regards Protoplasm," p. 38.

elements of difference which still subsist."* The kernel of the whole question lies in the last sentence. If Dr. Stirling can show that the analogy "can only seem to succeed by discounting the elements of difference that still subsist" between the two terms of the comparison—water and protoplasm—then Professor Huxley's argument is met. If, on the contrary, it can be shown that, notwithstanding the multifarious differences between water and protoplasm, Professor Huxley's argument rests upon the points in which the two agree, and not upon the disagreements,—upon the identity and not upon the non-identity of our knowledge of them, the argument has all the validity which any argument can possess.

Dr. Stirling in the first place examines the terms of the analogy separately, in order to show in what respects they differ, and having shown that wide differences exist, he concludes that we cannot safely infer from the one to the other. He admits that water and protoplasm are pretty well on a par so far as their properties depend upon chemical and physical structure; but he then shows that protoplasm has properties in excess, and that so far the analogy fails. The differences between water and protoplasm are, according to Dr. Stirling; (1) organization and life, (2) the objective idea—design, and (3) the subjective idea—thought. Now we totally object to the introduction of the subjective idea in this connection. Thought is not common

* *Ibid.*, p. 39.

to all forms of life. It is not a possession of any vegetable, nor indeed, for that matter, of most animals; and therefore it cannot be essential to life. The essential properties of life may, indeed, be found amongst those which are common to the functions of the lowest living beings, and to the highest operations of the intellect; but thought, as such, is not common to all living beings; hence it has no right to be obtruded into this comparison. But Dr. Stirling may reply that it was not he, but Professor Huxley who first thrust thought into the analogy. After noticing that all vital action "may be said to be the result of the molecular forces of the protoplasm which displays it," Professor Huxley proceeds: "And if so, it must be true, in the same sense and to the same extent, that the thoughts to which I am now giving utterance, and your thoughts regarding them, are the *expression* of molecular changes in that matter of life which is the source of our other vital phenomena."* Professor Huxley is not so absurd as to affirm that thought and molecular changes are identical; but he does affirm, and we do not think that even Dr. Stirling will deny, that every thought has for its concomitant molecular changes in the organized matter of life which constitutes the brain. It is probable that Professor Huxley would even go further (and in this particular Dr. Stirling would not follow him) and say that molecular changes in the brain are the *cause* of thought; inasmuch as we possess strict

* "Lay Sermons, Addresses, and Reviews," p. 152.

experimental evidence to prove that the former are invariable antecedents and the latter invariable consequents. But whatever may be the opinion upon this point is of little consequence for our present argument, the great point we have to attend to is that Professor Huxley is alluding to the science of mind in its objective aspect, and merely refers incidentally to the correlative subjective phenomena; and therefore our study must be confined in the mean time to the matter of life and to its statical and dynamical phenomena.

The subjective idea having now been got rid of, as something quite irrelevant to the comparison, we now turn to the objective idea—design.

But surely the objective idea can be traced in the form assumed by water at 32° Fahrenheit. Suppose, for instance, that water, on passing to the solid condition, contracted so as to become specifically heavier than water in the liquid state, the whole face of this globe would be so changed that it is very doubtful whether any living being, sufficiently advanced in intelligence to recognize an idea, could exist. Not only do we recognize the objective idea in the adaptability of living beings to their environment, but the same idea can be equally traced in the adaptability of the environment to living beings. Indeed, Dr. Stirling himself admits "that an idea may be found in inorganic matter, as in the solar and sidereal systems generally."* He will surely, therefore, not deny that the objective

* "As Regards Protoplasm," p. 43.

idea can be recognized in the solid, fluid, and gaseous forms of water; and if so, it is not a possession in excess on the part of protoplasm. Indeed, he appears to have been conscious that this argument could be turned against him; hence he endeavours to meet objections to it in advance. He thinks that the idea in organic matter is operative from within, and in inorganic from without. "The units that form the complement of an inorganic system," he says, "are but independently and externally in place, like units in a procession; but in what is organized there is no individual that is not sublated into the unity of the single life. This is even so in protoplasm."* How Dr. Stirling can prove that the idea acts from without in inorganic matter is more than we can understand; and it is perfectly certain that in the essay before us he does not attempt to prove it. He ought at least to have acknowledged that Professor Huxley, and those who believe in the doctrine of evolution, have a very different conception of the universe. To prove this, we will not quote the words of Professor Huxley, but those of an eminent theologian:—"The most remarkable analogy between nature and revelation," says the Rev. John Hunt, "is that of gradual evolution. Butler has dwelt on it with all the intenseness natural to his profound and far-seeing intellect. But the conception of the gradual process in nature is cleared and quickened by the most recent discoveries. It used to be sup-

* "As Regards Protoplasm," p. 43.

posed that God created the world instantaneously by an extraordinary miracle. But all evidence now tends to show that the origin of creation was miraculous only in the same sense in which its daily preservation is miraculous. God, working after the manner of nature, framed the things that are seen out of things that are not seen. *They were evolved from within, and not from without.*" * But not only do evolutionists, like Professor Huxley, regard the active forces of matter as being operative from within, but they also believe that, in every system which consists of equilibrated parts moving round a common centre, such for instance as the planetary system, there is no individual that is not sublated into the unity of the system. Suppose, for instance, that the orbit of a single planet is changed, this will alter the orbits of every other, in order that a new adjustment may be produced; and even the centre of gravity of the system must be changed, so as to accommodate itself to the new deviation. In short, it is as true of such a system as of living beings, that each unit acts upon the whole, while the whole reacts upon each unit. And if we suppose a drop of water at what is called complete rest, let but a single molecule be moved, and this will necessitate a readjustment of all the others; so that, even in such a simple case, each unit is sublated into the unity of the whole. And when the molecules of this drop of water arrange themselves at a certain temperature into the structure called *ice*, do

* *Contemporary Review*, November, 1873, p. 919.

we not see the organized concert of many to a single purpose? This organized concert is what, in Dr. Stirling's opinion, constitutes design, and is therefore the objective idea; and we must say that any one is blind who cannot trace such an idea in inorganic matter. Either, therefore, the idea is present in the forms of water as well as in protoplasm, or it is absent in both; but on either supposition, design is not a possession in excess on the part of protoplasm. We see, therefore, that both the subjective and objective idea have no right to be thrust into the comparison which Professor Huxley draws between water and protoplasm. Let us now examine how far Dr. Stirling is justified in obtruding organization.

We think it was in his address before the British Association at Liverpool that Professor Huxley declared his opinion that life precedes organization, an opinion he said which was constantly inculcated by Hunter. And if life precedes organization, the latter cannot be essential to life. In fact, creatures like the Protamœbæ of Hacckel possess no recognizable organization, even when examined by the highest powers of the microscope. And as Hacckel himself remarks, if such creatures are to be called organisms, they are organisms without organs. There is no differentiation into parts, and consequently no physiological division of labour. In truth, organization does not bestow life, but it renders different *degrees* of life possible. Organization means differentiation into parts, and the greater the differentiation, the more varied will be the

functions performed, and the higher the grade of life. But the *essential* properties of life are independent of degree, and they ought to be recognized in the lowest as well as the highest living beings. Hence, in making a comparison between inorganic matter and living beings, common sense as well as sound logic dictates that we should employ the most complicated and highest forms of the former, on the one hand, and the least complicated and lowest forms of the latter, on the other. Professor Huxley, therefore, could have found a much better illustration of the inorganic kingdom than water, had his object been to form an elaborate argument to an instructed audience. He could instance how chemists form the higher organic by successive combinations upon the lower inorganic compounds, and how, as they increase in complication, they become colloid instead of crystalloid, and possess many of the physical properties of the lower forms of living beings. Such an argument was not only possible, but it has actually been elaborated by Mr. Herbert Spencer and by Haeckel. Had Professor Huxley, however, endeavoured to place such a complicated argument before his audience, we are confident that he would never again have been asked to deliver a similar lecture. But although he, hampered as he was by the endeavour to render his argument intelligible to an audience only partially instructed, did not thus strengthen his analogy on the side of dead matter, this affords no reason why Dr. Stirling, who, in his criticism, had only to make himself intelligible to those who have had a comparatively

high mental training, should endeavour to mar the analogy from the side of living matter by selecting high forms of life possessed of organization and intelligence, instead of the lowest forms, where these elements are absent. It is not denied that there is a wide gulf between dead matter and the lower forms of life; but if the differences between dead and living matter are to be bridged, it must be across this gulf, which, wide as it is, is immeasurably smaller than that between dead matter and the living forms which have a fully-developed consciousness and a complicated organization. We ought to pass from the highest forms of dead matter to the lowest forms of life, and from the lowest forms of life, through all the intermediate grades, to the highest forms and the highest functions, such as the operations of the intellect. Of the differences which Dr. Stirling conceives to exist between dead and living matter, all have been eliminated, except the essential properties of life as exhibited by the lowest forms of living beings. But he maintains that life itself is a possession in excess on the part of protoplasm. If, by possession in excess, he means an entity added to the matter of protoplasm, he is begging the question, since Professor Huxley's argument purports to show that there is no reason to believe that such an entity exists. But we are not in a position to estimate the value of this argument until his mode of dealing with the other term of the analogy, namely, water, has been examined.

It has been seen that, when Dr. Stirling was

dealing with the living side, he endeavoured to thrust into the comparison elements which had no right there; and it will now be noticed that he subtracts from the dead side elements which ought to be present. Dr. Stirling's conception of dead matter is very different from that of modern scientific men. "A drop of water," he says, "once formed, is there passive for ever, susceptible to influence, but indifferent to influence, and what influence reaches it is wholly from without."* And a little further on he speaks of "molecules in their blind passivity, and dead, dull insensibility."† A drop of water, once formed, is there passive for ever! How is it passive? Is it so under all circumstances, or only under very peculiar circumstances? It is not passive when it forms in a cloud, since it falls to the ground. Dr. Stirling may say that it falls because the earth attracts it, and this is influence from without. In that case, however, activity cannot be denied to the earth; and few will now doubt that the rain-drop has been proportionately active in reacting upon the earth: hence neither the one nor the other is passive. In fact, water never is passive, except when its internal forces are completely balanced by external forces. In another place Dr. Stirling says that "matter itself shall be but counterbalanced motion";‡ and if it is possible to regard matter in this light, what is the meaning of saying that a drop of water, once formed, is

* "As Regards Protoplasm," p. 41.
† *Ibid.*, p. 44. ‡ *Ibid.*, p. 69.

"there passive for ever"? In the first place, a drop of water gravitates till its weight is opposed by a resisting surface. It then flows laterally unless checked by some force, usually the resistance afforded by the sides of a vessel. And even when placed in a vessel, it would not remain an instant at rest, unless its internal forces were opposed by other forces acting from above. This is rendered manifest if a little water is placed under the bell-jar of an air-pump. When a partial vacuum is formed, instead of remaining passive it begins to boil, part is converted into vapour and part into ice. Nothing has been done to the water, except removing from it forces which were opposing the free action of its internal forces, and see what is the result! But it is now known that even when a drop of water is at what is popularly regarded as complete rest, it is only apparently, not really passive. Its molecules are constantly undergoing those vibrations which constitute temperature; and even if it be regarded as passive when it receives vibrations of larger amplitude from the environment, it must be regarded as active when it communicates vibrations of larger amplitude to the environment. But modern scientific men believe that a drop of water at what is regarded rest is the subject of still more wonderful intestine movements. "The physical theory of this process [*electrolysis*]," says Professor Clerk-Maxwell, "has been studied by Clausius, who has given reasons for asserting that in ordinary water the molecules are not only moving, but every now and then striking each other with such violence that the

oxygen and hydrogen of the molecules part company and dance about through the crowd, seeking partners which have become dissociated in the same way. In ordinary water these changes produce, on the whole, no observable effect; but no sooner does the electro-motive force begin to act than it exerts its guiding influence on the unattached molecules, and bends the course of each towards its proper electrode, till the moment when, meeting with an unappropriated molecule of an opposite kind, it enters again into a more or less permanent union with it, till it is again dissociated by another shock. Electrolysis, therefore, is a kind of diffusion assisted by electro-motive force."* This, then, is the conception which modern scientific men form of the activities of a drop of water, and whether true or not, it is essentially different from Dr. Stirling's conception of them. It is not surprising, therefore, that this gentleman should have penned criticisms upon Professor Huxley's assertions, which, although they may be valid from his own standpoint, are yet perfectly irrelevant from the standpoint of the latter. Professor Huxley says: "We think fit to call different kinds of matter carbon, oxygen, hydrogen, and nitrogen, and to speak of the various powers and activities of these substances as the properties of the matter of which they are composed."† In reply, Dr. Stirling notices that both water, steam, and ice are composed of oxygen and hydrogen, and that the properties of all are to

* *Nature*, September 25th, 1873, p. 439.

† "Lay Sermons, Addresses, and Reviews," p. 149.

a certain extent due to the properties of the elements; but the properties of the latter will not explain the differences: hence we are driven, by the necessity of the facts, to the addition of heat. He then adds: "It is precisely so with protoplasm."* But both water, and the elements of which it is composed, cannot for a moment be thought of apart from a certain temperature; and when we speak of the powers and activities of hydrogen and oxygen, the molecular agitation which is the physical basis of their temperature is included. When, therefore, we speak of the powers and activities of water and call these its properties, we are not only contemplating the bare matter, but its affections also, heat being amongst the number.

Having separately considered the two terms of the analogy, and found that Dr. Stirling endeavours, in the case of living matter, to add unnecessary elements to the conception, and in the case of dead matter to subtract necessary elements from it, we shall now proceed to consider the comparison itself.

We have seen that Dr. Stirling regards water as passive, and living matter as active; and he therefore concludes that we cannot infer from the one to the other. The great error he commits is that he brings into prominence that condition of matter in which its molecules are in *stable equilibrium*, as water at rest, with a condition of matter in which the essential feature is that its molecules are in *unstable equilibrium*, as in living protoplasm per-

* "As Regards Protoplasm," p. 42.

forming active functions. But living protoplasm is not always performing active functions. Some of the protozoa become encysted, and pass into the "still" condition before multiplication; and, in this condition, they may retain life for long periods without change, except under favouring external circumstances; unless, indeed, external forces overthrow the equilibrium at which their molecules have arrived. And the initial stage of some at least of the higher organisms—the germ, the seed, the egg—may be kept for long periods alive without undergoing change; so much so, that seeds dug out of the Catacombs of Egypt, which must have been buried above 2,000 years ago, have been found to germinate when the equilibrium of their molecules has been overthrown by the action of external influences, such as warmth, light, and moisture. Indeed such a seed shows a much greater passivity than is manifested by any drop of water ever formed. This shows that Dr. Stirling has endeavoured to make the gulf between dead and living matter much wider than it is, even when water is taken as the type of the former; and this gulf is still further diminished if we take one of the more complicated products which have been formed in the chemist's laboratory as the type of dead matter. Let us now see how Professor Huxley passes from the one term to the other of the analogy. The main point we have to attend to is, whether or not he makes the points in which the one term agrees with the other the foundation of his inference.

We shall not follow the successive steps of his argument, but shall content ourselves with noticing just so much of it as will bring out the logical principle upon which he proceeds. When under the stimulus of an electric spark, hydrogen and oxygen disappear, and an equivalent weight of water takes their place, we do not assume that a new entity, "aquosity," enters into and takes possession of the latter as soon as formed; but we call its active and passive powers its properties, and believe that these were potentially present in the elements. The case is in no way different when under the stimulus of pre-existing protoplasm, carbonic acid, water, and ammonia disappear, and an equivalent weight of the matter of life makes its appearance. The active and passive powers of this matter are as truly its properties as those of water were found to be; and if we did not assume that an entity, "aquosity," entered into and took possession of water at the time of its formation, we have no right to assume that an entity, "vitality," enters into and takes possession of the matter of life at the time of its formation.* The true principle of this argument will be best elicited by urging objections, which not only might be, but which have been, advanced against it, and which Professor Huxley meets indirectly without openly stating them. It has been said that the phenomena of life cannot be regarded as the properties of the matter exhibiting them, because they are *inexplicable* on

* See "Lay Sermons, Addresses, and Reviews," p. 149, *et seq.*

this assumption. They are indeed so singular and exceptional that we must assume the existence of a *special* entity to account for them. Professor Huxley anticipates this reasoning, and points to the fact that the properties of water have also proved inexplicable; and if the argument of his opponents from the *inexplicability* of the properties is valid in the one case, it must be equally valid in the other; and we must also assume the existence of a special entity to account for the properties of water. "But," proceeds the objector, "before ordinary matter can combine into the peculiar condition in which it exhibits the phenomena of life, it requires the presence of pre-existing living matter; and surely this fact is so very exceptional and inexplicable as to require us to assume the existence of a *special* entity to account for it." The following is a paraphrase of what might be Professor Huxley's reply:—"The exceptional character of this phenomenon arises from the fact that it has not yet been explained; and if ever an explanation is forthcoming, it will cease to be exceptional. Therefore the foundation of your argument is that the action of pre-existing protoplasm in determining the combination of the matter of life has hitherto proved, and is likely for a long time to come to prove, inexplicable. But you appear to have forgotten that the action of the electric spark in determining the union of oxygen and hydrogen to form water is also inexplicable; and if the first inexplicability compels you to assume a *special* entity to account for the phenomena of

living matter, the second inexplicability should equally oblige you to make a similar assumption to account for the properties of water." The great objection which Dr. Stirling urges against this argumentation is that it is founded upon our ignorance. "No appeal to ignorance," he says, "in regard to something else, the electric spark, should be allowed to transform another ignorance, that of the action of pre-existing protoplasm, into knowledge, here into *the* knowledge that the two unknown things, because of non-knowledge, are perfectly analogous."* But it will not be difficult to show that it is not Professor Huxley's argument, but the one he is opposing, that is founded upon ignorance. He identifies our ignorance with regard to the mysterious power which underlies the phenomena of life with the mysterious power which underlies the phenomena of such ordinary matter as water. Is he justified in so doing? In the first place, those who contend for "vitality" appear to forget that there is any mystery connected with such ordinary events as the formation of water, and Professor Huxley directs their attention to this fact. He points out that common events are as mysterious in their essence as are so-called exceptional events. And further, when he identifies the mystery in the one case with that in the other, he has not ignorance, but the whole progress of knowledge on his side. At one time the motions of the planets were considered exceptional, and *special*

* "As Regards Protoplasm," p. 48.

entities were assumed to account for them; but when, during the progress of discovery, such motions were identified with such an ordinary motion as that described by a stone thrown by the hand, the *special entities* disappeared, but the *general mystery* remained. At one time, unusual storms, volcanoes, and earthquakes were regarded as inexplicable and exceptional events, and *special entities* were assumed to account for them; but these events are being rapidly assimilated in their causes to ordinary events. The *special entities* are disappearing, but the *general mystery* remains. These considerations, therefore, show that Professor Huxley is perfectly justified in identifying our ignorance of the formation of water with our ignorance of the formation of protoplasm. The identification of the two ignorances involves arguments derived from the historical development of human knowledge, and which are founded upon positive knowledge. Our not-knowledge of the formation of water is, of course, ignorance; and our not-knowledge of the formation of protoplasm is also ignorance; but the identification of the two kinds of not-knowledge is positive knowledge in a negative form. As Ueberweg says, "The sentence not-A is not-A, is only an application of the axiom of identity to a negative notion."* This is exactly the case when Professor Huxley identifies not-knowledge in the case of water with not-knowledge in the case of protoplasm. The individual notions are negative

* "System of Logic," p. 232.

and expressive of ignorance; but the identification of the two kinds of ignorance involves a piece of real and positive knowledge; and it is by a similar identification of ignorances that the *special entities* which were once supposed to pervade the universe have been merged into one general entity and one general mystery. If we now turn to the argument of those whom Professor Huxley is opposing, we shall find that it is positive only in form, while it really depends upon a sweeping universal negative proposition, and is therefore founded upon ignorance. The argument is, that since the phenomena of life are inexplicable, we must assume a special entity to account for them. We shall not at present insist upon the ridiculous conception of scientific explanation which any one must form who endeavours to explain phenomena by the assumption of a special entity. Explanation means the assimilation of the phenomena under consideration to better-known phenomena; but this is an attempt to explain the little-known by the less-known; the inexplicable by the incomprehensible. What we wish particularly to point out here is, that the existence of an entity, called "vitality," must ultimately rest upon the universal negative proposition that neither mind nor matter is adequate to produce the phenomena of life. It may be objected that this argument proves too much, and that, if admitted as valid in this case, it will lead to the extinction of both mind and matter, since their existence can be shown to rest upon the same basis. Following out this argument, our only warrant for

the existence of mind is the negative proposition that matter cannot think; and our warrant for the existence of matter, that mind is not adequate to produce the phenomena of the objective world. We admit the force of this argument, and if the logical canon—*entia non sunt multiplicanda præter necessitatem*—has force anywhere, its cogency must be admitted here; hence we are driven to merge all special forces into one general force, and to acknowledge that mind and matter are but the two faces of the one ultimate reality. What the nature of this one force may be is not now under consideration; but having once merged all special forces into it, we are necessarily driven to deny the existence of a special "vital force." And if any one contends that such a force must be assumed, his only warrant for the assumption is the universal negative proposition that the one force which underlies the universe, and of which the special forces are but modes, is not adequate to produce the phenomena of life. This argument, therefore, rests upon the rashest and blindest ignorance in the form of positive knowledge; while Professor Huxley's argument, as we have already seen, is positive knowledge in a negative form. What then becomes of Dr. Stirling's reiterated assertion that Professor Huxley's argument is founded upon ignorance? It has been abundantly proved that his argument is founded upon positive knowledge; while it is the one he is opposing that is founded upon ignorance. Dr. Stirling now proceeds, "for the sake of completeness," to criticise the Dar-

winian theory. It is not difficult to see why this theory should be very obnoxious to him. If he could, once for all, prove the erroneousness of the hypothesis that species were evolved by natural causes, this would very much assist him in upsetting the general doctrine of a *real* evolution, of which Mr. Darwin's theory but forms a part. This having been done, the way would be cleared; and it is probable, that afterwards our only refuge would be to take shelter under the *ideal* evolution of Hegel. It was to be expected, therefore, that Dr. Stirling would throw his whole strength into his criticism of this question, and at it is probable that he has done so, he has shown that his strength is weakness. We shall devote the next chapter to the examination of Dr. Stirling's objections to the Darwinian theory.

CHAPTER III.

THE DARWINIAN THEORY.

DR. STIRLING thinks that "Mr. Huxley would be very much assisted in his identification of differences, were but the theories of the molecularists on the one hand, and of Mr. Darwin on the other, once for all established." * With regard to the theory of the molecularists, all he says is, that it still awaits the proof. If by *proof* he means a rigid demonstration, like one of the propositions of Euclid, he is perfectly correct; but such a demonstration of this problem is not to be expected. All that can be expected towards the solution of such a problem, in the absence of inductive evidence, is a plausible hypothesis which will render the passage from dead to living matter perfectly conceivable, while no ascertained induction is contradicted, and no violent assumption made. Such a hypothesis has been advanced by Mr. Herbert Spencer in the appendix to the first volume of his "Principles of Biology"; and it is important to notice that while advocating this hypothesis he repudiates the ordinary doctrine of spontaneous generation. What

* "As Regards Protoplasm," p. 50.

can Dr. Stirling offer in opposition to this hypothesis? Nothing that possesses more validity than a universal negative proposition; such as, that it is impossible for ordinary matter to combine under any circumstances so as to give rise to living matter. By what means Dr. Stirling can measure the possibilities of matter under all circumstances we do not pretend to say; but until he declares his method and lays before us his calculations we may be permitted to doubt his ability to solve such a complicated problem. In short, the hypothesis that living matter was evolved by natural causes has some show of reason; while the opposite hypothesis, that it cannot be so evolved under any circumstances has no reliable foundation whatever. In truth, the fact that living matter cannot at the present time be evolved from not-living matter is no more a proof that it has not been so evolved in past time, and under very different telluric conditions, than the fact that we cannot in the present day breed a horse from an ass proves that these species have not been evolved by natural causes. In short, if Mr. Darwin has bridged over the difference between species, the difference between dead and living matter can be bridged by an extension of the same principles. This leads us now to the examination of Dr. Stirling's criticism of Mr. Darwin's hypothesis.

Dr. Stirling truly says, that Mr. Darwin's "theory, philosophically, or in ultimate analysis, is an attempt to prove that design, or the objective idea, especially in the organic world, is developed

in time by natural means."* The first objection he urges against the theory is that Mr. Darwin demands "infinite time"; and he thinks "that any fruitful application even of *infinite time* to the general problem of difference in the world is inconceivable."† And he then proceeds to prove that the existence of time, and space, and matter is as unaccountable as ever. In answer to these objections we must say that we had searched for a very considerable time in Mr. Darwin's works before meeting with the phrase "infinite time." But in the chapter of his "Origin of Species," on the imperfection of the geological record, he makes some remarks on the vast periods of time with which the contemplation of the superposition of the strata impresses us. He speaks of "incomprehensibly vast periods of time" and equivalent phrases; and he then says that the consideration of such facts impresses his "mind in the same manner as does the vain endeavour to grapple with the idea of eternity."‡ None of these expressions, however, imply infinite time. But he does use the word "infinite" in this reference. He has just advanced various considerations to show "that it is not improbable that a longer period than 300 million years has elapsed since the latter part of the secondary period."§ He then exclaims, "what an *infinite* number of generations, which the mind cannot grasp, must have succeeded each other in

* "As Regards Protoplasm," p. 51. † *Ibid.*, p. 52.
‡ "The Origin of Species," p. 285. § *Ibid.*, p. 287.

the long roll of years!"* Dr. Stirling himself will not maintain that "infinite" here is used in any sense except as a hyperbolical expression for a vast number. However vast a period 300 millions of years may be, it is yet far short of "infinite time"; and since Mr. Darwin was dealing with such finite periods when he spoke of an "infinite number of generations," he could not consistently with common sense, have used the word "infinite" in its strict and definite meaning. We will not deny that Mr. Darwin may have used the phrase "infinite time" in other parts of his writings, though we have failed to find it; but we are perfectly certain, if he does employ it, that he means merely an *indefinite period*. When one endeavours to grasp millions upon millions of years, the time, when compared with the span of human life, becomes *practically* infinite; and it is in this *practical* sense that Mr. Darwin must employ "infinite time," if he uses the phrase at all. But there is another important point in this connection which Dr. Stirling appears to have overlooked. It is not Mr. Darwin alone who demands a vast period of time. Geologists find it impossible to interpret the phenomena of their science, even those phenomena which are quite unconnected with the history of life upon the globe, without making a similar assumption. If, therefore, the great antiquity of the globe can be proved from the superposition of strata, and from denudations quite independently of palæontological

* "The Origin of Species," p. 288.

considerations, Mr. Darwin can obtain all the time required for his theory as a datum from the geologist; and he has not, therefore, to make any special assumptions respecting it himself. And, indeed, the considerations advanced by Mr. Darwin to show the vast antiquity of our globe are purely geological, a fact which shows that he proves the assumptions of his theory from facts which are quite independent of it. Mr. Darwin's problem was to account for the fact that plants and animals exist in the groups termed species, groups which are pretty distinctly definable from each other, instead of existing in a graduated series. The fact that species actually were, or were supposed to be, so distinctly marked off from each other, led to the opinion being entertained that it was impossible they could ever have been produced by natural causes; hence the formation of each species was referred to a distinct creative act. The great service which he has done to biology consists in his having introduced a fertile principle which has shown that the differentiations of living beings into the comparatively stable groups termed species can be accounted for by natural causes; hence there is no necessity for assuming a distinct creative act in the case of each species. Such, then, being the nature of Mr. Darwin's problem, he is not bound to trouble himself with the question of an absolute beginning any more than a geologist while interpreting the phenomena presented by the crust of the globe; or a chemist when explaining how it is that the coal which burns in our grates gives out heat. Accord-

ingly he does not trouble himself with this problem. He not only takes the existence of matter and motion, time and space, for granted; but he even assumes a few germs without the slightest endeavour to explain how those germs came into existence. But because he does not solve all the inexplicabilities and mysteries in the universe, that is no reason why his solution of the only inexplicabilities he pretends to solve should be rejected. Mr. Darwin never pretended that his theory of the origin of species solved the ultimate nature of things; but this does not in the slightest detract from its scientific value.

Dr. Stirling's second objection to Mr. Darwin's theory is, "that conditions are quite inadequate to account for present organized differences, from a single cell." * If Dr. Stirling means by this that, even granting a first organism and unlimited time, *all* the differences between existing organisms *have not yet* been explained, we quite agree with him; but we are in no worse plight in this respect with regard to living than to dead matter. *All* the differences in the inorganic world are not yet accounted for, and probably never will be accounted for in any time. If, however, Dr. Stirling means that the main differences between existing organisms *cannot be* explained in any time—are, in fact, hopelessly beyond the reach of the human faculties for all time—he is making a universal negative assertion which is as illogical as it is rash. A great

* "As Regards Protoplasm," p. 52.

many of these differences have already been explained, the most radical of them have been explained in such a general way as to bring them within the reach of scientific treatment; and it is impossible for Dr. Stirling, even although he has eaten out of the vessel of Hegel, to set bounds to what can, in future time, be accomplished by the human mind in the way of co-ordinating the phenomena of the universe, and of organizing them into that body of knowledge which constitutes science. In further development of this conception Dr. Stirling says: "Moreover, time apart, conditions have no such power in themselves. It is *impossible to conceive* of animal or vegetable effluvia ever creating the nerve by which they are felt, and so gradually the Schneiderian membrane, nose, and whole olfactory apparatus. Yet these effluvia are the conditions of smell, and, *ex hypothesi*, ought to have created it. Did light, or did the pulsations of the air, ever by any length of time, indent into the sensitive cell, eyes, and a pair of eyes—ears, and a pair of ears? Light conceivably might shine for ever without such a wonderfully complicated result as an eye."* If, when Dr. Stirling says that it is *impossible to conceive* of effluvia ever creating the nerve by which they are felt, he means that he finds it impossible for himself to form this conception, this is not much to the point; since it is very probable that he has not thought deeply upon the subject. If, on the other hand, he means that it is impossible

* *Ibid.*, p. 53.

for any one living to conceive this, and that he could prove his assertion, it would be more to the purpose. But an adherent of Mr. Darwin's theory could reply, that although he cannot conceive, even granting an initial organism, how the pulsations of air could ever indent a pair of ears; yet that this hypothesis is so useful and has received such high verification in other ways, that he will not reject it on this account, but will live on in the hope that hereafter this difficulty will receive an explanation in accordance with the requirements of the Darwinian theory. If, lastly, Dr. Stirling means that it will be impossible for the human faculties for all time to account for this problem—and this is the only proposition which will serve his purpose, he is making a sweeping assertion for which he has no warrant, and endeavouring to limit the possibilities of the science of the future by the limits of his own capacity. Surely such a statement is founded both upon arrogance and ignorance. But what Dr. Stirling thinks impossible to be conceived has already been conceived in a general way; and if he will peruse the account which Mr. Herbert Spencer, in the last part of the first volume of his "Principles of Psychology," gives of the genesis of the nervous system, it may probably enable himself to form the conception which he at present regards as impossible. We do not maintain that Mr. Herbert Spencer has demonstrated that the special senses have actually been developed in the manner described by him; but he has, without making violent assumptions or contradicting any other part of our

knowledge, sketched a probable method in which they might have been developed. And this is probably the only kind of solution which is at present attainable. And even if this solution be not accepted in its entirety, it shows that the formation of the special senses through the successive modifications produced by the action of the environment and afterwards transmitted, is perfectly conceivable; and this gives the hope that, if ever a fuller explanation is forthcoming, it will be perfectly in accordance with the requirements of the Darwinian theory.

Dr. Stirling's third objection to Mr. Darwin's theory is, "that the play of natural contingency in regard to the vicissitudes of conditions has no title to be called *selection*." We do not deny that some valid objections can be urged against the word "selection" as employed by Mr. Darwin. Selection implies a "selector" and a conscious act of "selecting"; implications which would of course be repudiated by Mr. Darwin in his new application of the term. It is impossible to choose a phrase quite free from this objection, and the one proposed by Mr. Herbert Spencer—"Survival of the fittest"—is probably as good a one as can be found. But the question for us to determine is not, what are the implications of the word in its ordinary acceptation, but how does Mr. Darwin define it in its transferred meaning? "Natural selection," he says, "implies that the individuals which are best fitted for the complex and, in the course of ages, changing conditions to which they are exposed, generally

survive and procreate their kind."* We see, therefore, that Mr. Darwin's meaning is very well expressed by "survival of the fittest"; and whatever objections may be urged against the word "selection" from a philological point of view, makes no fundamental difference in the doctrine taught. The real objection against the use of the word in this connection is, that the uninstructed and unwary are apt to carry the implications of the primary to the transferred meaning, and thus be led into error; but surely a philosopher like Dr. Stirling is above falling into such a transparent fallacy. The following quotation, however, shows that, transparent though it be, our philosopher has fallen into the fallacy, since he advances an objection which might possibly have some degree of validity, as coming from a petty grammarian, but is perfectly irrelevant when directed against a theory which purports to be founded upon facts. "The agency," says Dr. Stirling, "to which Mr. Darwin attributes all the changes which he would signalize in animals is really the fortuitous contingency of brute nature, and it is altogether fallacious to call such a process, or such a non-process, by a term involving foresight and purpose."† Without waiting to inquire how far the changes of dead matter are correctly attributed to "fortuitous contingency," or how far matter is properly described as "brute nature" with the present implications of that phrase,

* "Animals and Plants under Domestication," vol. ii. p. 194.
† "As Regards Protoplasm," p. 53.

what we wish particularly to point out is that Mr. Darwin is careful to exclude foresight and purpose from his definition of "natural selection." Now we maintain that Dr. Stirling, in criticising the word in its transferred meaning, ought to deal entirely with Mr. Darwin's definition, and that he has no right to thrust into it all the implications of the primary meaning. But although Mr. Darwin excludes foresight and purpose from his definition of "natural selection," his theory does assert that the principle so named, acting along with other concurring causes, produces effects analogous to the methodical selection adopted by breeders in rearing domesticated animals. Whether this assertion be true or not must be determined by reference to the facts adduced, and no mere verbal criticism of the terms employed in enunciating the principle is of the slightest use in deciding the question. Dr. Stirling notices that, what he calls this "ungrounded metaphor," has become *a principle, a law,* and been transferred by very genuine men into their own sciences of philology, physiology, and what not. People will wonder at this by-and-by."* In our opinion, one of the greatest wonders in connection with this point is, that a man of Dr. Stirling's intellectual capacity should imagine that he is offering a valid criticism upon a theory which professes to be founded upon facts, and which is therefore capable of being confirmed or refuted by reference to observation and experience, by making merely verbal

* *Ibid.*, p. 53.

objections to the language in which it is stated. There is another circumstance which strikes us with wonder, and that is, that Dr. Stirling appears to be ignorant of the literature of this subject. He urges his objections against the word "selection" as if they had been a perfect novelty. But so far back as 1864 M. Flourens advanced the same objections, and was replied to in the same year by Professor Huxley in an article which first appeared in the "Natural History Review" for October, 1864. This essay has since been republished in Professor Huxley's "Lay Sermons, Addresses, and Reviews," a work which was probably before Dr. Stirling when he wrote the second edition of his pamphlet. If he read this essay, he ought to have acknowledged that he was anticipated in his objections by M. Flourens, and to have made an endeavour to reply to what Professor Huxley says in defence of Mr. Darwin's application of the word selection. The passage in which Professor Huxley replies to this objection is so beautiful that it deserves to be quoted in full. "M. Flourens," says he, "cannot imagine an unconscious selection—it is for him a contradiction in terms. Did M. Flourens ever visit one of the prettiest watering-places of 'la belle France,' the Baie d'Arachon? If so, he will probably have passed through the district of the Landes, and will have had an opportunity of observing the formation of 'dunes' on a grand scale. What are these 'dunes'? The winds and waves of the Bay of Biscay have not much consciousness, and yet they

have with great care 'selected' from among an infinity of masses of silex of all shapes and sizes, which have been submitted to their action, all the grains of sand below a certain size; and have heaped them by themselves over a great area. This sand has been 'unconsciously selected' from amidst the gravel in which it first lay with as much precision as if a man had 'consciously selected' it by the aid of a sieve. Physical geology is full of such selections—of the picking-out of the soft from the hard; of the soluble from the insoluble; of the fusible from the infusible, by natural agencies to which we are certainly not in the habit of ascribing consciousness. But that which the wind and sea are to a sandy beach, the sum of influences, which we term the 'conditions of existence,' is to living organisms. The weak are sifted out from the strong. A frosty night 'selects' the hardy plants in a plantation from among the tender ones as effectually as if it were the wind; and they, the sand and pebbles of our illustration; or, on the other hand, as if the intelligence of a gardener had been operative in cutting the weaker organisms down. The thistle, which has spread over the Pampas, to the destruction of native plants, has been more effectually 'selected' by the unconscious operation of natural conditions, than if a thousand agriculturists had spent their time in sowing it."* The last objection which Dr. Stirling urges is, that "in the fact of 'reversion' or 'atavism," Mr.

* "Lay Sermons, Addresses, and Reviews," p. 347.

Darwin acknowledges his own failure."* Does he mean to assert that the fact of "reversion" has opened Mr. Darwin's eyes to the falsity of his theory? If so, why does he still write books illustrative of it, and in support of its validity? He does not make this acknowledgment anywhere that we know of, and if he did, his opponents would be glad to quote his own language upon so important a point. But Dr. Stirling may mean that Mr. Darwin acknowledges that his theory fails to account for the facts of reversion. But such an acknowledgment would be very unnecessary. It was never supposed by Mr. Darwin, nor by any of his adherents that we know of, that natural selection would account for reversion: hence it would be singularly unnecessary to make a distinct avowal of its failure. It is, however, possible, by a little straining of language, to put another interpretation upon Dr. Stirling's words. He may mean that Mr. Darwin acknowledges the fact of reversion; and that from the fact that living beings do revert to the ancestral form, the failure of Mr. Darwin's theory may be inferred. If this is what he means, it is a pity that he has not given us the different steps of the process of proof. We are not able to justify this inference ourselves, nor even to imagine how it can be justified, and therefore we cannot criticise it. In our opinion, the fact of reversion is so far from being destructive to the Darwinian theory, that it affords

* "As Regards Protoplasm," p. 53.

one of the best illustrations of an important principle which underlies it. The form assumed by an organism depends upon two great factors—inheritance and adaptation. Inheritance tends to make the succession of individuals of a species exactly alike, while adaptation to the conditions of their existence will only maintain them alike so long as the conditions of life remain uniform. Since, however, the conditions of existence never are uniform for two individuals, whether existing contemporaneously or successively, adaptation will tend to introduce variety. The conditions of life may, however, remain relatively, if not absolutely, constant for a long period; and then the individual differences will be small, and the form of the species will also be pretty constant. If, on the other hand, the conditions of existence change very considerably, and keep changing for a long period, the members of the species which can best adapt themselves to the changed conditions will survive and leave progeny, so that after a time the species may depart to a considerable extent from the ancestral form. These are theoretical considerations, and it becomes most important to find a verification of them in observed facts. No one will doubt that the conditions amongst which a species exists do change in time very considerably. Let us now see if there are any facts to show that the form of the individuals which constitute the species change also. The fact of reversion is a fact of the kind we are in search of. When a particular organism has reverted to the form of a remote ancestor, what is the implica-

tion? If the immediate parent of the organism which has reverted had maintained the ancestral type, the offspring would be regarded as exhibiting the ordinary mode of inheritance. It is the fact that the immediate parent has departed considerably from the ancestral type which brings the phenomena of reversion into prominence; and hence this is one of those facts which is required by Mr. Darwin in order to verify one of the most important foundations of his whole theory.

But it may be asked, why does Dr. Stirling criticise the Darwinian theory in connection with Professor Huxley's essay? In defence of the Category of Difference, of course! The result of his criticism leads him to the conclusion that "species, as species, is something independent, and holds its own *insita vis naturæ* within itself."* This declaration we take to mean, that the *differences* between species, and, *à fortiori*, between the superordinate organic groups, are impassable. An ass, for instance, does not breed a horse, nor a horse an ass. A monkey does not generate a man; nor, satirists notwithstanding, does a man generate a monkey. Now comes the question, Has each species been always as stable and independent as it is at present? Dr. Stirling would probably maintain that it has been; that it was first generated by a distinct creative act, and has maintained its stability and independence from that time to the present.

Now Mr. Darwin's conception of species is in

* "As Regards Protoplasm," p. 53.

accord with that of Dr. Stirling in every point except one; but that point is a radical one. Mr. Darwin fully believes that each species in the present day continues stable, and that under no circumstance does an individual of one species generate one of another. He also believes that each species has been independent, in the sense of being stable, for a very long period of time when compared with the life of an individual; and the main point in which he appears to differ from Dr. Stirling's conception is in the fact that he does not postulate a distinct creative act for the genesis of each species. On the contrary, he believes, if the history of two allied organic groups could be traced far enough back in time, that their forms would be found to converge gradually, and at last to merge into one ancestral form. The genera horse and ass, for instance, are at present divided from each other by an impassable cleft; and even if their life histories could be minutely traced, they have, according to Mr. Darwin's idea, been so divided for a very long period; but on going back to a very remote time he would suppose that the cleft is becoming less and less, until at last both would have to own a common ancestor in the extinct species—*Anchitherium*. The conceptions which Dr. Stirling and Mr. Darwin appear to form of two allied organic groups may be illustrated by two straight lines. Dr. Stirling would regard them as similar to two parallel straight lines which, being produced ever so far, never meet; while Mr. Darwin would look upon them as like two

straight lines which appear parallel for a very long distance (distance in this case represents time), but are found to converge gradually, and at last to meet at a point. Mr. Darwin's conception, therefore, does not appear to be particularly destructive to the Category of Difference. This, however, is not Dr. Stirling's opinion. After his supposed demolition of his opponent's theory, he exultingly exclaims: "Neither molecularists nor Darwinians, then, are able to level out the difference between organic and inorganic, or between genera and genera, or species and species. The differences persist in spite of both."* But Mr. Darwin does not endeavour to level out the difference between species and species, much less that between genera and genera, or that between organic and inorganic matter. If his theory is worth anything, it is owing to the fact that he recognizes the difference existing between species and species, and supplies an explanation of it. How could he attempt to level out the difference between species and species? Only by one means that we know of. By endeavouring to show that there is no distinct definable limit between any two species, but that in every case the one graduates insensibly into the other by intermediate forms. If it could be shown that the two organic groups—man and catarrhine monkey,—instead of being divided from each other by a wide gulf, graduated by intermediate forms the one into the other, this would

* "As Regards Protoplasm," p. 54.

be the nearest approach to a levelling out the difference between them that we can imagine; and the greatest levelling out of difference which we can conceive in the whole organic world is, that any one should endeavour to show that from the lowest to the highest organism was "a mighty chain from the moss to the man,"* and that, like a chain, the one link passed by an insensible gradation into the other; and that, therefore, our classification must be a serial one. But one of the great merits of Mr. Darwin's theory is that it explains why our classification of organisms must be in groups and sub-groups; and shows why our groups are separated from each other by limits which are generally distinctly definable, and do not graduate insensibly into each other. Instead, therefore, of ignoring the difference between organic groups, Mr. Darwin's theory openly asserts it; and his merit is that he has shown how it could have arisen by natural causes. We must, however, endeavour to explain how far this theory pretends to explain the differences between living beings. When commenting upon Mr. Darwin's supposed assumption of *infinite time*, Dr. Stirling says: "Any fruitful application even of infinite time to the general problem of difference in the world is inconceivable."† Enough has already been said respecting the meaning of infinite time; what we wish to point out at present is that Mr. Darwin does not undertake to solve the general problem of difference in the world. He

* *Ibid.*, p. 54. † *Ibid.*, p. 52.

does not even discuss, or at any rate does not endeavour fully to solve, the general problem of difference in the living world. He merely merges the special problem of difference in the living world into the general problem; and the general problem of the differences presented by individual organisms was never supposed to present any particular metaphysical difficulty, except what presented itself in the general problem of difference in dead matter. To descend to particulars, the differences of living beings present themselves to our observation in two leading aspects. If we note the individuals which constitute any species, along with the fact that they have a general likeness to each other, must be recognized the other fact that each differs from the rest in minor traits; that, in short, however close the agreement between them, each presents individual differences. No two plants, probably, and no two animals, are undistinguishably alike. The degree to which variation may proceed within the species is of no importance for our present purpose. What we want to point out is, that although the causes of variation might be obscure, no one supposed that the problem was entirely beyond the reach of science; hence it was not thought necessary to postulate distinct creative acts to account for those differences. From the minor differences which distinguish the individuals and varieties of a species from each other we pass to the major differences which distinguish species from each other. We will not lay any emphasis upon the fact that these latter differences are not found to be

always so wide in practice as they have been represented to be. We will take organic groups, say, catarrhine monkey and man—where the line of demarcation is particularly distinct. Between these genera there is a very wide cleft, not bridged by any intermediate forms; a difference which is simply impassable, and will continue impassable; since the whole evidence shows that they are diverging further from each other as time advances. A difference so remarkable presented a *special* problem. Not only had it not been explained, but it appeared so hopelessly beyond the reach of explanation, that it was concluded that it never could have arisen from natural causes; hence a distinct act of creation was postulated to account for it. In accordance with this view, species were defined as "so many individuals as are presumed to have been formed at the creation of the world, and to have been perpetuated ever since." A definition like this carries its condemnation upon its face, composed as it is mainly of hypothetical elements. The service which Mr. Darwin has rendered to Biology consists, as already remarked, in having merged the special into the general problem of difference. He accepts the facts of variation—the minor differences—as he sees them around him, and arranges them under empirical laws. He also accepts as a fact that the conditions of existence *do* change, without endeavouring to explain *why* they change. He then shows that the empirical laws of the minor differences existing between individuals and groups of individuals within the species, if assumed to be

operative for a long period, such as is claimed by geologists in their interpretations, when taken along with the laws of inheritance, growth, and multiplication, will explain the major differences which exist between species. Having done this, there is, of course, no more occasion to postulate a distinct creative act to account for the major differences than there is to make a similar postulate in the case of the minor differences. His theory, therefore, has shaken the very foundations of the hypothesis of special creations; although it does not militate in the slightest against the idea of creation as a progressive work, and it also leaves all the deeper problems of metaphysics and theology untouched. Mr. Darwin's theory might, indeed, be called natural extinction with nearly as much propriety as natural selection. If, for instance, every variation within a species were equally successful in the struggle for existence, and left progeny in equal proportion with all other individuals, the result would be an endless variety of changeable and unstable forms, very unlike our species. It is the fact that a great many of the varieties become *extinct* that maintains the stability of the species. And it is also because this extinction proceeds along definite lines, so as to cause extermination of the intermediate forms, that the lines of demarcation between species are so distinct. It is not true, therefore, that Mr. Darwin tried to level out the differences between living organisms. He found the differences, distinctly and emphatically declared them to exist; and, as already remarked,

his service to Biology consisted in his having resolved the major differences, which were supposed to be quite beyond the reach of science, into the minor differences, which no one supposed to be of supernatural origin; except in the sense in which the entire universe is of supernatural origin. Surely the Category of Difference has nothing to fear from the operation.

CHAPTER IV.

THE PHILOSOPHICAL ISSUE. THE CONCLUSION.

DR. STIRLING'S criticism of the purely scientific part of Professor Huxley's essay has been examined in detail in the previous chapters. And although it is to this part of the criticism that we have undertaken to reply, we cannot help alluding very briefly to the objections he urges to his opponent's philosophical opinions, before proceeding to sum up the results already obtained. We will endeavour to show that Dr. Stirling has misunderstood Professor Huxley's philosophical position, and that the objections he has advanced, on the supposition that the latter is a *subjective idealist* or *sceptic*, are irrelevant on the supposition which we make—that he is a *realist*. The reader, however, need not expect to find an exhaustive treatment of the subject.

Although the first part of Professor Huxley's essay is purely scientific, yet the facts are specially arranged with reference to the philosophical discussion which is to follow. Let us attend a little more closely to his mode of arranging his facts. He first takes a very rapid survey of the whole living world, and shows that from monad to man,

considered objectively (subjective phenomena are only included as correlates of certain objective phenomena), the scientific investigator has to deal with material organisms; and consequently scientific explanation is uniformly of the same character in reference to all orders of living beings. The only philosophical implication underlying this argumentation is the assertion tacitly made, that the metaphysical difficulties which meet us in the study of the objective phenomena of the higher organisms meet us equally in contemplating the lower organisms. His second step deals similarly with the lower organisms and dead matter. He arranges his scientific facts in such a manner as to show that the same metaphysical difficulties meet us in our investigations of both dead and living matter. In short, he shows in the first part of his essay that objective science has to do with explanation, that scientific explanation is uniformly of the same character, whether it be in reference to dead or living matter, or in reference to the lower or to the higher organisms considered objectively; and that, however far explanation may be carried, it leaves all the deeper problems of philosophy unanswered; has, indeed, of itself no tendency to solve them. Even if all external phenomena were reduced to terms of force acting in time and space, then comes the more purely philosophical question, what is the nature of those ultimate conceptions to which the objective phenomena have been reduced? We have already seen that Professor Huxley made a special reservation in favour of the "manifestations

of intellect, of feeling, and of will," * as known to the subject of them; and this is the other side of the philosophical problem to be considered. On the one side we have matter acting according to law; on the other, the subjective phenomena of the mind; and the problem of philosophy is to reduce these two factors into *one*. No one knows better than Dr. Stirling that this is the manner in which the problem of philosophy has always presented itself, more especially since Descartes drew such a sharp distinction between mind and matter. Professor Huxley has simply reasserted the old position. He has shown that philosophy has to reduce, not three factors—mind, matter, and vitality, but two only—subject and object, or the *ego* and the *non-ego*. How shall we proceed with the reduction of the two terms of the antithesis? (1) Shall we regard the *ego* as a mode of the *non-ego*, and say that mind is merely the result of material laws? A pure materialist would say—Yes. Professor Huxley, however, emphatically says—No. (2) Shall we regard the non-ego as a mode of the ego; and say that the material world is solely the result of the laws of mind? Dr. Stirling criticises Professor Huxley as if he had said—Yes. Indeed the whole of Dr. Stirling's arguments against Professor Huxley's philosophical opinions proceed upon the assumption that he holds that extreme form of *subjective idealism* in which each particular subject is supposed to construct its own external world.

* "Lay Sermons, Addresses, and Reviews," p. 135.

(3) Or shall we merge both the ego and non-ego into one ultimate substance, of which both are but modes? Dr. Stirling would say—Yes. At any rate, this is the way in which we understand the *absolute idealism* of Hegel. His criticism shows that it is his opinion that Professor Huxley would answer this question in the negative; but we believe this opinion to be erroneous. What, then, is the difference between the views of the two upon this point? Both reduce the ego and the non-ego to a *tertium quid*, distinct from either. The difference between their views only appears in answer to the further question, can we have any knowledge of the nature of this third substance, apart from the modes of its operation? To this question Dr. Stirling would say—Yes, and Professor Huxley—No. It would be idle for us to endeavour to decide between these opinions, unless we were prepared to write a whole system of philosophy. The decision of the question will depend upon what theory of cognition is adopted. To those who assent to the doctrine of the relativity of *all* our knowledge, without any reservation in favour of the ego, there is no logical halting-place but to deny that we can have any knowledge of the ultimate mystery of the universe. To those, again, who, even if they believe generally in the doctrine of the relativity of our knowledge, think that in the case of the ego, we get behind the phenomena and attain to a piece of *real* knowledge, there is probably no logical halting-place but to adopt the absolute idealism of Hegel. Our function as a critic does not require us to decide

between these views. Although it is very useful for both ourselves and the reader to have a general idea of the point of view from which Dr. Stirling criticises Professor Huxley, yet our business is not with the opinions of the former, but with his criticism of the views of the latter.

Let us now endeavour to ascertain what the views of Professor Huxley are. We need not expect to find a full exposition of any man's philosophical opinions within the compass of a few pages of an essay which was first delivered as a popular lecture. Any generous critic would put a wide interpretation upon words used under such circumstances, and would be glad to avail himself of any means whereby he might be able to attain to a fuller knowledge of his opponent's position. This is not the method, however, pursued by Dr. Stirling. He takes the bare words of the essay before him, places upon them the narrowest possible interpretation, without any reference to Professor Huxley's other writings. This is all the more inexcusable on the part of Dr. Stirling, since the essay "On Descartes' Discourse," which was written with the express purpose of giving us a fuller exposition of his philosophical opinions, was in print long before the second edition of Dr. Stirling's pamphlet was issued. Another fact ought to be kept in mind in estimating Professor Huxley's philosophical position. He undertook in this essay to defend the philosophical reputation of Hume against what he conceived to be historical injustice on the part of the Archbishop of York; and in sanctioning the main principles of

Hume, which were negative and critical, he may be supposed to have sanctioned what is generally understood as scepticism, or the subjective idealism which is very closely allied to it. Indeed, Dr. Stirling never appears to have any doubt upon this at all, and he shapes his criticism accordingly. It will not, however, be difficult to prove that Professor Huxley is neither sceptic nor subjective idealist.

In the essay which Dr. Stirling criticises Professor Huxley says, "There can be little doubt that the further science advances, the more extensively and consistently will all the phenomena of nature be represented by materialistic formulæ and *symbols*."* When he speaks of "materialistic symbols" this not only shows that he regards our conceptions of matter and material laws as merely signs of the reality; but it also shows that he believes in the existence of a *reality* of which those conceptions are symbolic. Now this is the metaphysical position which, according to Ueberweg, Aristotle held. "Aristotle," he says, "equally far from both extremes, sees thinking to be the *picture of existence*, a picture which is different from its real correlate and yet related to it, which corresponds to it, and yet is not identical with it."† This is, indeed, the metaphysical position which Ueberweg himself adopts, and he adds that he would not object to "have his system entitled an *Ideal Realism*." That this is in the

* "Lay Sermons, Addresses, and Reviews," p. 160.

† "A System of Logic," translated by T. M. Lindsay, M.A., p. xi.

main the position occupied by Professor Huxley is made more apparent if we turn to his essay "On Descartes' Discourse." After describing the leaning of modern physicists towards materialistic, and of modern metaphysicians towards idealistic conceptions of the universe, he says: "If a botanist found this state of things in a new plant, I imagine that he might be inclined to think that his tree was monœcious—that the flowers were of different sexes, and that, so far from setting up a barrier between the two branches of the tree, the only hope of fertility lay in bringing them together."* Such an illustration would be perfectly meaningless unless Professor Huxley had formed such an ideal-real conception of the universe as Ueberweg contends for. It is also generally understood that Professor Huxley adopts in the main Mr. Herbert Spencer's philosophy. Like Mr. Herbert Spencer, he believes in a *real* evolution, in opposition to the *ideal* evolution of Hegel, and he also sanctions the great extension which Psychology has received from the doctrine of the inheritance of mental modifications; and both of these opinions are compatible only with some form of realism, and are certainly not compatible with subjective idealism.

With regard to this Ideal-Realism, Mr. Herbert Spencer says: "The conclusion to which our General Analysis has brought us is in perfect harmony with these conclusions, yielded by inductive inquiry at the outset. While *some* objective

* "Lay Sermons, Addresses, and Reviews," p. 371.

existence, manifested under *some* conditions, remains as the final necessity of thought, there does not remain the implication that this existence and these conditions are more to us than the unknown correlatives of our feelings and the relations among our feelings. The Realism we are committed to is one which simply asserts objective existence as separate from, and independent of, subjective existence. But it affirms neither that any one mode of this objective existence is, in reality, that which it seems, nor that the connections among its modes are objectively what they seem. Thus it stands widely distinguished from Crude Realism, and to mark the distinction, it may properly be called Transfigured Realism."* This is what we imagine to be the philosophical position of Professor Huxley, and if such is the case, all the arguments directed against him on the supposition that he is a sceptic or subjective idealist, are simply powerless to affect him. Dr. Stirling says that the principles by which Professor Huxley endeavours to rescue us from materialism "concern the so-called 'limits of philosophical inquiry,' and may be reduced to what Mr. Huxley calls our *three ignorances:* our ignorance, namely, first, of *cause*; second, of *substance;* and third, of *externality*, or an external world. The evangile, according to Mr. Huxley, consequently is that, lost by knowledge, we may be saved by *ignorance!*"† We have met with a similar argu-

* "Principles of Psychology," second edition, vol. ii. p. 494.
† "As Regards Protoplasm," p. 59.

ment already, and have seen that it was perfectly unfounded. We are not, therefore, prepared to accept offhand Dr. Stirling's statement that his opponent's theory is based upon ignorance. He truly remarks that the question relates to the "limits of philosophical inquiry"; and it is evident that, if there is a limit to inquiry, knowledge must be on the one side and ignorance on the other. But if it is possible by any means to fix the *limits* beyond which inquiry cannot reach, this constitutes, not ignorance, but knowledge; and although it is perfectly possible to approach our knowledge from the negative and critical side, yet the fixing of the boundary of our knowledge must depend upon our theory of cognition, and this theory must be mainly founded upon positive knowledge. Dr. Stirling now proceeds to examine what he conceives to be Professor Huxley's three ignorances separately, and in this we shall endeavour very briefly to follow him.

"1. What concerns *causality*," he says, "may be stated thus: The material phenomena which constitute knowledge, are commonly regarded as in *connection* the one with the other; but into the *nature* of this connection, into the *necessity* of this connection, we do not at all see. All that we do see is the *fact* of *invariable association* among them." * After stating what he conceives to be his opponent's conception of causality, he proceeds to reduce it to an absurdity. "Knowing the fact only," he says,

* "As Regards Protoplasm," p. 61.

"and not its conditioning reason, we are obliged to say in fairness, it *may* vary. When the sun rises, it is day, *this* day, and any day we ever heard of; but to-morrow it may be night. A stone flung into the air returns to-day, but to-morrow it may not."* An so on *ad nauseam*. But here also, he has, in our opinion, misconceived the doctrine he is criticising. Professor Huxley does not deny that a connection exists between things; we think he would even admit that, phenominally considered, the connection is necessary; but he will not assert that this connection is as *absolutely* necessary ontologically, as it has become *relatively* necessary to our thought. Why he will not make this assertion is manifest. He conceives that our knowledge of things is symbolic of the reality, and our knowledge of the connection between things is equally symbolic; but we possess no means of ascertaining how far the symbol, in either case, is like the reality. If this, then, is the conception which Professor Huxley forms of the relation between cause and effect,—and it is the only conception which is congruous with his other opinions,—all the "effete rubbish" about whether we shall join the *cervicem equinam* to the *humano capiti* is perfectly inapplicable. The most valuable part of Dr. Stirling's pamphlet is that wherein he advances his own, or rather Hegel's, theory of causation, in opposition to what he conceives to be that of Professor Huxley. "In short," he says, "the reason of the causal

* *Ibid.*

nexus is—Identity." "The rain," says Hegel, "is the cause of the wetness; but it is the same water in the wetness that is in the rain." * But the reason of the causal nexus can be quite as readily explained from the point of view of the real evolution of Spencer, as from that of the ideal evolution of Hegel. In this reference we would particularly recommend Dr. Stirling to read Mr. Herbert Spencer's theory of the persistence of force in his First Principles; and his criticism of the reasonings of metaphysicians, more especially that of Kant, in the second volume of his Psychology.

2. The following is Dr. Stirling's statement of the second ignorance: "What do I know about this that you call substance?—I know qualities only—I know all things in their qualities, *not in themselves*, not in their *substance*." † And (3) the last ignorance is thus stated: "I know no external—world—namely, or I know no certainty of an external world. What I know of external things—what I *can* know of external things *must* be in my consciousness." ‡

On the supposition that Professor Huxley is, as we have supposed, an ideal realist, it will be at once seen how grossly these statements misrepresent his opinions. He denies neither the existence of substance nor of externality; he simply says that the knowledge he possesses of them is merely a picture of the reality; and although he believes the picture to be sufficient for his practical guidance, he cannot

* "As Regards Protoplasm," p. 68.
† *Ibid.*, p. 62. ‡ *Ibid.*

assert that it is *absolutely* like the reality. Dr. Stirling has not advanced a single argument that can touch this position. We will not follow him through all his tortuous insinuations, that Professor Huxley has advanced this doctrine with the view of emancipating us from the priest. It is well known that the priest is no great favourite with Professor Huxley when he is the representative of any form of ecclesiasticism, or even of dogmatic theology; but it by no means follows that he is equally averse to him as the simple representative of religion. And we cannot but think that the conception which represents the universe as the result of one Ultimate Power which is beyond human comprehension, is as conducive to religion as that which regards the nature of this Power as perfectly within the compass of the human intellect to explain. There can be no doubt that this Power was equal to the production of human consciousness; but we would not like to assert that it is not possible for it to manifest another mode as high above our consciousness as our consciousness is above the simple irritability displayed by the leaves of the sensitive plant. This view is in our opinion as favourable to the religious sentiment as the conception which regards the Ultimate Power as universal self-consciousness—as, "an *ego*, a boundless intussusception of thoughts, all in each other, and through or through each other, but all in the same geometrical point." * Even after we surmount the

* "Lectures on the Philosophy of Law," by J. H. Stirling, LL.D., p. 6.

preliminary difficulty of conceiving how thoughts can be folded the one within the other into the compass of a geometrical point; and of conceiving this point without difference or distinction into parts, and therefore without *form*, and as existing apart from time and space (both of which are differences), and therefore unlike other geometrical points, without position; we say, after these preliminary difficulties are surmounted, we do not ourselves find such a point well adapted to call forth the sentiments of reverence and love which constitute the main elements of religion as distinguished from morality.

In bringing this examination to a close, we shall revert for a moment to the point from which we started. We have already seen that Dr. Stirling summed up the results of his criticism in a sentence. "In short," he says, "the whole position of Mr. Huxley, (1) that all organisms consist alike of the same life-matter, (2) which life-matter is, for its part, due only to chemistry, must be pronounced untenable—nor less untenable (3) the materialism he would found on it."* We have also seen that Professor Huxley's reply was, that the three assertions which this sentence contained were "utter misrepresentations" of his views. This narrows the issue between the combatants to a small compass, and we shall now proceed to inquire how far Professor Huxley was justified in character-

* "As Regards Protoplasm," p. 58.

izing his opponent's statements of his views as "utter misrepresentations."

The first statement is "that all organisms consist alike of the *same* life-matter." Dr. Stirling uses the word "same" and its equivalents here, and throughout his criticism, in the sense of complete identity, an identity which does not admit of any difference. On the other hand, we have seen that Professor Huxley nowhere throughout his essay employs "same" or its equivalents in this sense. An examination of his *process* confirmed this view. His mode of proceeding was by induction; and this method compelled him to seize upon that which is *common* to all kinds of protoplasm, and to neglect for the time being that which is *special;* and however strongly he might insist upon the former, this can by no means be held to be a denial of the latter. Turning, then, to the *product*, we found that not only could nothing which Professor Huxley had said be regarded as denying the existence of differences in protoplasm, but that he made a distinct avowal of those differences. All he claimed for protoplasm was a "general uniformity of character," compatible with any amount of special modifications. And, lastly, this conclusion was placed beyond doubt by a searching examination of all the words and phrases which he had used in describing the relation of equality which he conceived to exist between all kinds of protoplasm. We found that he only asserted sameness of the *essential* properties, while there might be an indefinite number of differences in the *non-essential*. In short, Professor

Huxley conceived living protoplasm to be *substantially the same* wherever found; just in the sense in which Dr. Stirling's history of our knowledge of it is *substantially the same* as that in Stricker's "Handbuch."* Our examination, therefore, has shown conclusively that Professor Huxley was perfectly justified in characterizing the first statement as an utter misrepresentation.

The second statement is that "life-matter is, for its part, due only to chemistry." In connection with the question of the origin of life, we were compelled to enter into a somewhat lengthy history of the genesis of the conception of a "vital force," or "vitality." The object of this historical sketch was to show that some physiologists, at least, have conceived that a force called "vitality" exists apart from matter; and the reason why dead matter is enabled to pass into the living condition, is that at the moment of the transition this force enters into, and takes possession of it. Dr. Stirling did not himself advance anything very definite upon this point. In one place he said that he had no idea of suggesting that vitality was something "unconnected with" matter; and in another that life "adds a new and higher force to chemistry, as chemistry a new and higher force to mechanics."† These statements do not appear to be very reconcilable with each other. If life adds a new and higher force to chemistry, where could the force have been prior to the addition? If he says that

* "As Regards Protoplasm," p. 54. † *Ibid.*, p. 55.

it was connected with matter, it must have been connected with dead matter, and therefore he adopts the opinion of his opponents; namely, that life was potentially in the molecules of matter prior to their union into living matter. If, on the other hand, he says that this force has a separate existence, what becomes of his statement that it was not his object to prove that it was *unconnected with matter?* But although the position occupied by Dr. Stirling is not very clear, that occupied by Professor Huxley is perfectly intelligible. He was arguing against the validity of the assumption of an entity "vitality" conceived as existing apart from matter. And we found that the argument which Dr. Stirling thought to be founded upon ignorance, was really founded upon the *identification* of ignorances, and therefore upon positive knowledge in a negative form; while, on the other hand, we found that the assumption he is opposing rests upon absolute ignorance in a positive form. Such then is the position; how far is it properly described by saying that it is Professor Huxley's opinion that "life-matter is due only to chemistry"? Life-matter, or any other matter, due only to chemistry! The organized body of knowledge which we call chemistry depends upon the fact that special kinds of matter undergo various combinations and decompositions; but neither the matter, nor the outward process, which corresponds to our knowledge, depends in any degree upon the chemistry. We do not wish, however, to follow Dr. Stirling's example, and resort to merely verbal

criticisms. We prefer to inquire whether an interpretation can be put upon his words which will render them compatible with common sense, although this is not a rule which he observes in his dealings with others. The next interpretation which his words will bear is that the systematized knowledge which constitutes the science of life, and that which constitutes chemistry, are exactly on the *same* level, and to be prosecuted by the *same* means. Whether Professor Huxley would or would not assent to the proposition depends, in our opinion, upon what is meant by the word "same." If by "same" is meant identity in essentials with considerable differences in other respects, then we imagine that he would accept the position; but "due *only* to chemistry" can hardly be interpreted in this sense. If, on the other hand, "same" be taken to mean complete indentity in all respects, we have no doubt but that Professor Huxley would repudiate the proposition altogether, and that he "never said anything resembling it." It is not requisite to point out the differences between the methods of chemistry and biology in detail. In the classification of Mr. Herbert Spencer, the former is an abstract-concrete, and the other a concrete science; and to establish even this distinction involves very considerable differences in their methods; and we dare venture to assert that Professor Huxley never said anything, either directly or indirectly, which can be held to deny the validity of the distinction. By the exercise of a considerable degree of ingenuity, we can imagine one

other interpretation which can be put upon Dr. Stirling's words. By chemistry, he may mean, not the systematized knowledge which constitutes the science, but the external process of things which corresponds to it. If this is the case, his words may mean that it is Professor Huxley's opinion that the process of external things which is the correlative of our biological knowledge objectively considered, and that which is the correlative of our chemical knowledge, are, not scientifically, but *metaphysically*, on the same level. If this is his meaning, we think Professor Huxley would in the main agree with him. One of his principal contentions is that there is no necessity to postulate a special metaphysical entity to account for life; and hence he must acknowledge, and we have no doubt does acknowledge, that no metaphysical difficulties present themselves in the objective study of living beings, which have not already emerged in the study of dead matter, although the difficulties may not be so apparent in the latter as in the former case. If this is Dr. Stirling's meaning, we must say that the language in which he expresses it—"life-matter due only to chemistry"—is singularly infelicitous and inadequate; so much so, that even if Professor Huxley would accept the position according to this last interpretation, he was perfectly justifed in asserting that he never said anything in the least resembling this mode of expression. Dr. Stirling, therefore, can only be rescued from the charge of "utter misrepresentation" in this case, by fastening upon him a charge, which is equally odious to a

precise thinker, namely, the most slip-shod and careless use of language.

We come now to consider the third and last statement implied in the phrase "the materialism he would found on it." Dr. Stirling is very wroth with Professor Huxley for characterizing this as an utter "misrepresentation of his views." "If," says he, "Mr. Huxley does *two* things, namely, attempts first to set up materialism; attempts, second, to knock down materialism, how can allusion to the materialism he sets up, guarded by an equal allusion to the materialism he knocks down, be an 'utter misrepresentation'? 'One great object of my essay,' says Mr. Huxley! Yes, truly; but what of the *other*—great, greater, and greatest—object? 'Utter misrepresentation!' The only utter misrepresentation here is—Pshaw! the whole thing is beneath speech."* No wonder that the vessel of Hegel does not become more attractive, when he, who has eaten the *historic pabulum* out of it, gives way on slight provocation to such an ebullition of temper. But the question for us to determine is, whether Professor Huxley does *two* things, philosophically considered. Does he in his essay, either first or last, set up materialism? To this question we say emphatically—No. Neither first nor last does he set up materialism, and therefore he cannot knock his own materialism down, although it is possible for him to knock down the materialism of some other one. In some of his

* "As Regards Protoplasm," p. 59.

propositions the terms were distinctly materialistic, but it was only apparent, not real materialism. Indeed he was perfectly alive to the fact that a great deal of what he said in the first part of his essay might be mistaken for materialism by the uninstructed, and then he proceeds to sweep away even this appearance. Dr. Stirling himself acknowledges that the first part of his opponent's essay is physiological, and the last part alone philosophical. It was the first part of the essay which contained the propositions whose terms were distinctly materialistic; but will Dr. Stirling maintain that Professor Huxley or any other one could set up materialism in a physiological discussion? The first part of the essay has to do with scientific explanation, and although the facts are arranged with special reference to the philosophical discussion which is to follow, yet it is not itself a philosophical discussion. If the first part had been advanced by Professor Huxley without being followed by the second part, and if he pretended that this part discussed the problem of philosophy, we can imagine with what scorn our Hegelian would look down upon him. He would sneer at him, and justly so on this supposition, as a member of the "Aufklärung"; he would point out to him that scientific explanations are not philosophy, but that at the most they are only the materials from which a philosophy is constructed. He would tell him that "Philosophy receives all the explanations of the sciences, of science in general, and, so instructed and prepared, proceeds to put the final question, the question in

general, why, whence, whither."* In this way he could show, and loftily and disdainfully he would show, that what purported to be a philosophical discussion did not deal with any purely philosophical question at all, much less offer a solution of these questions. But since Dr. Stirling finds it convenient to label Professor Huxley's philosophical system—Materialism, the first part of his essay, which is almost purely scientific, is allowed to pass as if it were purely metaphysical. In the first part of his essay Professor Huxley assimilated all the phenomena of the objective world so far as scientific explanation is concerned, and it is at this point that the really philosophical part of the essay begins. If he had now said, "I accept materialism as the solution of the problem of the universe as it presents itself in dead matter," there would be no logical halting-place for him, or for those who accepted his previous argumentation, but to extend his materialism to living organisms, and probably even to the subjective phenomena of the mind. But he says virtually, not this, but the very opposite: "I don't accept materialism as the solution of the problem of the universe as it presents itself in dead matter, and consequently I totally reject this solution of the problem as it presents itself in living matter, and in the subjective phenomena of the mind." This being the case, it is "utter misrepresentation" of his views to say

* "Lectures on the Philosophy of Law," by J. H. Stirling, LL.D., p. 8.

that he set up materialism at all. But the misrepresentation does not stop here. Not only does he misrepresent Professor Huxley by saying that he sets up materialism; but he misrepresents him still more grossly by denying any validity to the mode in which he knocks it down. He says that Professor Bain "makes a *clutch* at originality"; but no drowning man ever clutched a straw with more eagerness than Dr. Stirling clutches any point which he thinks will fasten down his opponent to the grossest materialism. He even endeavours to form a quantitative argument out of the number of paragraphs in his opponent's essay, to which he attaches so much importance as to repeat it more than once. "We are to understand, then," he says, "that what Mr. Huxley claimed to have effected (physiologically) in fifty paragraphs—for materialism, he now claims equally to effect (philosophically) in one-and-twenty against it."* It is mere trifling to make such a remark, unless he wished the reader to infer that the relative importance which his opponent attaches to materialism and the escape from it is in the proportion of fifty to twenty-one. In another place he says that the fifty paragraphs are, "so to speak, in reality the wind, and the one-and-twenty only the whistle for it." † It is manifest that this elegant allusion is meant to convey to the reader that the substantial part of his opponent's philosophy is materialism, and that his idealism is nothing more than empty

* "As Regards Protoplasm," p. 59. † *Ibid.*, p. 23.

sound, without any real influence upon his life and thoughts. Even the title of the second part of the new edition of his pamphlet is suggestive in this respect. He calls it "The Escape from Materialism through the Modern Idealism of Ignorance." The idealism being founded upon ignorance is worthless; and consequently the only substantial part of his opponent's philosophical opinions is—materialism. But not only does Dr. Stirling not accept his opponent's extrication from materialism—that of course was not to be expected—but he almost goes the length of denying that it has any relative value for Professor Huxley himself. "That actual world," he says, "is simply materialism, and the idealism it talks of in consciousness is only, as it were, an occasional flash from a private lantern that is peculiarly convenient at times for the reassurance of others—perhaps of ourselves!"* The "perhaps of ourselves" added very unobtrusively to this sentence, shows that Dr. Stirling stops short of accusing Professor Huxley of the gross immorality of pretending to the public to hold a certain kind of spiritualism, in order more effectually to dupe them into the belief of materialism. He charitably admits that Professor Huxley may be his own dupe as well. But to Professor Bain, however, such immorality is distinctly attributed. "To Mr. Bain, for example," he asks, "is not the materialism all that is for him fundamental? And is not the idealism but, profanely to say it, the tongue in the

* "As Regards Protoplasm," p. 72.

cheek—to the priest, who incontinently sinks silent, dumbfounded?"* What can be thought of a philosopher like Dr. Stirling, who appears to think that Professor Huxley, or any other one, could set up *materialism* in a purely physiological discussion? What can be thought of one who persistently endeavours to laugh at his opponent's mode of escape from materialism, in order that he may fasten upon his opinions all the odium which the implications of the word will insure? And still more, what can be thought of one who does not hesitate to insinuate that his opponent is insincere in his rejection of materialism, and who even goes the length of hinting that his mode of escape from it has no relative value for himself, but is simply meant for the reassurance of others? "Utter misrepresentation!" Surely this language is not one whit too strong in characterizing such conduct. We are sorry to apply contemptuous language towards one who has rendered good service to philosophy; but we cannot help turning against him his own expression, and saying—"Pshaw! the whole thing is beneath speech."

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* *Ibid.*, p. 62.