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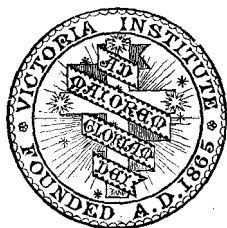
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The following Paper was then read by the Rev. J. L. CHALLIS.

ON THE METAPHYSICS OF SCRIPTURE. By the
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 University of Cambridge.

1. **T**HE reasons for entitling this essay "On the Metaphysics of Scripture" will be unfolded in the course of discussing the questions which the title is intended to embrace. At present it will suffice to state that "Metaphysics" will be taken to signify specially the department of abstract human knowledge which (as the name implies) comes after, and is intimately related to, natural science, and that it is the purpose of the essay to inquire whether the foundations of metaphysics in this limited sense may not be derivable from the revelations of Scripture. It might also, I think, be a matter for inquiry as to whether the science of Metaphysics, in the comprehensive sense in which it is usually understood and treated of, may not have its ultimate basis in divine revelation; but I do not intend in this essay to enter upon so large a subject.

2. It will, accordingly, be proper to begin with considering in what manner, and to what extent, metaphysical science arises out of, and depends upon, the special department of natural science usually called *Physics*, and afterwards to discuss its relation to other departments, as *Geology*, *Botany*, and *Natural History*. It will, for this purpose, be requisite to advert to the principal steps, in historic order, by which the science of Physics has advanced to a position which brings it into connection with Metaphysics.

3. The works of Aristotle give evidence that he directed his attention to various kinds of natural phenomena, and acquired to a considerable extent such knowledge of them as could be obtained merely by *observation*; but in his time, and long afterwards, the method of getting precise information about natural objects by employing the test of *experiments* had not been thought of. Bacon seems to have been the first to recognize fully the necessity of commencing the study of nature by gaining a knowledge of facts and laws by means of experiments; but he did little towards exemplifying the principles he laid down. This part was performed with

remarkable perseverance and success by his contemporaries Kepler and Galileo. The achievements of these two philosophers, which were essential contributions towards the advancement of natural philosophy, were widely different in character. The laws of the planetary motions, as discovered by Kepler, were formal relations of space and time, determined by observation alone, without reference to the action of *force*; whereas Galileo's experiments were expressly directed towards ascertaining *laws of force*. He proved by experiment that a projectile acted upon by gravity at the earth's surface moves in a *parabolic path*. By this means he established (in combination with the law of *vis inertiae*, according to which a body persists in a state of rest, or of uniform motion in a straight line, unless it be disturbed by extraneous force), the fundamental law of the acceleration of a body acted upon by a constant force; *viz.*, that the acceleration, as estimated in the direction in which the force acts, takes place in the same degree, whatever be the actual motion, and direction of the motion, of the body acted upon.

4. With prospective reference to an argument that is to follow, I now assert—what perhaps is not generally understood—that no mathematical reasoning, such as that employed by Newton or Laplace, was capable of demonstrating the parabolic motion which Galileo ascertained by experiment, and that the whole of the mathematical reasoning in physical astronomy depends on establishing *by experiment* that law of parabolic motion. This was perfectly understood by Newton, who frequently, in his *Principia*, refers to the results of Galileo's experiments as being of a fundamental character, and in particular calls the parabolic motion "Galileo's Theorem." If it be urged that there are well-known methods of calculating the parabolic motion of a projectile, without reference to Galileo's experiments, the answer is that these calculations take for granted the fundamental law of accelerative action above mentioned, which law is incapable of establishment on any other basis than that of experiments such as those made by Galileo.

5. Armed with Galileo's theorem, and with the powerful method of calculation (equivalent to the differential and integral calculus) which he had himself discovered, Newton was able to give an *à priori* demonstration of Kepler's Laws. But here it is particularly to be noticed that this demonstration rests on the *hypothesis* that the force of gravity varies inversely as the square of the distance from the particles from which it emanates. Besides this hypothesis, it is also assumed, in physical astronomy, that each particle of a given body attracts all the particles of the same body, as well as all the particles of surrounding bodies, according to the law of the inverse square. But physical astronomy furnishes no

means of demonstrating that law. It is true that by taking for granted Kepler's Laws, the law of the inverse square might be arrived at by reversing the process of reasoning by which the Keplerian Laws were demonstrated. But it would be reasoning in a vicious circle to call this a demonstration of the law of gravity. The truth is, the law and the universality of gravitating force are ultimate facts for which no *à priori* reason can be given, at least on the principles of physical astronomy, although the reality of these facts is abundantly demonstrated by the great number and variety of the explanations of phenomena which the hypothesis of their truth enables the physical astronomer to give.

6. I trust that I shall be held excused for bringing before the members of the Institute the foregoing statements, although the complete evidence for their claim to be accepted can only be understood by means of an acquaintance with the applications of mathematical reasoning which but few can be supposed to possess. The mention of these particulars was required for making intelligible and justifying the following general conclusion, of which essential use will be made in the subsequent reasoning:

All the results in physical astronomy that have been obtained by Newton, Lagrange, Laplace, and all other theoretical astronomers, are deductions by mathematical reasoning from Galileo's theorem of parabolic motion, and from the hypothesis of a universal gravitating force varying according to the law of the inverse square.

7. Supposing this conclusion to be accepted, there will evidently arise the question as to what is the quality of the fundamental conditions. Are they ultimate facts, or do they admit of being demonstrated on the basis of ulterior facts? The answers which these questions have received have given rise to two opposite and irreconcilable systems of philosophy, respecting which I shall here say, in anticipation of the sequel of this discussion, that one of them is in accordance with, and the other directly opposed to, what I consider to be properly designated as "the metaphysics of Scripture." It is, consequently of prime importance, as regards the purpose of this essay, to place these two philosophies in contrast with each other, and by all legitimate means to decide between their claims to acceptance. With this object in view, I adduce the following considerations.

8. When the laws of gravitation had been ascertained by the reasoning contained in Newton's *Principia*, much speculation arose as to the quality of this agent. As it was proved that one body was capable of attracting another without any discernible intervening substance, it began to be thought that gravity might be an *occult quality*, inherent in substances, and producing motion according to certain laws, but by means respecting which our

senses could give no information. It is well known that Newton rejected this view, contending that no one competent in philosophy could admit the possibility of such "action at a distance." He even conceived of the existence of a rare and universally diffused elastic medium which might perform the part of intermediate agent. But in Newton's time, and long after, neither mathematics nor physics were in a sufficiently advanced state for showing how the force and the law of gravity might be referable to the pressure of an elastic fluid. Under these circumstances it would have been legitimate philosophy to adopt the law of gravity merely as a convenient provisional hypothesis, in the expectation that a reason might be given for it in a more advanced stage of natural philosophy. This course, however, was not taken; the occult quality of gravity was almost universally admitted, and all attempts to assign a *cause* for the action at a distance were abandoned. At this juncture Hume, who was neither a mathematician nor a physicist, promulgated the doctrine that natural philosophy has nothing to do with *causes*, but only with *laws* of phenomena, and that these laws consist of an invariable order of antecedence and consequence of phenomena, the discovery of which order constitutes the proper and sole purpose of observation and experiment. This philosophy labours under the serious defect of affording no criterion whereby to decide whether a supposed consequent of an antecedent is *immediately* consequent, or whether it might not be possible to discover other facts which, by being interposed between these, would produce a *different* law of antecedents and consequents. It will presently be shown that no such indeterminateness pertains to the other philosophy.

9. Hume's doctrine has had, both on physical and metaphysical science, a widespread and persistent effect, and, perhaps, under no circumstances has its influence been manifested in greater degree than in the empirical philosophy of the present day. The doctrine seems to have been originally propounded with the view of proving the impossibility of *miracles*: this, at least, was the use made of it by Hume and his immediate followers. It has since affected in various ways almost all modern physical and metaphysical productions, and has even tainted the theological opinions of many who profess to believe the teaching of Scripture. Recently the advocates of the sceptical philosophy have begun to see that the possibility of miracles must be granted, if the actuality of creation and of a personal creator be admitted, miracles being nothing more nor less than a repetition of the exercise of creative energy. Hence, with an evident intention of getting rid of any reference to agency governed by *personal will*, theories have been proposed which ascribe to *law* functions which belong only to *creative power*. This,

I think, will account for Darwinism being excogitated, and for the character of its assumptions, as well as for other characteristics of modern science; for instance, the postulation by geologists of enormously extended periods of operations on the superficial materials of the earth, little different from those going on at the present time; the throwing back the beginning of the existing order of the external world to an immeasurable past, and placing the epoch of its termination in an immeasurable future; and the materialistic view which ascribes "potency" to atoms.

10. To show that in what I have said above I have not misrepresented the object and character of the modern phase of natural philosophy, I beg to refer to a work recently published, entitled *The Unseen Universe*, which may be regarded as exhibiting the latest development of the consequences to which that philosophy conducts. In page 132 the following passage occurs: "We think it is not so much the right or privilege as the bounden duty of the man of science to put back the direct interference of the Great First Cause—the unconditioned—as far as he possibly can in time. This is the intellectual, or rather theoretical, work which he is called upon to do,—the post that has been assigned to him in the economy of the universe." It does not seem likely that a man of science who has this preconceived view of "bounden duty" can devote himself to the pursuit of science with his mind unbiassed, and free from the influence of pre-judgment. Surely the man of science has nothing to do but to make use of all available means of acquiring knowledge, apart from anticipations of results, or obligations of duty.

11. The passage in the same work next after the one above quoted is this:—"If, then, two possible theories of the production of any phenomenon are presented to the man of science, one of these implying the immediate operation of the unconditioned, and the other the operation of some cause existing in the universe, we conceive that he is called upon by the most profound obligations of his nature to choose the second in preference to the first." There is nothing in this assertion, taken in its literal sense, that any physicist can object to. The case, however, has another aspect after ascertaining what the authors intend to include under the expression "the operation of some cause existing in the universe," and discovering that the assertion is not of so simple a character as at first sight it seems to be. From other parts of the work, as especially the latter portion of Chapter II., it appears that the causation referred to is subject to a "Principle of Continuity," the meaning and the reality of which may be called in question. For authority for the existence of this principle Groves' book

entitled *The Correlation of Physical Forces*, is cited (p. 53). It is true that the discussions in that work do point to some bond of connection between the different physical forces of such kind that together with diversity in the modes of manifestation of the effects of the forces, there is unity as regards the intrinsic quality of the forces themselves. (This, for instance, would be the case if the different kinds of force might be supposed to be modes of *pressure* of a universally diffused elastic medium.) But I fail to see how facts and laws which indicate the existence, between physical forces, of relations depending on such *unity*, establish the reality of an abstract and necessary principle of *continuity*. The authors of *The Unseen Universe* make large use of such a principle, which, after having studied their applications of it, I can perceive to be nothing but Hume's principle of invariability of antecedence and consequence put in a new guise. Whether or not this be admitted, it is certain that this principle, equally with that of Hume, is opposed to regarding a *miracle* as an act determined exclusively by *personal will*, and as incapable of being referred to antecedent conditions. This remark, which is clearly justified by the citations above given, is important as respects what I shall have to say subsequently concerning the philosophy of *The Unseen Universe*.

12. I proceed now to state as distinctly as I can the principles of the philosophy which I have already spoken of as directly opposed to that of Hume. This philosophy received its chief development at the epoch of Locke and Newton. With respect to Newton's share in originating or unfolding its principles, I do not so much refer to the natural philosophy established by the propositions of the *Principia* (although this was a necessary preliminary), as to "the Rules of Philosophizing" which he gave at the beginning of the third book, and to the conclusions he has come to in the general Scholium at the end. It is there that we meet with Newton's metaphysical views respecting matter and force, agreeing in the main with those held by Locke.

13. In the following arguments I use the expression "Newton's Metaphysics," or "Physical Philosophy," rather than "Newton's Philosophy," to avoid ambiguity, as the latter expression might be taken to include his theory of Universal Gravitation; whereas the subject I propose to discuss relates exclusively to the intrinsic qualities of *matter* and *force*.

Now the governing principle of the Newtonian metaphysics is, that there are no essential, or ultimate, qualities of matter and force, but such as we can understand by means of *sensation* and *experience*. This is a *regulative* principle, proper for being employed to determine what, according to this philosophy, are the

essential qualities of matter and force. I proceed now to make such application of this principle.

14. MATTER.—It is a fact of ordinary experience that bodies admit of being divided by breakage or cleaving into parts varying in number, form, and size. Newton speaks of “least parts” into which bodies are divisible, meaning parts of magnitudes so small that their qualities cannot be immediately discerned by our senses. According to the above-stated rule, these parts can have no other essential qualities than those which we are cognizant of by our senses, when we see and handle masses; namely, the qualities of *magnitude, form, mobility, and inertia*. This inference is expressly insisted upon by Newton in his Third Rule of Philosophizing. By taking magnitude to be an essential quality, we, of course, exclude the infinite divisibility of matter, and may properly designate Newton’s “least parts” as *atoms*.

15. That the quality of *inertia* is recognisable by the *senses* may be shown by such an experiment as the following. Conceive to be placed on a perfectly smooth horizontal plane a perfectly smooth sphere, and suppose the sphere to be pushed with the *hand* so as to be made to move in a straight course on the plane (without rolling) with a certain uniformly accelerated motion during a certain interval of time. This might be practically done, with sufficient accuracy for the purposes of the experiment, by regulating the motion communicated to the sphere by the hand, so that it shall be parallel and equal to the motion of another sphere (which might be called a *pilot* sphere), the latter having been caused to move by *mechanical* arrangements in the above-specified manner. Let the same thing be done with spheres of the same material, of twice, three times, &c. the size of the first, and in each case let the motion be regulated by *the same motion* of the pilot sphere. Then it would certainly be *felt* that the motion of the sphere was in each instance produced by a *personal effort*, and it would be perceived that the effort was greater the greater the size of the sphere, the effect of friction being assumed to be inconsiderable. The experiment might even suggest the law that the effort was in exact proportion to the size of the sphere; but it is not adapted to *prove* this law, the evidence for which, as will be stated subsequently, rests on different grounds. It proves, however, that the motion of the sphere was accelerated by a *personal effort* consciously exercised. Now the *inertia* of the body may be defined to be the quality which under the given circumstances necessitated the effort employed to accelerate its motion. Hence we may draw the noteworthy conclusion, that *the reality of inertia as a quality pertaining to bodies is recognizable by a sense of personal effort*.

16. It is also an essential peculiarity of inertia that it is not *quantitative*; that is, as Newton has remarked (Regula III.), it is not, like gravity, susceptible of any law of variation. The same matter may be more or less heavy according to circumstances, and there may be more or less of inert matter, but under no conditions can matter be more or less inert. For these reasons, inertia may be said to be an *innate* quality of bodies; while the same assertion is not true of gravity. To express this quality Newton uses the word "insita."

17. It is not necessary to adduce here the usual arguments of metaphysicians (those, for instance, of Locke), which show that we are cognizant of the other essential qualities of bodies,—*magnitude*, *form*, and *mobility*, by means of the senses of sight and touch. It will suffice to state that in the subsequent reasoning it is taken for proved that these fundamental qualities are all cognizable by information given immediately by the senses. Relative to this principle Newton makes the assertion, "This is the foundation of all philosophy" (Reg. III.).

18. To carry on the *à priori* argument respecting the ultimate properties of matter, another regulative principle is to be taken into account, namely, that these properties are *not quantitative*. We have already seen that the quality of inertia satisfies this condition. In order to satisfy it with respect to magnitude and form, we must suppose that in any given atom these properties are absolutely incapable of variation. The reasons for this second regulative principle cannot be fully unfolded till we have had Force as well as Matter under consideration. So much, however, as this may be said at present: Whatever is quantitative, or variable in a manner expressible by numbers, admits of being determined by mathematical reasoning. Such reasoning is necessarily based on principles, and conducts, according to ascertained rules, to quantitatively expressed results, or laws. The principles in the present inquiry are ultimate physical qualities, or properties; which, consequently, must be such as are not susceptible of quantitative variation.

19. With respect to the *forms* of atoms, if Newton's dictum, that "nature is wont to be simple and consonant with herself" (Reg. III.), be accepted, we might say at once that *all* atoms have the spherical form. Also "the tenor of facts of experience," attention to which is another rule laid down by Newton for forming *à priori* conceptions, conducts as follows to the same inference. If we agitate water in a vessel in any manner, and then leave it to settle into its original state, it will in all respects and for all purposes be the same water as before. But the agitation will have altered the relative positions of the ultimate parts in an unlimited number of

ways, and to conceive how such changes should produce no residual effect, it seems necessary to suppose the form of each atom to be such as to have no special geometrical relation to the positions of surrounding atoms. This condition can be satisfied only by the spherical form.

20. By the foregoing considerations we have been conducted to the following very definite result: *An atom is a very small inert sphere of invariable magnitude.* But however definite and intelligible this conception of an atom may be, inasmuch as the considerations leading to it were of an *à priori* character, we are not entitled, without inductive verification, to say that an atom is really such. We may, however, assert that the hypothesis of its being such is an appropriate basis of mathematical reasoning, and that by comparing results from mathematical reasoning thus founded, we can decide whether or not the hypothetical atom is a reality. The way in which this has to be done will be indicated by the discussion I am about to enter upon relative to the nature of Force. The discussion will at the same time take account of the property of *mobility* which is common to all matter.

21. FORCE.—From the experiment described in art. 15 we may gather that in the production of motion by force, the sense of touch tells us that *two* bodies are concerned, one of which is active, and the other relatively passive; one is the mover and the other the moved. As this is a mode of producing motion which is intelligible by sensation and experience, according to the philosophy I am expounding, there is no mode of producing motion which is essentially different from this. I assume that when a body is moved by being pushed with the hand, the physical action between the body and the hand is precisely the same as when one piece of *dead* matter moves another by pushing against it. And it must be admitted that in neither case have we reason to say that the parts of one body come into *actual* contact with the parts of the other. But in the case of the *personal* act there is a *felt* contact which is distinguishable from non-contact. Consequently our philosophy necessitates the conclusion that in every case of the production of motion (as of an atom by the ether) there is contact, *as felt*, between the moving and the moved body. Of course, if this be so, it is a necessary consequence that there is also the consciousness of a personal agent. For my part I accept this inference on the general principle that it is inconceivable there can be any production or event which is not determined by antecedent will, and by the power, in operation, of a conscious agent. But this part of the discussion I reserve at present, as it may be more appropriately handled with reference to a special metaphysical question that will

be treated of in a subsequent portion of this essay. I shall now only make the remark that this philosophy altogether excludes any action at a distance of one body on another which is not produced by means of an intermediate substance.

22. Newton, who regarded "the action at a distance" as a physical absurdity, has left on record his opinion that the substance by the intervention of which visible and tangible bodies act on each other is a fluid ("a certain very subtile spirit"), in all respects like air of given temperature, but exceedingly more elastic. This is the fluid which is now generally called *the ether*,—a term which, like *atom*, has come to us from a remote philosophical age. As the principles laid down in art. 21 do not allow of any other form of force than pressure, we have to assume that the ether has the property of *pressing*, and that, like air, it is susceptible of variations of density and pressure, as being in like manner atomically constituted. For the purpose of laying a foundation for mathematical reasoning, we may make the hypothesis (to be subsequently tested by results), that the variations of pressure are in exact proportion to the variations of density. After this there is no more occasion to refer to the atomic constitution of the ether, the calculation of the effects of its pressure being made on the supposition of its being a *continuous* fluid, and in exact accordance with the ordinary principles of *Hydrodynamics*.

23. Let us here briefly recapitulate what has been said respecting the foundations of Natural Philosophy. On the one hand we have the ultimate atom, endowed with inertia, spherical in form, and of constant and extremely small magnitude; on the other we have the ether, a perfect fluid, susceptible of variation as to density, and endowed with the faculty of pressing in exact proportion to its density. The ether is the active substance, the atom is the passive substance. But although the ether, regarded as being of uniform and constant elasticity and unlimited in extent, might be taken to be the source from which all *active* physical force emanates, it may still be true that there exists in the universe *another kind* of physical force having a different origin. The property of constancy of form and magnitude, with which we have supposed the atom to be endowed, would act as *resistance* to any pressure tending to change its form or dimensions, and, *pro tanto*, would be a real physical force. Such force could only have its origin, and be maintained, by the Will and Power that originally brought the atom into existence and affixed its properties. If Dr. Tyndall attributed to atoms only this passive and delegated "potency," I could agree with him; but I am not prepared to assign to them any active agency.

24. After the foregoing discussion of the principles of the

Newtonian physical philosophy, it is next required to show in what manner the consequences of its hypotheses may be calculated, and how by comparisons of calculated results with facts of observation the truth of the hypotheses may be tested. First, it may be remarked that the properties of the atoms and of the ether have been so defined that they form at once a basis for *mathematical calculation*. In short, under these hypothetical conditions, the facts of observation become for the most part only problems to be solved according to the principles and rules of *Hydrodynamics*. Towards effecting such solutions little could be done in Newton's time, because mathematics were not then sufficiently advanced to admit of this application. Not long afterwards, the occult quality of gravity, as I have already intimated (art. 8), having been generally accepted, Newton's metaphysical views were discarded or fell into neglect, and at the present day they are either silently put aside, or are even strenuously opposed. Consequently for pointing out the consequences to which that philosophy conducts (which for the purposes of my argument it is necessary to do), I am compelled to advert to researches which I have myself undertaken with the view of testing its principles and extending their application, none of my scientific contemporaries, for a reason which I shall shortly have to point out, having occupied the same ground.

25. Previous to stating by means of what calculations the hypotheses of the Newtonian system of Physics are verified, it is necessary to obtain a distinct conception of the meaning of "moving force." Reverting again to the experiment described in art. 15, it will be seen that what is there called a *personal effort* is, in fact, a *moving force* in the ordinary sense of this expression. It is, however, moving force in a special sense, having reference only to the personal efforts required for accelerating *different masses in the same degree*. But clearly another experiment, in which the mechanical acceleration of the pilot sphere could be changed at each trial, might indicate that different personal efforts are required for accelerating *the same mass in different degrees*, and might suggest that the effort is in exact proportion to the acceleration. Both kinds of experiment are required for exhibiting the complete meaning of "moving force"; and the metaphysical inference to be drawn, according to this philosophy, from the two together, is, that moving force is always and everywhere in essence *personal effort*. This, however, is not the inference with which we are concerned at present. In consequence of what is suggested by these and like experiments, moving force in its *scientific sense* is assumed to consist of two factors, one of which expresses that it is exactly proportional to the mass when the

acceleration is given, and the other that it is exactly proportional to the acceleration when the mass is given. After assigning to the two factors appropriate units, their product constitutes the analytical symbol which is universally employed in calculations relating to the effects of moving force. The hypothesis of the *exactness* of the proportions suggested by the experiments is abundantly verified by comparisons of the calculated results with experimental facts. It may, further, be remarked, as a corollary to this argument, that it verifies two of the fundamental qualities of matter; its *mobility*, by showing that it is capable of being moved by force, and its *inertia*, by showing that it requires force to move it.

26. Considering the special object of this essay as expressed by its title, and the usual character of the communications made to this Society, it would be altogether inappropriate to enter into details respecting the mathematical reasoning of which the adopted definitions of the atoms and the ether form the basis. Neither, as far as regards the exhibition of the general argument, is there any occasion to do so; but it will be necessary to state some of the principal results. Respecting these it is important to make the preliminary remark, that as they are deduced from definitions that are intelligible from *sensation* and *experience*, they are *theoretical* results in the strict sense of that term,—the sense it has by being derived from *θεωρία*, *viewing*. By modern physicists the word *Theory* is used in various senses, as, especially, to denote the representation by formulæ, however obtained, of the experimental laws of physical phenomena; but its proper scientific meaning is that in which it is applicable, as just mentioned, in the Newtonian system of physical and metaphysical philosophy. Now since, as I have already said, this philosophy has not been adopted, or carried on, by any of my contemporaries, it follows that I am alone responsible for the deductions from it which I am about to state. These are results which have been obtained by mathematical reasoning from precisely defined premises; and although, as must be admitted, the application of the mathematics is attended with difficulties, and the reasoning is for the most part of a novel and high order, the results may, I think, lay claim to consideration on the ground of being the fruits of labours devoted to the solution of hydrodynamical problems through a long course of years. At all events, I hope by means of the subjoined statements, whether or not they be assented to, to indicate what is the actual position of physical science, and to remove some prevailing misapprehensions as to its character and objects.

27. The following inferences, deduced mathematically from the adopted definitions of the atoms and the æther, are stated here as being of chief importance relative to the conclusions that will sub-

sequently be drawn from the foregoing discussion of the Newtonian Physical Philosophy.

(1.) Foremost among the results of Theory are to be placed the explanations of phenomena of *Light*, which are given by means of a mathematical investigation of the laws of *Undulations of the Ether*. These explanations, so far as they rest solely on the assumed properties of the ether, are analogous to explanations of phenomena of sound by vibrations of the air. So numerous and specific, and so complete, are the theoretical explanations of this class, that in published discussions of them I have ventured to express the opinion that of themselves they afford strong presumptive evidence not only of the reality of the ether, but also of its being such as it was assumed to be.

(2.) The mathematical investigation of the motions of the ether conducts to a unique species of motion which may be called ray-vibration, inasmuch as it consists of vibratory motions partly transverse and partly parallel to an axis. These ray-vibrations may be supposed to be the exponents of *rays of light*; and whereas experiment has shown that the sensation of light results from action on the retina of the eye, the direction of which is *transverse* to the direction of incidence of the light, it is reasonable to ascribe this action to the transverse vibrations above mentioned, and to suppose the direct vibrations to be in this respect inoperative.

(3.) The phenomena of Light which depend on relations between atoms and the motions of the ether are not in general as readily explained, on account of our not knowing the exact conditions of the problems, as those which depend simply on the motions of the ether. But in cases in which the atoms are constituents of regularly crystallized substances, phenomena under special circumstances have been observed which admit of satisfactory explanation on the Undulatory Theory of Light. It is here that the Theory of Light is brought into relation with the sciences of *mineralogy* and *crystallography*.

(4.) The sensation of Light, as well as the phenomena of Light generally, being attributable to motions of the ether which are of the *first* order, and consequently vibratory, or recurring motions, it follows that the transverse light-producing vibrations impress on atoms only vibratory motions. But I have found, by including in the mathematical calculation terms of the *second* order, that the direct vibrations of a ray, or those of a *wave* composed of an unlimited number of ray-vibrations, are capable of causing an atom to vibrate, and, at the same time, giving it a permanent motion of translation; and that even the transverse vibrations can produce the same effect. There is nothing antecedently improbable in this result; for, in fact, it has recently been ascertained by *experiment*

that translatory action, which appears as attractive or repulsive force, may be produced by vibrations. But if this be so, it is plain that we have the means, without having recourse to occult qualities, of framing a theory of attractive and repulsive forces, inasmuch as these might be accounted for by dynamical effects of vibrations of the ether. Accordingly, since it is allowable to assume that as there are light-producing vibrations of the æther, there are also heat-producing, we can by this theory give a reason for the observed repulsive power of *heat*.

(5.) By applying this theory of motion of translation of atoms caused by ethereal undulations to the case of *gravity*, I have found that this force may be attributed to the translatory action of undulations of such magnitude that they may be supposed to traverse large masses, such as the sun and the planets, without undergoing sensible change or retardation. The space occupied by the matter of the atoms must be supposed, even in the densest bodies, to be very small, compared to the intervening spaces. Under these circumstances it appears that both the law of the inverse square, and Galileo's Theorem, which were spoken of in articles 3 and 4 as constituting the foundation of Physical Astronomy, may be accounted for.

(6.) A *molecule*, as the name implies, may be taken to be a mass of *atoms*. One molecule may be conceived to differ from another solely by reason of difference in the *number* and *arrangement* of the atoms. The law of action of *gravity* on all bodies equally is most simply explained by supposing the constituent atoms of all bodies to be of the same size. My hydrodynamical researches point to the necessity for fulfilling this condition in order to account for that law.

(7.) As there are *winds* of the air as well as vibrations, so there are *currents*, as well as vibrations, of the ether. The ethereal vibrations are concerned in producing the repulsion of heat, molecular attraction, and the force of gravity. Electric Force, Galvanic Force, and Magnetic Force, are referable to steady ethereal currents in a manner I shall endeavour presently to give some idea of. From Hydrodynamics we learn that such currents are accompanied by variations of density and pressure from point to point of space, and to these variations of pressure differently produced in the three instances, the three kinds of force are attributable.

(8.) The solid, liquid, and gaseous states of the same substance are referable to different conditions of the action of the atomic repulsion of heat and molecular attraction within a superficial stratum of the substance of extremely small thickness. In the gaseous or aëriiform state there is no superficial molecular attraction to control the atomic repulsion, and consequently a gaseous body,

under the influence of heat, may be enormously expanded, as is seen to be the case with respect to the comæ of some comets on approaching the sun. At the surface of a liquid there is an excess of molecular attraction, giving rise to the phenomena of *Capillary Attraction*, but the resulting action is too feeble to affect sensibly the fluidity. On the contrary, in the solid state each atom in the superficial stratum is equilibrated by counteracting atomic repulsions and molecular attractions in such manner that fluidity is destroyed and the atom can only oscillate about a certain normal position. Experience, however, shows that this state of the superficial stratum may be altered by *friction* applied at the surface, and that the atoms may thus be made to take other positions, which it is found, they retain with more or less persistence, till at length the substance returns to its normal condition. Whilst the superficial atoms are in the abnormal positions the substance is in an *electrified* state.

(9.) It seems evident that when by friction the superficial atoms are disarranged and the electrified state is induced, forces are called into play which disturb the equable distribution of the atoms in the *interior* of the substance. They must become in some degree more closely packed at some parts than at others, and there will consequently be a *gradation of atomic density*. Now I have succeeded in showing, on the before-mentioned hypotheses of the hydrodynamical origin of attractive and repulsive forces, that so long as by the action of such forces the substance is maintained in the *constrained* state above described, there will also be maintained steady ethereal streams circulating in, and in the neighbourhood of, the substance. The dynamical effects of these streams account for *electrical attractions and repulsions*.

(10.) *Galvanic* Force accords with Electric Force so far as both are due to the agency of ethereal streams which have their origin in disturbances of the atomic state of superficial strata. But in galvanism the disturbance is the result of *contact of dissimilar substances*, intensified generally by the action of acids; and because this generating process is of a *continuous* kind, it is necessary to provide conducting wires for the circulation of the streams, or for transmitting them from one position to another in the earth's interior. Whilst in these respects electricity and galvanism differ, the conditions of *polarity* are the same in both.

(11.) In the generation, by Seebeck's experiment, of *thermo-galvanic* currents, the requisite gradation of interior atomic density is produced by *unequally* heating the two ends of a lamina of metal.

(12.) There is nothing in the state of the superficial atoms of a *magnet* which has any relation to magnetic force. Yet this, like

the forces of electricity and magnetism, appears to be due to ethereal streams generated under the condition of variation of interior atomic density. Such variation may be supposed to be produced in a magnetic bar in the following manner:—It is evident that in any case of *uniform* atomic density, the molecular attractions acting on a given atom will be equal in all directions, and will therefore just neutralize each other; and that similarly the resultant of the atomic repulsions acting on a given atom will be zero. But it is quite conceivable that the equilibrium of an atom might result from the counteraction of one set of forces by the other; only in this case there must be a *gradation of atomic density*, molecular attraction always acting in the direction from rarer to denser parts, and atomic repulsion in the opposite direction. The capability of satisfying magnetic physical conditions, which exists in an eminent degree in iron, can only be attributed to the particular constitution of the substance. The effect of the known processes of *magnetization* seems to be to induce a gradation of atomic density; in soft iron, temporarily, and in hardened steel, permanently. The ethereal steady streams, generated under the conditions in which this gradation of atomic density is maintained by the interior molecular attractions and atomic repulsions, produce by their action on temporary or permanent magnets, and on galvanic conductors, those movements which experimenters ascribe to *magnetic attractions and repulsions*. Such phenomena are consequently accounted for by the hydrodynamical theory of magnetism. I take occasion to state here that I have succeeded in demonstrating, according to the principles of that theory, two well-known experimental results obtained by Gauss; namely, that the action of a large bar-magnet on a small one, when the axis of one points perpendicularly to that of the other through its middle point, varies inversely as the *cube* of the distance between the middle points; and that, in case the axis of the small one points to the middle point of the large one, the action is just *half* what it is in the contrary case. The theoretical explanations of these facts are specially noteworthy, because they depend entirely on the supposition of the *spherical form* of atoms, and may be regarded as verifications of that fundamental hypothesis.

(13.) Like all other magnetism, *Terrestrial Magnetism* is to be referred to the agency of ethereal streams; but in this instance the streams are not due to gradation of atomic density, but are simply impressed on the ether by the constituent atoms of the earth in their diurnal revolution about its axis. The generating cause being steady, the streams also are steady, and have always nearly the same relation to the position of the earth's centre, the system of streams being, as it were, borne along by the earth's motion in its

orbit. Terrestrial magnetism is, however, subject to diurnal, annual, and secular *variations*, attributable, apparently, to modifications of the ethereal streams resulting from periodic changes produced in the distribution of temperature in the atmosphere, and other matter pertaining to the earth, through solar and planetary influences. It may be noticed that the above view of the generation of magnetic streams by impulses given to the ether by the earth's revolving atoms involves the fundamental hypothesis that the atoms are of *sensible magnitude*.

28. In deducing the foregoing inferences, (1)—(13), from the Newtonian physical philosophy, I have relied on mathematical arguments contained in three works relating to the study of mathematics and physics in the University of Cambridge, which I produced in the years 1869, 1873, and 1875, and on physical investigations which I have contributed from time to time to the *Philosophical Magazine*. Any one who wishes to be fully acquainted with the reasoning which, from a few intelligible hypotheses, has conducted to results so numerous and so various, would have to consult those publications. Perhaps, however, these results, even as stated above, may be considered to give, at least, *primâ facie* evidence that the system of philosophy I am upholding is in character and comprehensiveness such as, to be true, it is required to be. If it does not embrace the whole range of physics, it fails altogether. By inspection of the words which, in the statements, (1)—(13), are put in *italics*, it may be seen that the condition of comprehensiveness, as regards the different branches of physics, is fulfilled. Considering, therefore, that a presumption has thus been established that the principles of the Newtonian philosophy are true, I shall now proceed to inquire what, accordingly, are the character and limits of physical science, and what *metaphysical* consequences may be deduced from it.

29. In the first place it is to be observed that this philosophy postulates the existence of *two* kinds of realities, those of the first kind being the ether, the atoms, and their intrinsic qualities, as already defined, and those of the other kind, consequences shown by mathematical reasoning to flow from certain conditions and mutual relations which the first kind have been ascertained to be susceptible of. As our philosophy admits of no qualities other than those the cognition of which is acquired by sensation and experience, the first class of realities are perfectly *intelligible*; and such also are the other class, because they are shown by mathematics to be consequences of the first. The very term *mathematics* (from *μάθησις*) implies this. There is, therefore, nothing *occult* in this philosophy. When we have arrived at the second class by reasoning mathematically from the first, we may be said to have

given a mathematical theory of the former, and in this way to have accounted for them. It would evidently be absurd to attempt to give a theoretical explanation of the first class, inasmuch as they are the foundation of all physical theory. If then it should be asked, What was the origin of these fundamental entities? the only answer that can be given to this question is, that they came into existence, and are such as they are, by the immediate will and power of the Creator of all things. They are *facts*—things caused to be—as are all the objects which the ordinary observer or the experimentalist calls facts. (Possibly the word had its origin in personal consciousness of the power to act and to make.) Thus in physics we are concerned with two classes of facts, which may be distinguished as *primary* and *derivative*.

30. As it must be granted that every rational *act* is done by a person and with a purpose, it is reasonable to inquire, For what purpose has existence been given to these two classes of facts? This question admits of the following explicit answer: The world was created and furnished, as we may presume, with reference to man, its principal occupant. Having endowed him with intelligence, the Creator willed to show him both His power and His wisdom. The first class of facts are indicative only of the attribute of power; the others are significant of wisdom, as consisting of ends accomplished by means. These means take the form of *laws*; whence it follows that physical laws are proper subjects of human inquiry. The inquiry consists of two parts distinct from each other, but both indispensable for constituting physical science. First, the laws which govern the results of given physical circumstances have to be ascertained by observation and experiment; and then *reasons* have to be given for the laws by employing *calculation*, according to known rules, for deducing them under the given conditions from the primary qualities of the ether and the atoms. Such results of calculation are those stated in art. 27. The calculation is possible, because “all things are ordered in measure, number, and weight” (Wisdom xi. 20), and it is not too much to assume that the Creator so ordered them for the express purpose of enabling us to obtain complete knowledge of His laws. The discovery and certifying of laws by experiment does not constitute the whole of physical science; it is a necessary part of it, but subordinate to the theoretical part. Not till we have succeeded in accounting for laws by mathematical *reasoning* founded on intelligible and ultimate premises, can we be said to have reached physical *science* properly so called. These considerations may be appropriately concluded by the following illustration:—

31. An engineer who had constructed a steam-engine to do certain work, would be able to explain to us how, by the arrange-

ment of the different parts and adjustment of their relations, the proposed end was accomplished, and we might have good reason to admire the invention and skill with which he had adapted the means to the end through his knowledge of the properties of fire, fuel, water, and iron. But it would be unreasonable to ask him to tell by what means such properties were produced, inasmuch as it suffices for his purpose merely to know that they exist. Just so we may be able to understand the prescience and wisdom with which the Creator effects His purposes in nature by operating with instruments to which He has assigned certain cognizable qualities, although the instruments and their qualities should be referable to no antecedent physical causation, but exist by immediate creation. Further it may be said, when account is taken of the Scriptural assertion that man was created in the image of his Maker, that the human intelligence displayed in mechanical constructions is not essentially different from the divine intelligence whereby the mechanism of Nature was planned and executed.

32. Before proceeding to another part of the discussion, it will be proper to introduce here a question the consideration of which will bring the Newtonian physical philosophy into close connection with the metaphysics of Scripture. In art. 18 mention is made of a regulative principle, according to which the ultimate properties of matter which form the basis of physical theory are *not quantitative*, inasmuch that gravity, the law of which has a numerical expression, is on that account not an ultimate quality. There is, however, a noteworthy exception to this rule in the definition we have given of the ether. This medium was assumed to have the property of varying in pressure proportionally to variations in density. But this hypothesis is contradictory to the principle just mentioned of non-variability of ultimate properties. In addition to this, such relation between pressure and density is a *law*, actually pertaining to air of given temperature. Now, since it is the province of theory to account for laws, this law of the ether should be referable to some ulterior cause. As respects the air, I have reason to say that the law may be accounted for by the dynamical action of the ether. It would seem, therefore, obvious to ascribe the existence of the same law in the ether to the action of another ether of still greater tenuity; and so on. This inference respecting successive ethers is very analogous to the idea of "invisible universes" of successive orders proposed in pp. 170-172 of *The Unseen Universe*, on the agency of which the authors of that work lay great stress. But it seems to me much to be questioned whether there is reason to admit the reality of this succession of ethers in the sense in which we may admit the reality of the one ether whose existence and qualities we recognize by *phenomena* (see art.

27 (1)). I do not know that I can better express my views on this point than by quoting from one of the works referred to in art. 28, which was published in 1875 under the title, *Cambridge Mathematical Studies, and their Relation to Modern Physical Science*.

33. In page 92 of that work I have argued as follows: "It was legitimate to assume the existence of an ether having the properties of pressing, and of pressing proportionately to its density, provided it could be shown that these hypotheses were necessary for giving reasons for natural phenomena. Let it be assumed that this has been shown, or may be shown, by our system of philosophy, and that thus the pressure and variation of pressure of the ether may be proved to be realities. The question might then be asked, What account can be given of the agency concerned in this pressure and variability of pressure? It is to be noticed that this is not a *physical* question: we have now (on the above assumption) passed the boundary of physics. It can, therefore, receive answer only by reference to *metaphysical*, or *spiritual* agency." (These assertions are made on the ground that, as presumptive evidence has been given that the Newtonian physical philosophy is true (see art. 28), we may suppose all physical phenomena to be explainable on the hypothesis of a *single* ether, and consequently infer that there can be no phenomenal evidence of the existence of any other as a physical agent.) "It seems to me not unreasonable to suppose, since we, as partaking of a spiritual nature, are endowed with power over the gross matter which constitutes our bodies, to move it at our will within prescribed limits, that there may be intelligent spiritual beings of another order, by whose conscious and immediate agency, exerted in fulfilment of their Maker's will, the pressure of the ether, and the law of variation of its pressure, are maintained, that thereby it may perform its destined physical functions. This view is in conformity with the teaching of the Scriptures respecting *angels*, to whose agency they uniformly ascribe what we call Nature's operations, apparently because, as I have already said, it is inconceivable that there can be any production or event apart from the purpose and consciousness of an operator." May we not in this sense interpret the text, "He maketh His angels spirits and His ministers a *flame of fire*"? (Heb. i. 7). According to St. Paul's preaching to the Athenians, we possess the power of moving the body by reason of union with our Creator, for he asserts that "in Him we live, and *move*, and have our being" (Acts xvii. 28). So also the power of angels is conditioned and derived, and what is done by angelic agency is done by God Himself. The foregoing argument may be taken to be the sequel of that which was begun in art. 21.

34. After the preceding discussions we may proceed to consider in what relation the Newtonian physical philosophy stands to the question of *miracles*. Since it has been shown that according to this philosophy there are two kinds of natural facts, one primitive, the other derivative, one referable to no physical causation, but resulting immediately from creative energy, the other derived from the first by recognizable physical causes operating according to ascertainable laws, obviously a miracle may be put in the first class of facts, and be regarded as the product of a re-exertion of creative power. By whatever personal instrumentality a miracle is performed, it is the act of a *Creator*, who must be conceived to be Omnipotent, and consequently no human judgment could be antecedently formed as to what might be the character or limitation of miracles, their actuality and quality being absolutely determined by will and power which are not subject to limitation or condition.

35. Yet the testimony of the senses is as adequate to certify respecting the reality and character of a miracle as if it were any ordinary event. This may be shown by the following argument. According to the principles of our philosophy, a miracle cannot be a *violation* of physical laws, inasmuch as these laws are *logical* consequences of primitive facts of an invariable kind. It is true that these facts, or premises, may by a miracle be changed as to number, mutual dependence, and relations to time and space, but the characteristics of the primitive facts, and the *reasons* derivable therefrom for the laws (as shown in art. 30), remain always the same. When, for instance, five thousand persons were fed with five loaves miraculously multiplied, the bread that they ate was endowed from the first with the same qualities as ordinary bread, and became subject to the same laws. The miracle consisted in the *multiplication* of the loaves by an operation which, as being *creative*, is incapable of being submitted to logical inquiry. But the wonderful effect was matter of actual observation and experience.

36. The Scriptural miracles may be placed in the category of "Metaphysics of Scripture," not solely because they are due to personal will and agency, for this, as we have argued in articles 25 and 33, is to be predicated of all natural operations, but because they are due to such agency exercised for special purposes *supernaturally*. Consequently, in so far as the metaphysics of Scripture include the supernatural agency whereby miracles are wrought, they stand in no contradiction to the Newtonian physical philosophy, which, according to our argument, allows of creative miraculous acts; rather, miracles may be regarded as the logical outcome of that philosophy. On the contrary, the metaphysical philosophy of Hume, as also that maintained in *The Unseen Universe* (see the citations and remarks in articles 10 and 11), are directly

opposed to such definition of a miracle as that which is proposed and exemplified in articles 34 and 35. The reason of this diversity may be stated in few words. It arises altogether from a gratuitous rejection, on the part of these philosophers, of the physical doctrine, that the essences of matter and force are cognizable by sensation and experience, and their inability, in consequence, to admit the existence of the class of facts which Newton asserts to be the foundation of philosophy.

(To prevent misapprehension, I take occasion to explain that I have made no allusion to what the authors of the above-mentioned work say respecting Newton's *mechanical* philosophy, which they make much of, and about which there is no room for dispute. I refer only to their persistent opposition to Newton's Third Rule of Philosophy at the beginning of his Third Book, in consequence of which, as it seems to me, they deviate from the prescribed path of physical *theory*, and are compelled to have recourse to arbitrary *speculation*. In justification of this remark I may appeal to the vast amount and singularity of the speculations which the authors of that work, and others who think with them, have recently promulgated. See what I have said in pp. 73—81 of the publication cited in art. 32.)

After what has now been said on the question of miracles, in addition to the views expressed in articles 8—11, and considering that the same subject is discussed in my remarks appended to the Rev. Prebendary Row's Paper on "The Principles of Modern Pantheistic and Atheistic Philosophy" (contained in No. 31 of the Journal of the Transactions of the Institute), to which remarks I beg to call the attention of readers of this essay, there is no need to say more on the relation of Scriptural Metaphysics to the department of science designated as *Physics*. I shall now proceed to analogous inquiries relative to other departments of Natural Science, as especially *Geology*, *Botany*, and *Natural History*.

37. There is this particular advantage in having treated of Physics first, that as being more completely understood than the other branches of science, it furnishes a pattern whereby the discussion of these for the purposes of our argument will have to be regulated. Accordingly it may be presumed that in each department there will be both primitive and derivative facts, and we shall have to employ all available means to distinguish one kind from the other. Also, arguing analogously from the conclusions arrived at in Physics, we might say that in all cases the primitive facts exist by immediate *creation*, and that by this criterion they are distinguished from the derivative facts, which are results of the operation of *laws*. Now, the first chapter of Genesis professedly

gives an account of the creation of heaven and earth and all the things therein. Considering that this account treats of subjects that were far removed from all human cognizance and experience, it would be a foolish proceeding to draw inferences from it on any other hypothesis than that it is a direct communication from the Holy Spirit of the Creator. On this ground alone can it be accepted as trustworthy. And surely there is nothing unreasonable in the belief that the Creator has Himself given to His intelligent creatures an account of His creation. The principles I am advocating are such as to make it necessary to insist on this point. For, by definition, the primitive facts cannot be reached by reasoning, although, without knowing them, the sciences to which they respectively belong have no theoretical foundation. It may be admitted that something may be done towards *hypothetically* laying such foundation by observation and research, since, in fact, this has been done in the case of theoretical Physics; but with respect to other departments of Natural Science I shall presently have occasion to remark that attempts of this nature have led to very uncertain results. It is, at least, evident that no surer foundations for the sciences of Geology, Botany, and Natural History could be laid than authoritative declarations from the Author of the Universe as to what are really the ultimate and primordial facts of these sciences. At the same time it must be admitted that with respect to the *laws* of the operations whereby facts of observation result from the ultimate facts, no information can be obtained from the first chapter of Genesis, which states only primary conditions and final causes, leaving apparently the *modus operandi* for our scientific researches. It may, however, be said that it is legitimate to employ the knowledge acquired by such research in *interpreting* the Scriptural statements.

38. This being understood, we may next inquire what information respecting the foundations, or ultimate facts, of Natural Science may be gathered from the revelations of Gen. i. In making this philosophic use of that chapter I propose to take it just as it is given in the Septuagint, on account of the sanction which this version has received in the New Testament, and the improbability that any rendering of Hebrew texts of later date by many centuries than the text which was in the hands of the Seventy Interpreters can as faithfully express the meaning of the original and the mind of the Spirit as that ancient Interpretation. The literal translation of verses 1 and 2 is as follows:—"In the beginning God made the heaven and the earth. Now the earth was invisible and unfurnished; and darkness was upon the abyss; and breath of God was borne upon the water." The first verse may be taken as simply asserting that all the constituents of external nature were

originally created in such manner that, as explained in the Epistle to the Hebrews (xi. 3), "things seen were not made of things that do appear." Interpreted on the principles of physical science, this original creation may be understood as referring not only to the ether and the atoms, but as embracing also the composition of all visible and tangible substances, whether simple or compound, as respects the number and arrangement of their constituent atoms and molecules. This supposition does not exclude, but rather lays the foundation of, the sciences of *Chemistry* and *Crystallography*, the former consisting, for the most, in analyzing, and to a limited extent compounding, bodies, and the other in determining the forms of their superficial boundaries as resulting from their composition and the ætherial forces which maintain the arrangement of the atoms.

39. It does not seem possible to conceive how the *proportions* of the gaseous, liquid, and solid parts of our earth were determined to be such as they are except by creation according to an antecedent design. What is said in verse 2 implies the existence already of these components, mention being there made of earth, water, and air (γῆ, ὕδωρ, πνεῦμα), and of relations between them. Of the earth, or solid part, it is stated that it was "invisible and unfurnished," which might well be, owing to its being covered by an "abyss" of water, of unperceived depth, but bounded by an upper surface. On this surface rested the air we breathe, πνεῦμα Θεοῦ.

(The Septuagint does not admit of the translation "the Spirit of God," because the article τὸ is not prefixed. Also the word translated "was borne" (ἐπεφέρετο) applies only to a material substance, being the same word as that used in Gen. vii. 18 to express that the ark was borne up by the waters of the Deluge. What in Job xxvii. 3 is called "the Spirit of God" according to the English version, and πνεῦμα θεῖον according to the Septuagint, and is said to be in the "nostrils," is evidently air that is breathed. When, however, it is considered that it is only in consequence of perceiving effects of the air we breathe that we speak of *the spirit of life*, it will appear that the adjunction of Θεοῦ to πνεῦμα necessarily has implied reference to the Holy Spirit, the Giver of Life.)

40. Hence, according to the statements of Scripture, as scientifically interpreted, we have to think of the primordial earth as consisting of a solid nucleus, enveloped by a shoreless ocean, on the surface of which an atmosphere is incumbent. The generation of Light by God's command on the first day might be the sensible evidence of the contemporaneous commencement of all the vibrations and motions of the ether by the action of which, according

to the principles of our philosophy, the gaseous, liquid, and solid states of the earth's tripartite materials are maintained. It will be seen that in these views no account is taken of Laplace's *Nebular Hypothesis*. I confess that I have never been able to accept that hypothesis, on account of the hopelessness of the possibility of our ever comprehending in what way masses of porphyry and granite, and such substances, could have been produced from cosmical nebular matter. Since, as I think I have shown, the words of Scripture point to the existence of primordial conditions of quite a different kind, and since also, according to our principles, we can look for information respecting such conditions only from the Word of the Creator, I conclude that there is no foundation for the Nebular Hypothesis.

41. In Eastern nations it seems that a traditional cosmogony was extensively prevalent, according to which the original state of the earth is likened to an *egg*. Whether or not this idea had its origin in Scripture, it certainly approximates closely to the view taken above of the description in Genesis i. of the earth's primordial condition. Now, as by mere application of heat the chick is generated out of the albumen and yolk of the egg, analogous effects might result from the action of *heat* on the component parts of the earth disposed as above stated. The first effect of such action might be to produce the *firmament* spoken of as made on the second day, the heat generating by evaporation from the ocean-surface a cloud-stratum, separated by a certain interval from the earth's surface, and analogous in that respect to the ever-varying and cloud-like stratum which the telescope shows to us as encompassing the body of the sun.

42. Before proceeding to the next step, I beg to call attention to a singular circumstance relating to the distances of the planets from the sun. The intervals between successive orbits increase, it seems, with distance from the sun according to an empirical law, called *Bode's law*, which, however, has no pretension to exactness, and was found, in fact, not to be satisfied in the case of the distant planet Neptune. As the theory of gravity will not account for such a law, possibly it may be ascribed to a repulsive action between the planetary masses at very remote geological epochs, when their internal and radiated heat might far exceed the amount of any existing at the present time. Supposing a change of distances from the sun to have resulted from this operation, till the planets settled down into their present mean distances, and supposing their masses at the same time to have undergone a process of cooling, we have in the consequent variation of the earth's internal heat, and in the before-mentioned cloud-stratum, just the conditions which, according to the arguments in my paper "On the Relation

of the Scriptural Account of the Deluge to Physical Science," would suffice for causing *the dry land to appear*. It is here, I think, we may see on what kind of foundation the science of *Geology* rests. We cannot predicate the primordial state of the earth; but this being told us, the physical consequences are matters for logical inquiry and mathematical investigation.

43. By the combined action of water and heat the surface of the dry land might be prepared for the reception of herbs and trees, which in Gen. i. 11, 12, are said to have been created on the same third day. Respecting this creation it suffices for my purpose to remark that the Scripture states that the herbs and trees were of different kinds, and that each kind was complete in itself, having *seed* in itself, and yielding *seed*. The *seed* is the primitive fact. The science of *Botany*, which has nothing to do with the origination of seed, consists in ascertaining the laws of *growth* therefrom, and of the *reproduction* of herbs and trees.

44. The creation of "the two great luminaries" and of "the stars also," is referred to the fourth day. Speaking scientifically, we should say that they were already in existence, having been created at the same time as the earth. But here a principle discoverable in Scripture narrative is to be taken into account, the non-recognition of which has given rise to much error (as, for instance, in Dr. Colenso's writings on the Pentateuch). The principle is, that an order of narration with respect to time is subordinated to an order governed by relation. The pervading purpose of the statements in Genesis i. is to indicate the successive steps by which the earth was made fit for the life, growth, and reproduction of plants and animals. Alternation of day and night and of seasons might not have been necessary for the life and growth of *plants* in remote geological times, and, in fact, would not have existed, if, as might reasonably be assumed, the earth, by reason of a high degree of temperature, was then *self-luminous*. But, according to existing circumstances, alternations of day and night and seasons are required for the life and sustenance of *animals* and of man. Between the epoch of the first creation of plants and that of the creation of animals, the decrement of terrestrial temperature might have so modified the cloud-stratum as to give it the ever-varying and intermittent conditions which we witness at the present day, and allow the luminaries to be seen so as to rule days and nights, and months and years. According to the above-stated principle, their creation would be mentioned in connection with that change. It is to be noticed that what began to be *effected* by the luminaries on the fourth day is chiefly dwelt upon, their creation being only incidentally mentioned.

45. On the fifth day God commanded the *waters* to bring forth

fish and fowl. As this is not a natural process of generation, the command given to the waters signifies that the effect was produced simply by a *creative* act. It is expressly said that both fish and fowl were *thus* created "after their kind," which is a direct assertion of the original generation of *species*.

46. So also on the sixth day the *earth* is commanded to bring forth beasts, and cattle, and reptiles; which, for the same reason as that just mentioned, means absolute *creation*. Lastly, man is created, male and female, in the image of his Maker. Adam was made of the dust of the ground, and Eve of a bone of Adam, expressly to show that the human race had its beginning in a single pair by *creation*, all others coming into existence by means of natural generation. The creation of *species* of beasts and cattle is as expressly affirmed as that of fish and fowl.

47. I suppose that no advocate of development would contend that an oak might have had its origin in a lichen, or a blade of grass. There is just as little reason to say that man was developed from an oyster. Different species were created *ab initio* for different purposes. The lion, the horse, the lamb, severally have assigned parts both in nature and in Scripture. The ape, possibly, might be intended for setting forth by contrast the grace and nobleness of the human form, being all the more adapted to that end by its proximity in external appearance in some respects to man. But the Scriptural doctrine of species forbids us to admit that man could have had his descent through an ape.

48. I propose to conclude this Essay by directing attention to the leading points of the arguments I have adduced. With respect to all that has been said, the most essential principle is the distinction between created existences and those which result from them by the operation of laws. To this principle I have been led by adopting the Newtonian Physical Philosophy. The distinction pertains to all departments of physical and natural science. In Physics the primitive entities are the ether and the atoms, the creation of which is implied in the account of the Creation in Gen. i., although their names have been derived from Greek philosophy, and their reality is established by modern science. But with respect to the other departments of natural science, my contention is that we are absolutely dependent on Scriptural statements for knowing what are really the primitive facts originating in creation. Modern theories of the origination of the facts of the external world are only vain attempts to dispense with having recourse to the Word of God for information. Darwin has invented *phrases*, which have become current, but how far they express realities still remains to be shown. The *protoplasm* of Huxley only demonstrates the perfection of the instrumental means

by which the *consequences* of the primordial conditions have been traced to their minutest particulars, but is itself in no respect *primary*. In an article contained in the *Fortnightly Review* for November, 1875, Dr. Tyndall expresses great admiration of the beauty of the form of the *snow-flake*, which he seems disposed to attribute to some undefined virtue in atoms, but dares not say that there is "Mind." The mathematical physicist, who has ground for expecting that he may be able to account for this form by reasoning from the properties of the ether and atoms, has not the less reason on that account to admire its beauty; and besides, as knowing that his mathematical symbols are only means to help him to *understand* how the effect is produced, he is compelled to believe that the *modus operandi* was ordered by mind, which from the first perceived the consequences. It is remarkable that in Gen. i., where after each creation it is said that "God saw that it was good," the word for "good" in the Septuagint is *καλόν*, which, as applied to material substances, can only mean "beautiful."

The authors of *The Unseen Universe* are certainly not chargeable with opposition to Divine Revelation. But by not accepting the Physical Philosophy which ascribes our perception of ultimate qualities to sensation and experience, they reject the aid of *personal consciousness*, which in Scripture is recognized as a source of knowledge. ("That which may be known of God is manifest in them."—See Rom. i. 19, 20.) This, I think, accounts for the *inconsecutiveness* of the arguments by which they attempt to connect physical science with the truths of Revelation. (See Appendix II. of the work cited at the end of art. 32.)

I am well aware that arguments have been adduced in this Essay that are insufficiently developed to be generally intelligible, and others that might be called in question. I think, however, that I may have done something both for science and for religion if I have succeeded in demonstrating that physical science consists of two distinct parts, one relating to *causes*, and the other to *laws*, and in indicating their respective relations to Scriptural truth.

The CHAIRMAN.—I am sure you will unite with me in returning cordial thanks to Professor Challis for his very able paper; it will be open to those present to offer remarks thereon after two communications have been read.

The HONORARY SECRETARY then read the following letters:—

"THE CLOSE, LICHFIELD,

"28th April, 1876.

"DEAR SIR,—I have to thank you for your courtesy in sending me the 'proof' of Professor Challis's paper, which is to be read at the Victoria Institute on the 1st prox. I see by his first paragraph, and his subsequent handling of his subject, that he uses the word 'metaphysics' in its etymo-

logical and Aristotelian sense only, and not in the 'comprehensive' and technical sense in which the term is now ordinarily used. I wrote to you, therefore, under a misapprehension of the Professor's intention. I am sorry that he has given by his terminology any countenance to the idea that metaphysics, in their ordinary sense, are to be found in Scripture. I learnt from Bacon's *Advancement of Learning*, that 'natural theology hath been handled confusedly with metaphysique,' (p. 134); and again, I learnt from him to beware of basing divine revelation on any *à priori* grounds of reasoning, (p. 129). 'Out of the contemplation of nature, or ground of human reasoning, to induce any verity or persuasion concerning the points of faith is in my judgment not safe, "Da fidei quæ fidei sunt."—*Conf.* p. 310, Pickering's edition, 1825. I should imagine that all that can be truly said about the metaphysics (properly so called now) of Holy Scripture would be that the Bible *takes for granted* a Personal God and our own personal consciousness—('God and my own soul,' as Dr. Newman phrases it) and the existence of external matter. With the Professor's paper I am not capable of dealing.—I remain, yours faithfully,

"C. J. ABRAHAM (Bishop)."

"COLLEGE, REGENT'S PARK,

"April 26th, 1876.

"MY DEAR SIR,—I cannot agree with what Professor Challis says in para. 39, the part within brackets; or in part of the preceding paragraph.

"It will not be generally admitted that *πνεῦμα Θεοῦ* cannot mean 'the Spirit of God,' or rather 'God's Spirit,' on the ground that the article is omitted (see *e.g.*, Matt. xii. 28; Luke iv. 18; 1 Cor. xii. 3; 2 Cor. iii. 3; where the reference to the Spirit of God is clear though there is no article). Nor is it well to paraphrase *πνεῦμα Θεῶν* as the *air*, or the air we breathe. The conclusion reached, that by the addition of Θεῶν there is an implied reference to the Holy Spirit as the *Giver of life*, is, I think, just, but it is hardly consistent with the *verbal* criticism that precedes.

"The general principle is, I think, accepted—that when *πνεῦμα* refers to the Spirit of God, τὸ Πνεῦμα calls attention to his PERSONAL agency and πνεῦμα to his *influence*. Hence our Lord was begotten not by τὸ πνεῦμα but by Πνεῦμα ἕγιον simply.

"I think it likely that Professor Challis may intend to affirm that *πνεῦμα Θεῶν* means the *vitalizing* air of which God by His Spirit is the Creator; but this is hardly expressed; and the Greek criticisms are not, I think, sustainable in the strong form in which he puts them.—Yours very truly,

"JOSEPH ANGUS."

REMARKS BY MR. JOHN WALTER LEA.—I wish to say a few words upon one point in Professor Challis's paper, viz. his censure of a passage in *The Unseen Universe*, quoted in para. 10. "We think it is not so much the right or privilege as the bounden duty of the man of science to put back the direct interference of the Great First Cause—the unconditioned—as far as he possibly can in time. This is the intellectual, or rather theoretical, work which he is called upon to do—the post that has been assigned to him in the economy of the universe." "It does not seem likely," says Professor Challis, "that a man of science who has this preconceived view of 'bounden duty' can devote himself to the pursuit of science with his mind unbiassed and free from the influence of pre-judgment."

Now I grant that, at first, the statement is startling. The authors may have intended to startle, in order to compel thought. For myself, though alive to its possible abuse, I am, on reflection, ready to adopt it.

For I take it to mean no more than this: that the vocation of the man of science, the distinctive work which God has given him to do, and which it is his "bounden duty" to do, is to investigate physical phenomena and their causes; to relegate every such phenomenon to its corresponding physical cause, if it has one; and if no such cause exists, to show its non-existence, *i.e.* to explore the chain of physical causation to its first link; and as in every successive link the cause is but the effect in the link immediately preceding, the process extends backwards indefinitely, though necessarily not infinitely. But in every case, in the absence of, at least, overwhelming probability to the contrary, the presumption will be, and ought to be, that physical effect is preceded by physical cause: this is the essential condition of his working at all. It is always so. The spectrum-analyst presumes that every substance under properly arranged conditions will present *some* kind of spectrum; the chemist, that every compound substance is a combination of elements in *some* definite proportions; the biologist, that every organism has had a similarly organized immediate progenitor; the zoologist, that every example of an animal whose ordinary mode of reproduction is known has been produced accordingly; and every one of these men will work on that presumption, unless in any given case it is plainly untenable. So, generally, the scientific man must work on the principle that physical phenomenon involves physical cause, till the contrary be proved; and this is nothing but "to put back the direct interference of the Great First Cause—the unconditioned—as far as He possibly can in time," not because he wishes to be rid of it, or fancies that the process of "putting back" can go on for ever, but simply because God has given him work to do which he can do in no other way; and therefore fidelity to his vocation and to his God demands it of him.

No doubt the godless investigator may abuse his vocation. He may worship secondary causes and deny the First altogether, or only recognize Him as exerting a momentary creative energy, followed by a virtual self-extinction in favour of an endless routine of blind automatic "law." Both these theories are practically atheistic. The one denies the existence, the other the providence of God. But the atheism of the latter is in no wise the necessary result of his veneration for "law." A saint may place the immediate intervention of the Creator at a point equally remote. His humility may forbid him to say, "I have reached the limit of the chain: beyond this there is nothing but the fiat of the Supreme Will." He knows that a point exists where the Creator and the created stand face to face; but though it may be impossible at some conjecturally attainable point to predicate absolutely the continuity of physical causation, its necessary discontinuity is obviously equally unpredicable; and in such a case I think duty requires that (practically) science should have the benefit of the doubt, and that the inquirer should never despair of ultimate success in a search for what he cannot, perhaps, at the time even hypothesize. There is no necessary tendency in this to get "rid of any reference to agency governed by *personal will*" (para. 10), since intellect and religion seem satisfied by the conception (to quote the words of Professor Nicholson lately delivered to this Institute) of the "Government of the world by Providence, acting through and by secondary causes and according to invariable laws." Unroll the coil of secondary causes as far back as we will, if we hold fast by Providence we are secure. For it excludes for ever the idea of a world "constructed

originally like a huge machine,—that now goes on without the presence or intervention of the mind that made it.” On the contrary, it constrains us to “believe that the Divine Mind is never absent from nature ; that every event, even the smallest, is individuated by it,” and the recognition of “law” only requires us to believe that in every event, small or great, the forces of nature are so guided and directed by the Supreme Mind as to give effect to His will” (see *Church Quarterly Review*, vol. ii. p. 26). Practical atheism may concede an original creative act, but not a continuous Divine Providence, even though acting through invariable laws, and thus operating only mediately. God’s Providence preserved the three Hebrews in the furnace and Daniel in the den ; the same Providence truly and literally gave us every meal we have eaten. But in all these cases probably numberless laws intervened ; the greatest number, perhaps, in the ordinary case of our daily food. Law and Providence are in perfect concord. “One sparrow shall not fall on the ground without our Father” ; yet “till heaven and earth pass, one jot or one tittle shall in no wise pass from the law till all be fulfilled.”

The conception is not incompatible with the doctrine of evolution. It is as literally true that God “made me” as if I had been not only the first man, but the primordial germ of all created things. And I perceive no logical or other inconsistency between this and the further belief that every event of my life, though governed by invariable laws, has been as completely under the guidance of an ever-present and ever-acting Providence as if it had been the immediate result of a special exertion of Divine power.

The dictum of the authors of *The Unseen Universe* may, I think, be accepted by any scientific man without arrogance or irreverence. The greater his humility and the more profound his adoration of the unsearchable wisdom of God, the greater may be his unwillingness to believe that he can ever run up the clue of causation to the Throne of the FIRST CAUSE. God is “a God that hideth Himself.” Surely a man may attribute it to his own infirmity that he can see no further along the golden chain, rather than flatter himself that he has run through the links home to the beginning. And so I, for one, prefer to call such a persistent search after secondary causes a seeking after God rather than an attempt to get rid of Him.

Such a man may believe with Dr. Lionel Beale, that vitality is a distinct force or “power unknown to physics,” and that “the more minutely we investigate the phenomena of living matter the less likely does it appear that the causes of these will be discovered in the domain of physics, or that any vital action will be proved to be in the grasp of physical law” (*Protoplasm*, 3rd ed. pp. 310, 343) ; but none the less will he increase the power of his microscopes and patiently peer into those silent depths whose very simplicity is so awful. Or again, he may hold to the physical theory of life ; he may overleap, with Dr. Bastian and others, the line of assumed demarcation between the living and the non-living, the organic and the inorganic ; he may even reach out, with Professor Tyndall, to the “potentialities of the primeval mist” ; still there is nothing even here incompatible with true religion and true reverence, if only he believes in God the Creator and Preserver, Who, as Creator, gave His creation a “law which shall not be broken,” and, as Preserver, ever sustains it in conformity with that law. God’s providence is the real test. Such a conception of “invariable law” differs *toto caelo* from the soulless and barbarous necessitarianism which is the outcome of the philosophy of some who dream that they, if not they only, “think deeply.”

I contend that religion and faith are not necessarily implicated either way

in these strictly scientific speculations. To myself personally the evolution theories of Professor Tyndall, Dr. Bastian, and Mr. Darwin, as well as the physical theory of life generally, have always seemed scientifically unsatisfactory; but evolution of some kind, as at least an important factor in the Divine method of creation, commends itself to me more and more. And so far from its obscuring the recognition of a personal God or weakening belief in His never-failing Providence, it has an eminently contrary effect. And I desire to express my earnest conviction that the advocates of special creations and immediate providences, and the assertors of continuity, evolution, and invariable law, may meet on common ground of piety; and falling down together before God may worship Him in that glorious Trisagion which deserves to stand as the confession and thanksgiving of every true son of Science, "Holy, Holy, Holy, LORD GOD Almighty, Which was, and is, and is to come. THOU art worthy, O LORD, to receive glory and honour and power; for Thou hast created all things, and for Thy pleasure they are, and were created."

Rev. Prebendary Row.—I am desirous of offering a few remarks on the present paper. The examination of the strictly mathematical and scientific portions of it I shall remit to others. My observations will be chiefly confined to those portions of it which deal with the subject of miracles, which may be considered to come more particularly within my province. To some points, as laid down by the Professor, on this subject, I shall have to take exception. Before doing so, however, I wish to ask a question as to the atoms and the ether, which are so frequently referred to by Professor Challis. He seems to divide the universe into two portions, atoms and ether. Are we to understand that the ether is material, or immaterial? If the former, does it consist of atoms? If so, it is merely dividing the universe into atoms and atoms. The ether is described as possessing the power of pressure. Whence does this power originate, if the ether consists of atoms? There is something analogous to the Professor's views on this subject in the work called *The Unseen Universe*; but its authors go a step further, and affirm that *force* is a thing which has an actually objective existence in the universe, and as such, that it passes from the visible into the invisible universe. This is certainly, to say the least of it, a startling position. I wish to express my full agreement with the Professor's observations in paragraph 10 of this paper; as to what the authors of *The Unseen Universe* assert as to the duty of men of science, "to put back the direct interference of the Great First Cause—the unconditioned—as far as they possibly can in time." One thing, and one thing only, is the duty of the man of science, to discover truth, and to embrace it whenever it can be found; and not to enter on his investigations of the universe with any prepossessions whatever. It seems to me, that such a view of the universe is one which resolves it into a huge machine, which goes on in a series of self-evolutions, and represents the Creator as standing entirely external to it. If my memory is correct, they make use of the following metaphor to give us an idea of their meaning.

They represent the position of the Creator, as if He were seated at the head of an interminable avenue of pillars, and the utmost that we can do is to get an extremely distant view of Him. This idea may be all very well, if God is nothing but a perfect mechanist, who has contrived a machine so marvellous that it goes on grinding out its results in so admirable a manner as to dispense with the necessity of His presence in His works. Such, however, is certainly not the God of the Christian Revelation. If there is one thing which the Bible affirms more strongly than another, it is the constant presence of God in His works. The forces of nature are His forces. "In Him," not simply by His agency, "we live and move and exist"; and this idea seems to me to permeate Revelation from one end of it to the other; affirming, as it does, His constant presence and energy, not only outside, but also in everything that exists. I also fully concur with the remark made in the following paragraph, that the views in question are inconsistent with regarding miracles as acts determined by personal will. The authors in question, if I remember rightly, have at any rate partially adopted Mr. Babbage's theory of miracles. This, as you will remember, consists in applying to the laws and order of the universe, the principles of his calculating mill. Its Auctor in fact has constructed the universe so as to grind out miracles, whenever occasion arises for them, in the same manner as Mr. Babbage's machine will grind out a new series of numbers differing from those which it habitually grinds, and then quietly return again to the first series. This idea of Mr. Babbage is a most ingenious one, and precisely such as one might have expected would commend itself to his mechanical mind. Viewed in this aspect, the universe may be designated a miracle-working machine, which is capable of producing events which will answer the purposes of miracles, without any interference whatever with the action of its ordinary forces. The author of *Supernatural Religion* objects to this miracle-working machine, as an evasion of the real point at issue, and, I think, justly; for the plain fact is, that whatever things of an apparently miraculous character such a machine might be able to produce, it would be utterly unable to give out the most important miracles of the New Testament, as, for example, the resurrection of Jesus Christ. With abstract theories about miracles generally, we have little concern; but the very existence of Christianity is involved in the objective reality of some of the facts which are affirmed in the New Testament. These, no cunningly-devised operations of Mr. Babbage's miracle-working machine could possibly have effectuated; and therefore, however wonderful a piece of mechanism such a machine may be, it is useless to us, for it is plain that the great supernatural events recorded in the New Testament require the intervention of personal will, which no piece of mechanism, however ingenious, can possess. I now turn to Professor Challis's theory of miracles, embodying the assertion that the conception of a miracle involves an exertion of creative power, by which I understand him to mean, that the conception of a miracle

implies an exertion of that power of God which we designate creation, as distinct from that power which is exerted in the providential government of the universe. Such a view seems to be laid down in several parts of this paper, especially in para. 35 ; and by the reference to the miracle of the loaves and fishes, it seems to imply that their multiplication necessarily involved the creation of matter not previously existing. I think it most inadvisable to include in our definition of a miracle any statement of the *modus operandi* which has been employed by God in its performance. Of the mode of the divine action we are profoundly ignorant ; and therefore to affirm that God must have acted in this or that particular way in the performance of a miracle, is only to involve the subject in a number of needless difficulties. I have been under the necessity of giving the deepest attention to this subject in answering *Supernatural Religion*. Its author has taken advantage of the imperfect definitions which theologians have given of miracles, and which opponents of Christianity have borrowed from them, to involve the whole subject in a complete fog. It has taken no less than six chapters of my answer to that work, to clear away the mists of confusion in which we have become involved. Among these imperfect definitions are the assertions that miracles are contrary to the laws of nature ; that they are violations of them, that they are suspensions of them, or that they necessarily involve creative acts. I contend that there is nothing in the conception of a miracle which requires us to assume that the laws of nature have been either violated or suspended. The narratives of some of the miracles in the Old Testament directly affirm the contrary, as, for example, the passage of the Red Sea ; for it is expressly asserted by the historian that the division of its waters was effected by God having employed the agency of an east wind for that purpose, a force already existing in nature. A similar affirmation is made as to the miracle of the locusts. Not one word is there to imply that they were created for the occasion : they were conveyed to Egypt by the agency of what we designate second causes. So again with respect to Peter's walking on the water. The account in the evangelists makes it plain that the forces of nature were so far from being suspended on the occasion, that they were in active energy all around him, for the moment his faith failed him he sank. The force of gravitation must therefore have been in active energy at the moment of the performance of the miracle. How it was effected we are profoundly ignorant ; but it is important to observe that the only thing which the miracle necessarily presupposes is, the presence of a power able to counterwork the force of gravitation by which Peter's body was borne downwards. A similar power we exert whenever we lift a stone from the ground ; when we do so we neither violate nor suspend a single natural force. Surely what is possible to man must be possible with God. If man can regulate the forces of nature so that he can effectuate his purposes through their agency within his limited sphere, without violating or suspending them, much more can God within

His infinitely extended one. Similar remarks are applicable to the multiplication of the loaves and fishes. I entirely disclaim the intention of making any affirmation as to how this miracle was accomplished ; but to affirm that it involves the creation of matter which was not previously in existence is only to involve the subject in needless difficulties. I have fully pointed this out in my answer to *Supernatural Religion*. The constituents of the seven loaves and the two fishes had been built up into their existing forms by God through the ordinary forces and laws of nature. Who will affirm that He could not have effectuated the same result by means of some combination of these forces different from that which He usually employs ? The ingredients necessary for multiplying the loaves and fishes were all present, either in the earth, the water, or the air. In the ordinary processes of nature He builds these up into loaves and fishes in one way ; in the miracle in another. Of the mode of the divine operation we are ignorant, but it is simply to encumber the entire question with needless difficulties to affirm that a miracle must involve either a suspension of the forces of nature, or a violation of its laws or order, or the creation of matter not previously existing, or even the creation of a new force ; for God is everywhere present in nature and its forces. The question of miracles has been already sufficiently confused through the ever-varying senses in which both theologians and scientists have used the terms, nature, law, force, natural, supernatural, miracle, and then arguing on them as though they had one clear consistent and invariable meaning. Such confusion forms the very storehouse from which unbelievers draw their weapons. What, for instance, do we mean by the word "nature" ? Does it include all things that exist ? or is it confined to the regions of necessary law ? or does it include man, his voluntary actions, and self-originating power ? According as our use of it includes one or the other, we apply it to wholly different classes of phenomena ; and the ideas intended to be conveyed by the terms "natural and supernatural" must undergo a corresponding variation. Thus the whole question about miracles has been allowed to drift into a mass of confusion, through the ambiguous use of words ; and by the introduction of unnecessary terms into our definitions. It is a deep sense of the confusion into which we have thus fallen which leads me to protest against introducing into our definition of a miracle, that it necessarily involves the exertion of what is popularly called "creative power." To my own mind, to speak of a power in God which is creative, as a thing which is distinct and separate from that which He constantly exercises in the universe, conveys no clear or definite conception. I hold that a miracle involves the energetic action of the power of God ; so does the growth of an oak tree ; so do all the energies of what we call nature ; but what kind of power we know not. The essence of a miracle is *not a display of power, but of purpose*. The power displayed in many of the miracles recorded in the Bible is quite on a small scale compared with that which God exerts in His providence every day. The evil is, we have got

into the habit of thinking and speaking in such a manner as to imply that the ordinary operations of the universe are *automatic, and not the energies of God*. One word in conclusion on paragraph 33. Professor Challis endeavours to account for the pressure of the ether, and the law of its variation, as well as other physical operations, by the operation of angels. This, like some other positions in this paper, is a pure assumption, of which we have already had far too many, both in theology and science. Some expressions in this paper have brought strongly to my mind another class of phenomena of very serious import, which bear some degree of analogy to those here mentioned. I have just completed the reading through of Mr. Wallace's work on Spiritualism, in the marvellous and grotesque phenomena of which he not only avows himself a believer, but of some of them an actual witness. It was all very well for us to pooh-pooh these kind of things as long as the belief in them was confined to weak-minded people; but it seems to me to be impossible to do so with safety any longer, when several Fellows of the Royal Society, men eminent as lawyers and physicians, and persons well known in the literary world, publicly state their conviction of their truth. It is impossible to deny that the facts are attested by very strong evidence; yet they are so prodigiously grotesque, and absolutely unmeaning, that I cannot accept them as actual occurrences; and I feel firmly persuaded that there is a delusion somewhere. It is impossible to deny that the whole subject has a very intimate bearing on the question of miracles. Mr. Wallace affirms that the force of evidence has converted him from an unbeliever in the existence of spirits, into a believer in the reality of these spiritual manifestations and the immortality of man. I fail to discern in his work any approach towards Christianity. On the contrary, the miracles of our Lord, even the multiplication of the loaves and fishes, are assigned to a special form of this spiritualistic influence. To a precisely similar influence, the demon of Socrates, the pagan oracles, and various other phenomena of the ancient world are attributed. I regret to add that some of the alleged phenomena of witchcraft are also traced to the same source. Mr. Wallace is a believer in answers to prayer. But how are prayers answered? By prayer ascending up before God? No; but by spirits of the departed sympathizing with the offerer of the prayer, and making known his wants to those who are able and willing to supply them. According to Mr. Wallace, no spirit of the departed knows anything more about God or Christ than we do. Surely such are very serious matters when they are propounded by men whose scientific attainments are undeniable, as well as by men of eminence in other callings. It is high time that such delusions, if delusions they are, should be traced to their origin, and proved to be delusions. To do so is certainly a work which lies within the legitimate functions of a society like ours, which professes to be at once both religious and philosophical. Mr. Wallace tells us that there are several millions of spiritualists, and that no one who has become convinced

of its truth has ever become an apostate. The facts which they affirm as real have a most intimate bearing on Christianity. Surely they ought to be thoroughly sifted by an institution like the Victoria Institute.* I must also express dissent from the views which are propounded in this paper as to the authority of the Septuagint version, on which some of the theories before us rest for their support. The opinion of its superior accuracy as a representative of the autographs of the Old Testament writers is founded on the supposed "sanction which this version has received in the New Testament," and on the supposed impossibility that subsequent scholars can have translated with equal accuracy. I fear that in this opinion Professor Challis has not the support of any eminent modern authority. Different parts of the version differ greatly in point of merit; different parts of it were made by different persons, and at considerable intervals of time. The old story about the seventy translators, their each translating the Old Testament separately, and the verbal agreement of each separate translation—in one word, that its authors were supernaturally inspired—is abandoned as a myth by every man of sense. It is also no less clear that on certain points its authors accommodated their translation to the Greek taste, and that they have not succeeded in doing this with perfect correctness. This is especially manifest in the manner in which they have toned down several of the more striking anthropomorphisms which the Hebrew has applied to God; and in several other peculiarities of the version. Alterations of this kind have been systematically made by its translators. Nor can any weight be attached to the affirmation that it has received the sanction of the writers of the New Testament by their constant quotation from it. In the first place, this is not the fact; and in the second place, the citations of the Old Testament in the New are very far from being made with anything like consistent accuracy. Any person desirous of testing this question for himself may see the case clearly stated in Mr. Sanday's work in answer to the second part of *Supernatural Religion*. In this work the quotations are tabulated under the different heads of accurate, slightly variant, and widely variant citations, and the result proves that the position taken by the Professor in this paper cannot be maintained.

Rev. T. M. GORMAN.—I think the references to the Septuagint a weak point in the paper: take for instance the word *καλόν*; the original Hebrew word means "good," a different word being used for "beautiful."

Rev. A. I. McCaul.—Mr. Gorman has just spoken of the word *καλόν*. I do not think there is any doubt that the Hebrew word is used for beautiful, and therefore I do not agree with Mr. Gorman. Neither do

* Since these remarks were made, the subject of "Spiritualism" was very ably taken up at the Glasgow meeting of the British Association, shortly after which the lengthy "Slade" investigation took place.—ED.

I quite agree with the wording of Professor Challis's passage on the subject :—

“It is remarkable that in Gen. i., where after each creation it is said that ‘God saw that it was good,’ the word for ‘good’ in the Septuagint is *καλόν*, which, as applied to material substances, can only mean ‘beautiful.’”

There are several passages in the book of Genesis alone, where this word *καλόν* is used as the translation of the Hebrew word *טוב* and is applied to material substances, and yet there is no one of them in which it would be translated “beautiful.” In Gen. ii. 9 you have it used with reference to food, and again in iii. 6. So again in xv. 15, where it stands “in a good old age”; and in xxv. 8 and xxx. 20, “God has endowed me with a good dowry.” Other instances are to be found in xli. 35, and in xlix. 15, “having seen the rest that it was good.” I think, therefore, that the facts scarcely bear out the assertion that the word *καλόν* as applied to material substances must mean beautiful. In the 45th paragraph of the paper Professor Challis says :—

“On the fifth day God commanded the waters to bring forth fish and fowl.”

In the Hebrew the two clauses are co-ordinate, and the Hebrew does not represent the fishes as produced from the water; the English version is faulty. There is no necessity for making the second clause subordinate. The fact is, that the relative pronoun in Hebrew is often omitted, and therefore the rendering of the English version, and of the Septuagint, and of the Vulgate, is not contrary to Hebrew, but it is quite unnecessary—it is unnecessary in raising any argument as to the Mosaic account of creation. As to the use of the word *ἐπιφέρετο*, referred to in the 39th paragraph of the paper, we may decide that matter without going to the Hebrew at all. The word is used of moral agents elsewhere. You have it in the Second Book of Maccabees, xii. 35. I do not quite see the point of saying that the word applies only to a material substance. Then we come to a point concerning which I feel the greatest anxiety—that is as to the meaning of the phrase translated in the Septuagint *πνεῦμα Θεοῦ*. I have seen it stated that because the Hebrew expression had not got the article it must mean the wind, but I never before saw it stated that because the Septuagint had not got the article it must mean the wind. In the genitive relation in the Hebrew the article is not admissible. You cannot put it in in that construction, and the Septuagint generally follows the Hebrew in these matters. I think it is unnecessary to have any argument upon the absence of the article, but here again I would rather rely on the custom of the Septuagint. Anybody can test the matter. The expression is one which occurs often, and it is translated sometimes *πνεῦμα Θεοῦ* without the article, in other passages *πνεῦμα θεῖον*, and sometimes *πνεῦμα κυρίου*; but in all the passages the article is omitted. I will mention a few passages where the phrase occurs :—In Gen. xli. 38; in

Exod. xxxi. 3 ; xxxv. 31 ; in Num. xxiv. 2 ; in 1 Sam. x. 10 ; xi. 6 ; xix. 20 and 23 ; in 2 Chron. xv. 1 ; xxiv. 20 ; and in Ezek. xi. 24. I will not read the verses at this late hour, but the point of them would be to show that nothing else will suit the facts—that nothing else can be meant but the Spirit of God : nothing else will translate it. In his 38th paragraph Professor Challis says :—

“In making this philosophic use of that chapter I propose to take it just as it is given in the Septuagint, on account of the sanction which this version has received in the New Testament, and the improbability that any rendering of Hebrew texts of later date by many centuries than the text which was in the hands of the seventy interpreters can as faithfully express the meaning of the original and the mind of the Spirit as that ancient interpretation.”

Now I am not aware that there is the least breath of a suspicion that there was ever any different text from the text which we have now in the first chapter of Genesis. The differences which arise are simply paraphrases, and it is not at all necessary to assume any other text, and therefore I think this expression about a text of later date is unhappy, because it is liable to misapprehension. And so with regard to the quotations from the Septuagint. I think any ordinary reader would suppose that the author of the paper inclined to the opinion that the way in which quotations are dealt with in the New Testament is such that the Septuagint is set entirely above the original Hebrew text in point of authority. I do not say that that is Professor Challis's opinion, but I think an ordinary reader would argue that it was ; and I think that is unfortunate, because it is likely to do a great deal of mischief, and it is not borne out by the facts. The great majority of the texts quoted in the New Testament from the Old are simply the ordinary straightforward renderings which any average Greek scholar would have made in translating from the one to the other. There are a few passages where the quotation taken from the Septuagint differs from the English translations, but that is not the case in any quoted here, and therefore there is no necessity whatever for introducing another text. I thank Professor Challis for his paper.

The CHAIRMAN (C. Brooke, M.A., F.R.S.).—No one has yet touched upon the important physical aspect of a considerable portion of this paper. In his 13th paragraph Professor Challis has applied the test of sensation and experience to such things as matter, force, and inertia ; but sensation and experience are not the substratum of a great deal that followed, and it appears to me that Professor Challis has indulged in a very large scientific use of imagination as Professor Tyndall calls it. But with regard to ether, that is purely a hypothesis : atoms and ether are not matters either of sensation or of experience. We cannot perceive ether or examine it chemically or physically ; we know nothing of it, and it is merely a hypothesis that it exists. As to atoms, an atom is generally supposed to mean an indivisible

portion of matter, so minute that it cannot be further reduced, and it is perfectly legitimate to suppose that atoms have a spherical form : if, however, as Newton has suggested, the spaces intervening are indefinitely large compared with the atoms themselves, it does not much matter what form they are supposed to have : but the phenomena of crystallization, which require the existence of unequal polar forces in two and sometimes three directions, seem to point rather to a spheroidal, or ellipsoidal form. Afterwards Professor Challis speaks of their "sensible magnitude."

Professor CHALLIS.—I mean matter not infinitely divisible.

The CHAIRMAN.—I supposed the phrase meant magnitude capable of appreciation by the senses, but that is not the case with regard to atoms of matter. Then Professor Challis has ascribed both gravitative attraction and, as I suppose, magnetic and electric attractions and repulsions, to currents of ether : it may be so, but as we know nothing of it, and cannot tell whether ether has currents or not, the whole of that part of the paper is to my mind imaginative, and is not capable of being in any degree reduced to the test of sensation and experience. It is a theory, and must stand as such. In one place Professor Challis speaks of a moving force being personal force, but in many cases that is not so, a watch spring moves a watch, but that is not a personal force.

Professor CHALLIS.—It seems to mean the same.

The CHAIRMAN.—I may remark, in conclusion, that there are many other points on which, if time permitted, I should be disposed to join issue with the author of the paper.

Professor CHALLIS.—Through defect of hearing I have not heard nearly so well as I wished to have heard the remarks which have been made upon my paper, and I therefore must hold myself excused if I pass over a good many things which I have not sufficiently heard. I will, however, make mention of a few, the purport of which I caught and can remember. Prebendary Row asked me whether I thought ether was composed of atoms. I say it is composed of atoms, because I do not know of any material substance that is not so composed, and I consider ether to be a material substance. With regard to my use of the Septuagint, I have stated in the paper the grounds on which I use it. I anticipated that there would be a discussion relative to the Hebrew text, but I had determined beforehand that that would be shifting the basis of my argument, and that I could not enter upon it. I only enter upon what I have undertaken, and that is to draw inferences from the Septuagint ; but I have not undertaken to compare them with the sense of the Hebrew text. The word *ἰπερέτερον* I referred to simply as respects one point, and that point was that the word is used in the first chapter of Genesis, just as it is used in that passage of Genesis which relates to the ark being borne up by the waters of the Deluge. Other applications of the word were not to the point I was concerned with. The identity of the use in the two passages was all that I had to consider, and it is remarkable that

in the Septuagint the form of expression in the two cases is absolutely the same. I cannot agree with the supposition that atoms and ether are only imaginative. I think they are as real as anything else that is real. I do not know what is real if they are not, because they compose all that is real. The Honorary Secretary of the Institute (Capt. Petrie) kindly sent me a letter he had received from Dr. Angus, on which I think it right to make some remarks in reply, because its contents bear on other criticisms which have been made during this discussion. It is specially with reference to the expression, *πνεῦμα Θεοῦ*, that I have to speak. Dr. Angus has misunderstood me where I say that, on account of the article being absent, the phrase cannot be translated, "the Spirit of God." I did not say so in any general sense. What I said was only with reference to that particular passage. In a hundred places *πνεῦμα Θεοῦ* might mean "the Spirit of God," without the article; but in each such case there is something in the context which will tell you that the Spirit of God is signified, and that every other sense is excluded; whereas, in this passage of Genesis, there is a sense which is not excluded—namely, that the air, a material substance, was borne upon the water. Perhaps I may be allowed to give a reason, which is strong in my mind, why we have in the Scriptures the expression *πνεῦμα Θεοῦ*, signifying the air we breathe, although it usually signifies the Spirit of God. In the Scriptures, wherever there is an abstract sense or meaning there is also the concrete, and the two are put so close together that you cannot separate the one from the other; and this is done on purpose to show their necessary connection. St. Paul, for instance, says: "They are not all Israel that are of Israel." "Israel" is here, in one case Israel after the flesh, and in the other it is spiritual Israel, both senses being expressed by the very same word. That same principle extends through the Scriptures from beginning to end. Perhaps, in conclusion, I may just advert to another part of the essay in which I speak of angelic agency. Very likely there may be a difference of opinion on that point, and I want to say that I do not claim originality in regard to what I have said about it. I was led to speak of it by reading the recently-published work, *The Unseen Universe*. The authors of that book do not assent to Newton's idea of referring our understanding of all things to sensation and experience, and therefore they cannot assent to the notion that pressure is the only form of force that we can understand. Thus they have to find out some means of accounting for pressure, and the way in which they do so is by supposing that there are an infinite number of little corpuscles in the space where pressure is in action, falling in all directions, and striking against each other, and that by their impact pressure is produced. This view is quite contrary to what we were taught at Cambridge by Professor Airy, namely, that impact is a short and violent pressure. These authors cannot, on their supposition, account for variation of pressure, and consequently they put forward this strange hypothesis, that there are certain little doors in the space where pressure operates, and at each door

there is stationed a being—a spiritual, intelligent being—who opens or shuts the door to let the atoms pass through or to stop them, so as to regulate the amount of the collision, and thus to produce variation of pressure. This is the most extraordinary idea relating to physical science I ever saw propounded. No doubt it is a very great difficulty to account for the variation of pressure on any physical hypothesis—I mean the variation of the pressure of the ether; and the difficulty is not diminished when the attempt is supplemented by this sort of spiritual agency. My view is, that we have nothing to say about the quality of pressure excepting that we have an instance in our own persons of spiritual agency, by which matter can be moved. That idea Sir John Herschel, the greatest of modern philosophers, produced in one of his publications, where he said that the power of moving the arm is one of the most wonderful facts in creation. The idea amounts to this, that there exists a spiritual power which we, as spiritually constituted, are conscious of, whereby we can move matter. It is but a short step from this to say that there is a spiritual power which can move the ether and produce the great effects we perceive to be consequences of its motion. This is not a very violent transition, and I think it might be accepted, rather than have recourse to the idea of the agency of little spiritual beings. With regard to the question of miracles, and the phrase “creative energy,” which Prebendary Row objected to, I cannot see any difficulty about the application of that expression to miracles, if we allow of creation at all. If you do not allow of creation, why, then, the objection to applying that expression to miracles remains in force. Philosophers, who object to miracles, try to get rid of personal agency in creation; but, if creation be admitted to be a fact, I do not see that it could have taken place without personal energy. I may also mention that I have heard it constantly said that no atom was ever destroyed—that an atom of matter is indestructible. Now, it seems to me that that is very false philosophy; for if you make that assertion, you do in effect maintain that matter was not created. You cannot assert of matter that it is indestructible, because that would be equivalent to saying that it was not created. I think a great deal of philosophical error arises from assuming as an incontrovertible truth that matter can never be destroyed. This point, as implying the non-creation of matter, touches the question of miracles. One would think, for instance, that the miracle of the feeding of the five thousand must have involved the creation of matter—it is hard to see how it could otherwise have been wrought.

The Meeting was then adjourned.

SUPPLEMENTARY REPLY.

[PROFESSOR CHALLIS having imperfectly heard the discussion on his Paper, and not being accustomed to address audiences extemporaneously, requested that the speech which he made in reply, on the occasion of the Meeting, might be supplemented by the following remarks, written after seeing the discussion in printed form]:—

I was not surprised to find that the title of my Paper had given rise to misapprehension as to its purport, such as that mentioned by Bishop Abraham, and I therefore take occasion to explain further, that I adopted this title with reference to the views of modern metaphysical writers, who draw from facts and laws established by physical science conclusions adverse to the statements of Scripture relating to miracles and spiritual agency (which I designate generally by the terms "The Metaphysics of Scripture"), and it was my object to prove that the *Newtonian Physical Philosophy*, rightly understood and comprehensively carried out, stands in no contradiction to these statements.

Relative to the remarks in Dr. Angus's letter, I wish only to add that I have no objection whatever to translating πνεῦμα Θεοῦ "the Spirit of God," on the general linguistic principle of diversity of usage of the article in different languages, its use, for instance, in Greek being partially dispensed with, and in Latin entirely, where in English and French it could not be omitted. The context decides whether in the absence of the article in the original it should be admitted in the translation. If the article had been present in the passage of Genesis, the translation must have been "the Spirit of God," and the Septuagint would then have asserted what is altogether unimaginable, namely, that spirit—the Spirit of the Creator—was borne up by the material substance of water. On this ground alone I said that "the *Septuagint* does not admit of that translation." The absence of the article allows of escape from this incongruity by translating "breath of God," meaning air, the breathing of which is a necessary condition of life. I forgot to mention at the meeting an intimation from my son, who read the Paper for me, that Josephus with reference to this passage has "a wind."

I beg to return my thanks to Prebendary Row for the full and careful consideration he has given to portions of my essay, and for the measure of accordance therewith which he took occasion to express. There are, however, points of difference which I propose to take notice of. Having already answered the question as to the materiality and atomic constitution of the ether, to the additional question. "If it is so constituted, whence did the power of pressure it is supposed to have originate?" I make reply that I know nothing of either power or pressure apart from the indications of my own consciousness, and that I am conscious to myself of being able to press by

the intervention of the material substance of my body. It is conceivable, therefore, that the Creator, of His own will, exerts pressure by the intervention of a material substance, atomically constituted, but of much finer composition than the gross bodies we see and handle, and that such pressure, acting under different external conditions and circumstances, takes the various forms usually called physical forces. Accordingly, the origin of pressure and of forces in nature is the will and power of the Creator *immediately* operative in the ethereal medium.

With respect to Prebendary Row's strictures on the view I take of the character of miracles, I begin with admitting that I certainly regard that exertion of power of God which we designate creation as distinct in mode of operation from the power which is exerted in the providential government of the universe, and that I consider a miracle to be wrought by the former kind of power. I am accustomed to make the distinction in my own mind by means of the following analogy: We know that a planet moves in an elliptic orbit about the sun, not alone because the sun's gravitation attracts it, but also because it is endowed with the quality of *inertia*. So long as we only take account of gravitation and the *vis inertiae*, we cannot see how the motion ever had a beginning, or how it will ever have an ending. But, supposing that the body received an impulse at a certain moment of time, causing it to begin to move with a certain velocity in a certain direction, the motion in all subsequent time can be submitted to calculation, and be proved to be regular and conformable to law. The original impulse would be due to power momentarily exerted, whereas the subsequent motion would be due to power exerted to maintain the attraction of gravity and the *vis inertiae* of the planet. Thus the actual motion is the result of two quite different kinds of action, the one sudden, arbitrary, and having no relation to antecedent circumstances; the other producing motion which is continuous, governed by law as to amount and direction, and dependent at each instant on antecedent conditions. The former corresponds to a creative or miraculous act; the other to the continual direction of events in the ordinary course of Providence. It is, however, to be observed that there are instances in which a miraculous act occupies time; but in that case it consists of a sustaining, during an arbitrary interval, of the impulsive power above characterized.

After this preliminary, I go on to state that I can assent to Prebendary Row's assertion respecting miracles, that "of the mode of the Divine action we are profoundly ignorant"; only I should not adopt these terms, but rather say of a miracle that it is something so entirely *sui generis* that it does not admit of *logical* inquiry, and, therefore, we cannot predicate of its essence either ignorance or knowledge. And here I cannot forbear remarking that by saying that the expression "creative power," which I have adopted, involves a statement of the *modus operandi* of a miracle, Prebendary Row charges me with a fault which he has himself committed. For, where he says,

with respect to the miracle of multiplying the loaves and fishes, that "their constituents had been built up by God through the ordinary forces and laws of nature," and that "the ingredients necessary for multiplying them were all present in the earth, the water, or the air," is not this affirming something about the *modus operandi* of the miracle; something, too, involving inference from modern physical science? The view I take of the character of miracles absolutely forbids my entering upon any such considerations, inasmuch as I hold it to be out of the province of the human intellect to inquire concerning either mode or limitation relatively to miracles wrought by an Omnipotent Creator. In sec. 35 of the Paper I say of the miracle just mentioned that "it consisted of the *multiplication* of the loaves by an operation which, as being *creative*, is incapable of being submitted to logical inquiry." The word "multiplication," inasmuch as twelve baskets of fragments were taken up, simply expresses the matter of fact; and as to the word "creative," when it is considered that the creation of the universe was the first and greatest of all miracles, no term for specifically designating miracle-working power could be more appropriate than one significant of creation. In fact, the external world supplies no other term indicative of the essential character of a miracle, the word "miracle" having properly only the subjective meaning of *wonder*, such as an act of creation might be supposed to produce.

I come now to a part of Prebendary Row's speech, the consideration of which will serve to point out the source of the divergence of views above referred to. That a miracle involves no "violation of the laws of nature," I fully admit for special scientific reasons which I have stated definitely in sec. 23 (1) of the Essay on "*The Indestructibility of Matter*," read at the Meeting of the Institute on May 7, 1877. I concur also in taking the view that God brought on the plague of locusts, and divided the Red Sea, by natural operations expressly adapted to effect these purposes. Still I maintain that it is not allowable to try to account for miracles by natural causes not specified in Scripture, or to derive explanations of them from suppositions gratuitously made relative to the operation of laws known only by scientific research. If such explanations were valid in any instance, they should be applicable in all. But that this is not the case will, I think, appear from the following argument. It is, first, to be especially noticed that in *all* instances of Scriptural accounts of miracles an instrumental cause is mentioned, which according to all human judgment and experience would be pronounced to be wholly inadequate to produce the observed effects. For instance, handkerchiefs and aprons brought from the body of the Apostle Paul to the sick, cured them of diseases, or sent evil spirits out of them (Acts xix. 12). It would demand a great effort of the imagination to conceive of any natural operation by which such effects could be produced by such means. As another instance, our Lord "made clay of spittle and anointed the eyes of a blind man," and *then*, after washing in the pool of Siloam as he was bid to do, the

blind man "came seeing" (John ix. 6, 7). It may be presumed that the miraculous effects were caused to be consequences of such antecedents that eye-witnesses might be the more convinced of the actuality of the miracles. The account of the plague of locusts states that Moses stretched forth his rod over the land of Egypt, and the Lord caused an east wind to bring the locusts; "before them there were no such locusts, neither after them shall be such"; and "the Lord turned a mighty strong west wind," which cast them all into the Red Sea. Again, with respect to the passage of the Israelites through the Red Sea, the narrative states that Moses stretched out his hand over the sea, and the Lord caused the sea to go back by a strong east wind, and the waters were divided so as to be a wall to the Israelites on their right hand and on their left; and when Moses again stretched his hand over the sea, the waters returned and overwhelmed the Egyptians. I have collected these particulars in order to demonstrate the hopelessness of attempts to refer Scriptural miracles to any mode of natural causation. Even where natural causation is specified as to quality, the effects are such in kind or degree as have never been known either before or since. In short, as respects their antecedents (Moses stretching out his hand, &c.) and the limitation of their consequences through *personal* agency, the miracles of Scripture (at least those performed in Egypt) are wholly out of the category of intelligible physical causation.

What I have said about angels is a logical and necessary consequence of an axiom stated in sec. 21 of the Paper in these terms: "It is inconceivable there can be any production or event which is not determined by antecedent will, and the power, in operation, of a conscious agent." This, it must be admitted, is true with respect to what God does. It is true also with respect to what man does, as I can tell by my own consciousness. But since in God "we live, and move, and have our being," our acts consciously performed under conditions of time, space, and bodily organization which He has imposed, are His acts. But besides God and man there are other agencies in the world, "Fire and hail, snow and vapours; stormy wind, fulfilling His word" (Ps. cxlviii. 8). Inasmuch as these natural phenomena fulfil God's word, they are the products of conscious agency. This agency is ascribed in Scripture to *angels*, on the principle of the axiom above enunciated. And whereas this power of producing fire, hail, snow, &c., is, as well as human power, derived from God, and is exercised under conditions which He has ordained, it is, in fact, God's power, and we reasonably regard these natural phenomena as coming from God. Thus, operations which we ascribe to *Nature*, and those which Scripture ascribes to angels, are identical entities. This is all that I meant by what is said about angels in sec. 33. Of course, I only refer to angelic agency as concerned in the ordinary circumstances of natural phenomena: the extraordinary appearances of angels in human form mentioned in Scripture come under the category of miracle.

I little expected that I should have to say anything on the subject of *Spiritualism* as having relation to the contents of my paper; but as Mr. Row asserts that expressions in the Paper brought this class of phenomena to his mind, and spoke upon them at considerable length, I ask permission to state certain decided views which I have for a long time entertained on this subject. I begin with quoting a very pregnant passage in the Book of Ecclesiasticus (xxxiii. 14, 15): "Good is set against evil, and life against death: so is the godly against the sinner, and the sinner against the godly. So look upon all the works of the Most High; there are two and two, one against another." In conformity with this law God and Satan (the adversary) are contrary one to the other, and the power of Satan, always delegated and conditioned (see Job, chap. i.), is opposed to the power of God. Now, as miracles are spoken of in Scripture as being primarily wrought by God, the Creator of heaven and earth, so Satan, "the prince of the power of the air," has the power of working miracles; and just as the miracles which God performs by the agency of man demand *faith* on the part of the agent, so Satan works miracles under condition of the faith of an operating *medium*; but in this case the faith is that of an operator who is *under delusion and believes a lie*. The quality of the faith is shown by the character of its fruits. Mr. Row justly asserts that the phenomena of Spiritualism are "prodigiously grotesque and absolutely unmeaning," but at the same time he admits that "it is impossible to deny that the whole subject has a very intimate bearing on the question of miracles." Certainly the phenomena cannot be referred to any kind of *physical* causation, and must, therefore, be ascribed to a certain mental, or spiritual state, which, although it has its foundation in *error*, is permitted to display miraculous power, in order, apparently, that by the character of the manifestations the existence and source of the error may be exposed. The miracles of Spiritualism are so utterly opposed in character to the beneficence and dignity of the miracles of the Gospel, that a Christian should have no hesitation in deciding that they are *miracles of Satan*. It is no proof of weak-mindedness that some persons should be influenced, however mistakenly, and others perplexed, by these strange manifestations. Although I have never at any time witnessed any of these phenomena, I am yet unable, in common, I believe, with many others, to resist the evidence of their reality which has come from all quarters of Christendom. Personally, I have been as much convinced by the evident unfairness of what has been done by those who deny them, as by what has been testified by those who affirm them. It now only remains that I should state what I believe to be the source and root of all this evil. On this point I shall only say what I said as long ago as 1863 in a letter to the editor of the *Clerical Journal*, inserted in page 58 of the number for July 16th of that year. I have there said that these "signs of the times" have their origin in a wide-spread and persistent belief of a great untruth, the reality of a *spirit-world*, of which Scripture, rightly interpreted, says not one

word, but rather gives distinct intimation that consciousness of existence consists only with union of body and spirit. I said also that these evidences of the prevalence of an unsound spiritual condition are on the one hand a refutation and a rebuke of the modern scepticism relative to miracles, false miracles being sent to those who reject the true, and, on the other hand, they are answers to fools according to their foolishness for believing beyond what is written, this being only another form of unbelief. I ventured, moreover, to predict at that time, that "the evil would grow" if the source of it were not recognized and acknowledged; which has come to pass. I refrain from saying more now on this important subject, except to avow my concurrence in the opinion expressed by Prebendary Row, that this is a matter which deserves to be investigated by an institution like the Victoria Institute. I beg to refer the members who may desire to know more of my views upon it to the letter above mentioned.

I admit that Prebendary Row and Mr. McCaul have not without reason taken exception to the statements made in art. 38 respecting the Septuagint and Hebrew texts, which, as having been incautiously expressed, require to be farther explained. I had in mind the known facts that all extant MSS. of the Hebrew text are comparatively recent, and that translations from strictly Hebrew originals are all later by many centuries than the rendering by the Seventy Interpreters of the Hebrew original of their time. Then, considering that every translation is in degree an interpretation, and that the difficulty of interpreting increases with lapse of time from the date of the primary document, I spoke of the improbability (not impossibility) that any translation should as nearly express the primary sense of the Hebrew text as "that ancient interpretation," assuming always the purity of the text. On the principle here laid down it may, for example, be asserted that difficulties are now met with in interpreting St. Paul's Epistles, which could not have been felt by those to whom they were addressed, simply because they were his contemporaries. My meaning will, perhaps, be made clearer by the following instance. The transition from the first to the second verse of Gen. i. is made by the particle *δὲ* in the Septuagint, and by *autem* (probably the translation by Jerome of the Greek particle) in the Vulgate. Supposing verse 1 to signify the original creation of the primordial elements of the inorganic world, the usage of Greek or Latin would allow of taking the connecting particle as indicating an *immediate* transition to the statement in verse 2 of the composition, and primary order of arrangement of the components, of the world *so created*. Then would naturally follow accounts of steps in the unfolding of the inorganic creation by the physical forces, and of successive creations of organized bodies. All this agrees well with the view I have been led to take of the facts of creation by reasoning on scientific principles. But some modern Hebraists say that the transition particle (the same, I presume, as that rendered by the Septuagint) may be taken to imply that a long course of

time and a *bouleversement* of the original creation intervened between the creation of heaven and earth declared in verse 1, and the state of the earth described in verse 2. Which interpretation, then, ought to be adopted? I have no hesitation in saying that, for the reasons I have given above, the older interpretation is to be preferred.

I think I have sufficiently taken account of Mr. McCaul's criticisms relative to the translation of πνεῦμα Θεοῦ by what I have already said on this point. With respect to the translation of καλόν, the instances adduced by Mr. McCaul prove that the same latitude of application prevails in the use of this word in Greek as in the use of "good" in English. Both words are applied in very various ways with reference to what is excellent in quality or quantity. We speak, for instance, at Cambridge of "a good man," meaning a *clever* man; the familiar expression, "a good deal," means a large quantity, and property is called "goods." The different applications seem to be all referable to the idea of excellence commonly attached to beauty and goodness. But in Gen. i., where the word καλόν is applied to *all* created objects of the heavens and the earth when first created, it cannot have any such secondary meaning, but must be taken in its *proper* sense, which is, "beautiful." Accordingly, in Gen. ii. 1, the beauty and order of the whole creation is named ὁ κόσμος.

Having referred to the passage in the Second Book of Maccabees (xii. 35) cited by Mr. McCaul, I find that it is an instance of the well-known usage of a verb in passive form having a middle signification: ἐπενεχθέντος αὐτῷ, "being borne against him of his own will and act," that is, "attacking him." This is quite consistent with giving to the verb a passive sense in Gen. i. 2 and Gen. vii. 18.

There are three reasons why I think that the Chairman, Mr. Brooke, should have abstained from applying the word "imagination" to the hypotheses which I make the foundation of my physical researches. First, they have due regard to the antecedents of physical science, neither theorist nor experimental physicist having been able to dispense with the conceptions of an ether and of atoms, which Newton himself admitted into his philosophy, although he said, *hypotheses non fingo*. This dictum, of which the emphatic word is *fingo*, means that Newton disclaimed having *made* the hypotheses which he pronounced to be "the foundation of all philosophy," regarding them as abstractedly true and necessary. Secondly, only such hypotheses are admitted as are perfectly intelligible, being capable of enunciation in terms derived from the indications of sensation and experience. This condition places them in direct opposition to what is merely imaginative. Thirdly, they are capable of being tested by comparison of results, derived from them by calculation, with experimental facts, inasmuch as they satisfy the condition of being proper foundations of mathematical reasoning. Such being the character of the hypotheses, I am under no necessity to give attention to any mere expression of opinion as to their quality, and am only required to conduct, as I best can,

the mathematical arguments required for testing their truth by the explanations they give of natural phenomena. In this difficult and indispensable research, in which I have made some advances, I might have expected the aid of some of my junior contemporaries; but unhappily those who would be capable as mathematicians of taking this part have so let their imagination run wild on "doors," and "demons," and "vortex-atoms," that they have no thought left for sober theoretical reasoning. In my opinion, nothing so much at this time stands in the way of the progress of true physical science as the propensity of physicists to disregard the strict rules of philosophizing, and betake themselves to those creations of the imagination which Newton calls "*somnia*." It is a little hard that, having laboured much to counteract this tendency, I should be charged with advocating an imaginative course of philosophy.

With respect to the remarks in the concluding part of Mr. Brooke's speech, I beg to say that I have ascribed gravitating attraction, and magnetic and electric attractions and repulsions, to action of the ethereal medium only so far as by mathematics I arrive at consequences of my hypotheses which are counterparts of the *observed* effects of these forces. One word in addition respecting Mr. Brooke's reference to the phenomena of crystallization. I make a distinction between an atom and a molecule, considering a molecule to consist of a congeries of atoms, having sometimes, but not generally, an arrangement in accordance with strict geometrical figures. Such arrangement is the theoretical basis of crystallography. The aggregate of the ethereal forces emanating from the atoms so arranged, may well be conceived to give rise, simply by reason of the arrangement, to the existence of molecular forces having axes of maxima or minima, and therefore poles, in two or three rectangular directions, and consequently recognizable experimentally by spheroidal or ellipsoidal forms. But all this is quite consistent with a spherical form of the individual atoms.

The remarks by Mr. Walter Lea are mainly concerned with defending a passage in *The Unseen Universe*, in the censure of which I am supported by the opinion of Prebendary Row. I think I may appeal to views which I have expressed in communications to this Institute and elsewhere, that I can quite agree with the position maintained by Mr. Lea that there is no real incompatibility between religion and natural philosophy, but the philosophy of which this is affirmed must be *true* philosophy, which, I believe, cannot be said to be the character of much that passes for philosophy in the present day.