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ORDINARY MEETING, APRIL 6, 1868.

CAPT. E. G. FISHBOURNE, R.N., C.B., HON. TREASURER,
IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The SECRETARY, in the absence of the Author, then read the following paper :—

ON THE IMMEDIATE DERIVATION OF PHYSICAL SCIENCE FROM THE FIRST GREAT CAUSE. By RICHARD LAMING, Esq., M.R.C.S.

IF I can show how, according to human notions of possibility, matter may have been formed out of nothing, and that the laws of matter, as we learn them from practical observation, involve the necessity of a superintending intellect for maintaining them perpetually without change, something will have been done towards reconciling the Scriptural announcement of a Creator to the minds of philosophers of every shade of opinion. And if I further show that the fixedness of the physical laws, and the uniformity of their operation, are compatible with variety in events, the unbeliever in Revelation will no longer be able to require the praying Christian to prove the laws of Nature to be variable, or their operation subject to change, as a condition necessary to moral government. To do these things is within the reach of human reason; and by a means that will more intimately relate the sciences to one another and dissipate much of their complexity. It is, besides, of no little import that the argument made use of is at its very first step as thoroughly theological as it is natural,—a combination which it continues to exhibit for ever afterwards. This twofold character it owes to its foundation on an obvious truth, which alone makes it to differ widely from arguments starting out from experimental observations about which we must always be more or less in doubt. That truth, too, is universal in its character; and thus the conclusions deduced from it have no limited applicability, but comprehend from the first all physical sciences, instead of being restricted to the one upon which we may have made an induction from experience. All this, however, the argument will better explain for itself,

as we allow ourselves to be carried from one to another of its conclusions.

Suspending our reliance on Scriptural authority, except in so far as to assume the existence of God as set forth for our belief, let us see whether we can, as natural philosophers, understand *how He made the material world out of nothing*. This is the truth from which I start.

I begin by remarking that the only *nothing* it is possible for me to conceive is empty space, which I think of as boundless in extent, eternal in endurance, but—with respect to entity—uncreated and absolutely nothing. Now, God is described as *ever filling* all space; for which we can conceive the qualification to be His boundlessness and eternal existence. Whenever, then, we observe created things to be in space we must conclude that they are, together with ourselves literally, also *in Him*; but to receive this at the hand of reason with all the satisfaction which truth should confer needs some little preparation. That matter can exist in space—which we should be inexact in calling an immaterial thing, as it is a simple negation of *all* things, whether material or immaterial—is easy to be understood; but to believe matter to be received into *intellect* or spirit is an incongruity so long as we look upon matter as we now do. We cannot imagine any mind to be tenanted by the actual hard solids of Newton's system. If, then, the creation be in God, we must prepare to believe it to be only a mental conception, however real and material it may seem to us; and that seeming reality we must account for.

These considerations suggest a way in which the creation of material things may possibly have taken place. Mind is capable of forming and entertaining geometrical conceptions; and there is no difficulty in concluding the power of the Almighty to be limited only by His will. Now, men have minds, and each can form conceptions—it may be of small geometrical spheres, which it truly imagines to be within itself in space. Those spheres may be conceived to be either distinctly separate, or to so intersect one another that any number of them may be more or less compounded with each one. As in the case of our own mind at every instant to a finite extent, so the mind of God at the creation can be imagined to have occupied itself to an infinite extent with first conceiving such immaterial spheres, and then, with a sovereignty entirely His own, *commanding them never to penetrate or intersect one another, even in thought*. That irresistible command, which no creature has the power to issue or to question, would to all intents and purposes convert the geometrical spheres instantaneously into the hard resisting matter of Newton, existing as *a conception in*

the mind of God, just as they had done while purely geometrical in character. How well are thus united the opposite systems of Newton and Berkeley, so far as integrity of volume is concerned, I need not stay to point out; but it may be well to say that their reconciliation in minute details is provided for on principles equally perspicuous.

Created matter is, on this showing, still immaterial to all immaterial things, which have no bounding surfaces for them to rest against; and materially solid to all material things which have such surfaces. From this it follows that things are not what they are in themselves absolutely, but rather what they are in relation to something else. Now, when we duly extend this *consequence of relation*, we perceive other truths, among which I shall hope some day, if spared to undertake the task, to enlarge upon the following physiological doctrine:—Mental perceptions of the relations of material things to organs of sense are immaterial, because the perceptions are things which relate only to immaterial mind. And almost immediately I shall have to prove that on this doctrine of *relationship* hangs the whole explanation of cause and effect throughout the length and breadth of all the natural sciences.

The change of geometrical solids into material solids takes date from the act of mental volition to which the change is due. Up to that moment the thing which has been created geometrically, and which is still immaterial, is susceptible of infinite division; but at that instant of becoming material with relation to all similar things, its divisibility, on these principles, ceases, and it remains for ever after a *definite atom*, greater or less in volume, but to our minds always inconceivably minute.

The atoms of matter *thus constituted* have only *form, volume, and physical solidity*, without any means of changing their places in space, either to collect together or to disperse; but Omnipotent volition is competent to invest them with a tendency to approach one another from any distance, which tendency we should call attraction, meaning, by the term, some power calculated to lessen distance between their bounding surfaces. Now, geometrical spheres have no such tendency, while atoms are reciprocally attracted. *Attraction, therefore, must start into existence AT THE MOMENT WHEN the geometrical solids become atoms*; and whether we call that force immaterial in relation to its source, or physical in relation to its results, it is just the same an operation of Divine volition. We have seen that the geometrical solids become definite in volume at the instant of changing into material

atoms ; just so, then, we must conceive their force of attraction, and its laws, to be determined at the moment when volition lays aside its distinguishing characteristic to appear as physical. The importance of epochs cannot, for the purposes of this essay, be overrated ; we shall not fully comprehend that importance until we come to treat particularly of force, which, by means of its laws, I shall be able to refer unmistakably to a power exercising both will and intelligence. But I must first call attention to some other uses in the marking of time, by which we may prepare ourselves for what is to follow.

Observation has familiarized us with the force of attraction. Attraction in atoms, when not counterbalancing itself in opposite directions, gives rise to motion ; and motion of the atoms attracted is not only a physical event, but the only event attraction can immediately occasion. It may be objected that the mind cannot conceive spaces, say small geometrical spheres, to change their places ; but that is no difficulty, as it is quite conceivable that the Omnipotent volition, which gives to spaces material solidity, can transfer their solidity to similar spaces in a linear direction, and thus, in effect, cause the atoms of matter to move towards one another.

Physical events, material facts, or natural phenomena, by whatever name they may be called, are matter in motion—some relative position of things which *has been* changing into that which *is*. Now, it is of the utmost importance to observe that all physical events, without exception, whenever and in whatever part of space they may occur, must be related to each other by *time* and *place* ; that is to say, either by co-existence or antecedence, and by relative position. In the present, as in the past, space is replete with events to which it would be impossible to deny the relations of time and place. And, on the other hand, it is equally obvious that to those relations alone no effect can be ascribed, for they can produce no motion in which only physical events can originate ; they are insufficient to change one event into any other.

Among physical events there are some which follow certain others with an invariableness not to be explained by the relations of time and place, and about which the mind is conscious that it perceives something more than orderly sequence. It perceives in the uniformity which marks their successions the necessity of a third relation to occasion what the first two relations cannot effect ; some influence connecting consecutive events by an action which cannot be questioned, without first admitting that invariable uniformity can result from no cause, and which of course we cannot assent to. Whatever be the

nature of that influence, the relation we are now speaking of as the third must therefore be admitted to be as palpable to reason as the other two ; and we call it *force*.

Of the three relations, time, place, and force, one of them—namely, *time*—never has a constant identity. Time is incessantly changing ; but inasmuch as in passing away it substitutes a reproduction of itself, the change in identity virtually leaves the relation of time unaltered. The second relation, *place*, can only be disturbed by motion, which, however slight, changes one event by substituting another. If motion in the things related could be an accidental occurrence, we might have new events by accident ; but as that cannot be, the system of nature would, if there were only two relations of time and place, be a perpetual reign of unbroken sameness. It is only by the production of motion by the third relation, *force*, that its associates, time and place, have any influence in causing physical events ; otherwise impotent, they are thereby, as I have said, made productive. Force inseparably appertains to the materials whose relations to one another *cause* events by undergoing change. Consequently we have, as the cause of events, not force alone, nor place alone, nor time alone, *but all three together*, each determining by its existing relation to the materials what the influence on them shall be ; there must be force to act on them, time must have the relation of being present, and place must determine what depends upon relative position.

At this point the system I am describing furnishes a truth most extensively borne out by observation—namely, that *if we neglect the ideas of antecedence and subsequence*, the expressions *cause and effect* become interchangeable, because all the relations between them, with the exception of time, are minutely reciprocal and equally consequential in one direction as in the other, by which is shown the necessity of taking the relation of time into consideration. Cause must in some slight measure occur before its effect, and so far one is different from the other ; but during the time that they co-exist *each is the cause of the other*. Attraction may possibly move the effect towards its cause, or the cause towards its effect ; or the two may be moved simultaneously ; and, however slight the change of place may be in either, the movement will be productive of a new event, or fact, each originating its own series of consequences. For want of recognizing the several elements of cause, physical science has been involved in serious mistakes, being made responsible for what mechanical writers call accelerating forces, entirely unknown to nature ; for when moral power takes upon itself to become physical, it

assumes the new character only by becoming definite in its action, with which the idea of acceleration is utterly incompatible. When force, at consecutive times, or with variable relations of place, acts with variable intensities, determined by a law of time or of distance, it is the practice to merge all the events in one, and to impute them to a force of some peculiar nature rather than to force acting as distinct causes. Such a force is the gravitation of mechanical science.

Cause and effect, each as a whole, are necessarily equal in all cases; whether a cause involve one or several forces, and whether it concentrate its effect on a single event or many.

The triplicated cause of effect, according to this system, may be immediate, or remote. It is immediate, when the term cause is applied to the relations which unite it to its effect without the occurrence of any intermediate events; and remote, when applied to relations no longer existing, but which have established subsequent and intervening ones. Cause may thus be more or less remote, extending back through any period; and it may be also, when immediate, more or less *continuous*, the time changing in its *identity*, but all the three relations remaining constant.

The existence of these several relations being understood as explanatory of the observed sequences of cause and effect, and there being in the relations of time and place nothing further that needs to be here noticed, I wish to direct inquiry more particularly to the relation—force. Now, without assuming any further knowledge of force than has been given in speaking of attraction generally, but proceeding to judge of it as required by the exhibition it makes of itself, we have only to contemplate the immense variety of material events, for each one of which force is an element of cause, to feel assured it must be less multitudinous in its kinds than they are. But, on the other hand, observation will not justify us in ascribing all effects to a single force; which in that case would have to be rendered into distinct causes merely by diversities in the relations of time and place. We might, it is true, under the relation of place, extend our conceptions to *position*, and thus include much that would not be involved in the idea of *distance*—indeed to position I have to attribute much; but no view we might take of the events which science has classed under distinct branches of physical knowledge would enable us to suspect there were not some essential differences between the forces of gravitation, electricity, and heat, which all the world acknowledges to be perfectly distinct at least up to that point—sufficient for my present purpose—at which one is supposed by way of “cor-

relation," to pass into another. By the operation of these three varieties of force, each acting in its own particular way on atoms of matter, and under the conceivable varieties in the relation of place, we shall have a great diversity of causes, though we repudiate all other alleged forces implicated in magnetism, chemistry, physiology, and light, of the separate identity of which we have no positive evidence, and as it seems to me no need.

The forces of gravitation, electricity, and caloric, or heat, are each so common that we may consider them to be acting in concert in insensible spaces intervening between the atoms in masses of matter. What their several actions are is not of moment in the present state of our argument; it cannot be doubted that each action is peculiar to the force to which it belongs, nor that the consequence of each at any time varies with the relation of place. In the interstitial spaces the action of each force will be distributed probably among many reactions, reducing effects to greater minuteness, while increasing them in number, to operate as causes in the next ensuing stage of the physical operation.

I would point here to an instructive metaphor, illustrating the production of physical events by the reciprocal relations of causes and effects, to be found in the formation of language. Consonants may be likened to the atoms to be related at any particular time; vowels to the forces which relate them; and the varied sounds of each vowel to the forces under the different relations of place. Consonants with a certain modification of vowel-sound, make up a definite syllable; so atoms, combined by certain forces and relations, constitute a certain material thing. And just as two syllables will not result from the same orthography and orthoepy, so a sameness of physical cause, or in other words, sameness of force with sameness of place, cannot produce two facts.

We thus arrive at sufficient knowledge of the fundamental principles of physical nature to perceive a distinction between *Cause* and *Force* which seems to have been lost sight of. We have been putting one for the other by philosophizing as though force governed by laws irrespective of the relation of place, were the same thing as *Cause having the relation of place involved in its constitution*. We have made the mistake of supposing that all which is true of cause, remains true when we substitute for it its two elements, force and time, omitting its important element, place. The *laws of force*, like all the other truths of Nature, are invariable; not so the action of force between cause and effect, which we know by observation is determined by their relative positions, often

subject to modifications at the suggestion of even human volition. Those modifications being made, it is a law of Nature that the action of force shall adapt itself to the circumstances; leaving the rigidity of the laws of force *under constant circumstances*, perfectly uninvaded. With *changeable causes* it is therefore puerile to insist upon *unchangeable effects*, merely on the plea that Nature's laws are inexorable; nor can law determine for the future what events shall occur at any time, when they must depend upon causes that may be determined, so far as their element place is concerned, independently of the laws of physics.

As events depend upon the relations existing between cause and effect, and these relations are altered by motion, events will often result from material organizations, whether endowed with intellect or not. Mind multiplies and modifies events by its volitions. The agriculturist multiplies organizations, and consequently modifications of motion, by sowing and planting; the chemist, by changes in place, produces changes in things; the physician, by new relative positions, supersedes pestilence by health; and every one *moves* to intercept events which otherwise would happen. At one time we secure the repetition or avoidance of an event of which we have learned the conditions; or, when experience has served us less well, we empirically trust to probability for obtaining a desirable event. And, assuredly, we may carry the same mode of determining events up to a higher intelligence than our own. If we, and in its measure, every lower intelligence, can at the dictate of personal *will*, work changes in events, knowingly or unknowingly, then a power in the Creator of us and them to do the same thing, cannot be questioned; to doubt this would be to imagine the *command* He has given to our own minds over the matter so mysteriously associated with them in our persons, wanting between His own mind and the universe of matter to which He is so intimately united.

From whence, then, is scepticism to obtain reasonable justification for its charge against praying Christians of ignorance and presumption, when they, putting their shoulder to the wheel to roll away a pressing evil, find the task beyond their powers? Christians know that converts to their faith are not to be made by physical evidences; still, science may remove many a stumbling-block out of the way; and there will be one the fewer if the distinction now pointed out between force and cause lead to its being perceived that variation in effect is not incompatible with invariability of law.

In the foregoing pages I have connected causes and effects by their mutual relations with respect to force, time, and place. Force has appeared as an attraction tending to shorten distance between cause and effect, every motion it produces in accomplishing that end substituting for the old a new state of things, which is a new fact, a new phenomenon, or a new event. I have presented only three kinds of attraction—the electrical, the gravitating, and the calorific; each acting simultaneously with the others and producing the whole variety of physical nature. Time has marked the relations of force and place reciprocally to one another, all which are epitomized in the laws of force. The relation of place between cause and effect has been shown to change with the motion produced by force, sometimes put into operation at the instigation of intellect either human or divine. And as a result of all this, while elucidating the fundamental principles of nature, and pointing to the intervention of man in the rigid operations of the universe, his appeal in faith to an intellect superior to his own in knowledge and power has been justified for doing without any interference with established laws, things of which he himself is incapable.

Of far greater interest to man than the composition of cause and the operation of force, is the *nature* of force. By believers and sceptics alike, with very rare exceptions, physical force is regarded as something inherent to matter for its government, either placed in it once for all at the creation, or as the Atheists suppose, existing in it from all eternity: a something which can be distinguished from moral force even by those who admit its derivation from it. I have already referred to its origin by saying how moral force could assume to be physical, and at what epoch it was necessary the change should be made. It is impossible to conceive the creative mind to have made the rudimental matter of the universe, and to have left it an instant without forces and laws. What further knowledge we require we obtain from experience. We observe that the laws of its forces are unchangeable, by which we distinguish the physical from the moral. In reality it is moral still, moral volition assuming to act without any variableness from the plan fixed upon for the creation. Our own personal experience furnishes us with evidence that this is the true distinction to be recognized between the moral and the physical Forces; for we change our moral volition into physical force. In making the change we can even determine up to a certain limit what the magnitude and laws of the

force shall be. The empire over which our moral power has this command extends however no further than to our own persons. Man's mind wishes to raise say any weight not exceeding the limit which has been assigned him, and his will—commanding a material organization constructed for obedience to it in some manner to us unknown—calls into operation an amount of physical force suited to the work the moral power requires to be done, neither more nor less; for, *if the will be so*, the weight is steadily suspended, becoming no more than balanced however much it may be reduced in magnitude, the physical force, mysteriously put in operation within the material organism at the dictation of the moral volition, being, in every case, precisely equal to the external physical resistance to which it is required to act in opposition. *How* the mind acts upon the material is no more a mystery, nor less a fact, than the action of one mind upon another; we know both, we can comprehend neither.

By this experience of our finite moral power, simply expanded to comprehend the infinite case of the Divine practice, I think we may understand on what principles the work of creation and preservation proceeds. Physical force, as I have conceived it, is none other than moral power acting—not on mind only but also on matter as well; and, in the case of God, uniformly with an intensity of force previously determined, and subject to laws which this system takes into account under the relations of place and time.

To estimate the competence of this view of *the nature of force* to get us over the difficulties of physical science we must submit the force to measurement, which its definite nature enables us to do. We measure different magnitudes of the same physical attraction relatively to one another by comparing them under like relations of place. Unlike physical attractions may also be estimated by comparison with one another. Moral forces are unsusceptible of relative admeasurement; and as all forces are originally moral, those which we compare and measure must, as I have before said, have passed from the moral into the physical character; *after which*, if a physical force be, under given relations, equal to another physical force, it cannot, under the same relations, be unequal to the same force. But when the relation of place is changed, every measurable force practically becomes greater, or lesser, as it operates at a lesser or greater distance, the force, as we observe it, varying inversely in the duplicate ratio of the distance. Now, it is by taking that law into account, under the relation of place, that *causes and effects are made equal, while the absolute forces implicated are at the time un-*

equal. This inequality of force at variable distances puts a negative on the possibility of what is called the *conservation of force*; and, of course, on its dependent doctrine of the *correlation of physical forces*, about which I shall have presently more to say.

The Divine Mind, having determined what shall be permanently the *absolute force* of the several attractions, will in each case have adopted *the law for varying its action* which has been foreseen to be necessary *for the universe as it is*. He might have established for distance between cause and effect any ratio other than that of the inverse square; or even the law might have embodied some other command with which distance had nothing whatever to do. Thus while, as we know, it has been established that two masses of matter gravitate between cause and effect through a given distance with twice the force of one of them; we are unable to perceive any reason why the gravitation should not have become on the coalescence of two equal masses, *and by reason of it*, four, or any number of times, instead of only twice as great. Of course, as a unit of matter gravitates with a unit of force, two similar units of force under the same relation of distance must—being entirely independent of one another—have a force of gravitation exactly twice as great; but *who can discern any necessity for the existing independence?* Dependence, or independence, is determined by the volition in exercise, and volition is subject to no necessity. Until we discovered by observation what moral power *had* elected to do, the existence of any one law, or ratio, between force and matter could no more be anticipated by us than any other law or ratio; and for those in nature we are without a reason, unless we find it in this—that the laws in operation are what they are because none other would have produced things as we actually find them, and as we can have no doubt they were intended to be.

But it is plain that if the coalescence of a double quantity of matter in action had exhibited a four-fold force, the ratio would certainly not have furnished a warrant for regarding, as it is the common practice to do, matter and force as the simple measures of one another. It would have been as easy then as it is at present to ascertain the quantities of ponderable matter corresponding to amounts of gravitating force; and we should have observed that they varied otherwise than in a simple ratio with one another. Now, although that is not the case with gravitation, it may be the case with one or other of the attractions, which we cannot know to be alike either in their laws or in their absolute forces, unless we learn it from observation; and observation teaches us a very different fact, as

I pointed out in the *Philosophical Magazine* so long ago as June, 1838, and have since leisurely and fully verified. The science of electricity is in a very anomalous condition, from which this system seems appointed to extricate it. In the latter part of the last century experiments were made by the Hon. H. Cavendish, and since that time by Sir W. S. Harris, over which both those philosophers abstained from theorizing, for the simple reason that neither of them could comprehend how it was that while electricity only doubled in quantity, the force with which it acted increased in the duplicate ratio. This truth it first fell to my lot to naturalize, and it is now so well known *as a fact* as to be generally received without question, although *as a law* it is still held to be an anomaly. The late Sir W. S. Harris, accustomed to treat forces as causes, and finding them in electrical cases to be *unequal* to the observed *effects*, put electrical forces through an imaginary "*reverberation*" to magnify them; and a contemporary mathematician still multiplies the electrical forces "*as in opposite mirrors*" under the same necessity. Strange physical principles these to adopt, and with no better end than to perpetuate our intellectual blindness! As we are now reading physics, the simple explanation lies in the appointment of the duplicate ratio of intensity by the moral volition; after which only can the measurable effects have measurable causes to be compared with. It was before noticed that distance causes force to vary in its effect; and now we witness the electrical attraction a second time varying, not in its effect by reason of distance as before, but in absolute intensity, because of variations in the *quantity of electricity*. A double and a triple quantity, the distance being given, acting with four times and nine times the force; a result which it is impossible we can conceive to come from anywhere but direct from the Creator's mind, and for which we shall learn abundant reason when we look into the phenomena of nature. Now, if these evidences prove anything at all, *they must prove a distinction between electricity and electrical force*; for one and the same thing cannot vary in different ratios. How unfortunate, then, was Faraday, when he worked only with forces, throwing overboard the matter of electricity, because he found it embarrassing. And how deplorable is now the position of his followers to whom he could only bequeath despair as a reward for their only too unquestioning discipleship!

If electricians were left alone with electricity, I have no doubt the requisite elements of the science would soon be acknowledged and restored; but, unfortunately, its destinies are wielded by other philosophers from whom we have no

reason to expect the speedy restitution of electrical materiality. They require for their own views that electricity shall be nothing but force, nor must there be in their system of physics any matter of heat; the forces of electricity and heat being, according to them, only phases of motion, a doctrine which it devolves upon me to characterize as, according to my view, a transparent and absurd fallacy. I will do it as briefly as I can.

“Conservation of force” has lately become “conservation of energy,” it being too evident that force is subject to variations. *Energy* is now put forward in its place; and its *conservation* dignified as the “one great law of nature.” In laying a foundation for the doctrine of invariable energy, its partisans set out with asserting that *force is lost if it produce no motion*. It will be safer to state what I require to say, as much as possible in their own words; after truly asserting that “in general, force is defined as that which produces or tends to produce motion,” they add, “now, if no motion be produced, the force which may have been exerted is absolutely lost.” Nothing can be more illogical than that conclusion; for, by the definition, force may *tend to produce* motion without producing it; and tending to produce motion has in physics no signification whatever, unless it means *acting* with a tendency to produce motion in opposition to some more powerful reaction which is rendering the action of the force—not inoperative, but inadequate. Now, *force in action cannot be said to be physically lost*; or all the *static* forces in the universe would be absolutely lost, although actually occupied in quietly resisting and balancing one another. How pregnant with importance is the import of a word! Had not a mechanical meaning of the term *tendency* been substituted for the physical one, no one would have been so simple as to ask in their disdain, “What becomes of the enormous force with which the earth continuously attracts a mountain, or that with which the sun attracts the earth?” They would have perceived that nothing becomes of it; but that the force, in continuously attracting, *continuously exists*; and consequently never becomes lost. Do not the questioners perceive that they are seeking for mechanical utilitarianism under the word *work*? “We do no work, however much we may fatigue ourselves, if we try to lift a ton from the ground. If we try to lift a hundredweight, we can raise it a few feet, and have then done work.” In physics *effect* is work; and is there no *work* done—no effect—when the static pressure of the ton is reduced by the lifting force to nineteen hundredweight? Is the force which is capable of lifting the one

hundredweight lost because the ton of which it is part is not put into motion? The error lies in that begging of the whole question which makes work to consist of motion; but that utilitarian idea will hardly be mistaken by physicists for the *work* which science takes into account under the calculations of action and reaction.

Force, then, operating physically at a constant distance, is never lost, as those who teach the "conservation of energy" assert that it can be; nor is the immunity from loss under those particular circumstances, by any means "conservation of force,"—a doctrine which requires the total amount of force existing in the universe, under some one of many alleged forms, to be never greater, nor less, at one time than at another; whereas we know, in the case of gravity for example, that by the law of distance the downward force of a ton's weight at the earth's surface would become gradually lessened as its distance from the earth was made greater. The same also with other forces of matter; experience teaches that one and the same quantity of electricity varies very palpably in absolute force under unchanging relations of time and place, according as it may be acting alone or in concert with other similar quantities.

So far as force is concerned, it is plain, then, that it cannot be conserved, though not for the reason alleged by the partisans of conservation. Those philosophers, believing in the loss of force, and requiring something that will remain always the same in amount, give force a new name; and, calling it energy, admit under that appellation only such dynamic, or unbalanced forces as are capable of producing motion; but the doctrine is not made by the limitation any the more consistent with truth. Of the distinction thus introduced, I reason as follows: All force, whether under its proper name, or that of energy, *tends* to produce motion, and force is either in a static or a dynamic condition. In the static condition force, tending to produce motion, is counter-balanced, though still existing, but being counter-balanced, produces no motion. In the dynamic condition, force actually produces motion, and ends in becoming static by establishing an equivalence of reaction.

Now, inasmuch as motions end with the expiration of the dynamic condition on which motion depends, energy, which is only a new name for that condition, cannot be a continuation or phase of motion. And to the above there is to be added this positive denial of the doctrine of conservation: Motion cannot be a phase of force, for if it were so, force should invariably become greater when motion ceased, whereas it

sometimes becomes less, as we always find when the motion increases the distance at which the force is acting. Again : Motion is alleged to change into heat, but to produce heat is to establish dynamic force, whereas to produce motion, which is alleged to be correlative to heat, is to change dynamic into static force. Besides which the allegation violates an axiom by imputing to a single cause two effects, each equal to itself ; for it imputes to motion heat on the one hand equal to the motion, and on the other, physical reaction equal to the energy which has caused the motion. And, finally, we may reason thus, on analogy : If electrical force be distinct from electrical matter, then it is not likely that heat is a force, while caloric is only an imaginary material ; in denial of the long and almost universally prevailing belief that heat is a force consequent upon the operation of a material caloric.

Let me close this argument in disproof of the alleged constancy of energy or force under any form whatever, by citing a fact which has now become very commonplace ; and must either be explained away in some manner which no one has been able to suggest during thirty years, or be received as settling the question for ever. Adopting the language in use, the *energy* accumulated in a horizontal disc weighing one pound raised one foot above any resting-place paralled with it would be a *foot-pound*. If, instead of the gravitation of the disc, there were substituted an equal downward pressure by electrical charge, the *potential energy*, as some call it, would still be one foot-pound. Suppose now half the electrical charge to be withdrawn ; this, on the conservation theory, should reduce the downward pressure to *one half of a foot-pound*, but practically it makes the foot-pound only a quarter of a foot-pound ; where then is the other quarter of a foot-pound if "energy can never be lost" ?

With difficulties insuperable as these opposing the doctrine of "conservation," and with a problematical immateriality of electricity and heat for its foundation ; we may well think out of place the flippancy with which the general views of heat, while they are acknowledged to have been long "believed in, written about, and taught all over the world," have lately been ridiculed, as "the pleasant fiction called Caloric ;" by writers, who, seemingly without a misgiving, can thus complain that their own mechanical and utilitarian speculations are not adopted by physicists as infallible guides : "no one who knows the present state of science can ignore the fact that many of its most certain truths are still misunderstood, and their very opposites often taught, even by men who by their position or their notoriety are supposed by the public to

be among the best informed." If those writers know the present state of electricity, as men so confident ought to do—electricity being at the root of all physical science—the question irresistibly suggests itself, whether any better illustrations than themselves can be found of the literal propriety of their own satire? One conclusion is, at all events, inevitable, they are reduced to the necessity either of ignoring the new and universally required law of electrical force, now shown to be feasible, or abandoning the doctrine of conservation as absolutely untenable, letting the dependent "correlation of forces" sink to a mere relation of action and reaction, in which either of them is made to counterbalance any of the others. If the physical attractions cannot be *conserved*, there is, of course, no need of one changing into another to account for its diminution; and it is quite satisfactory to conceive that each is produced in its required magnitude under any present circumstances as a result of the moral operation of the Deity, capable of seeing the end from the beginning, and of preparing by the physical laws for every eventuality.

Reverting to the common nature I have attributed to mind, am I chargeable with straining analogy too far in adducing, as I have done, a creature, albeit the most dignified that observation has made known to man—man himself, to portray in humble degree the moral likeness of his Great Creator? I think not; when I contemplate what man can accomplish with respect to the material universe by his finite mental powers to conceive, to will, and to achieve, I perceive that those powers need only to be infinitely magnified to become identical with some of those displayed in the character of the Creator. And in the light of human reason there can be nothing irreverent in believing that the Deity has delegated certain of His mental attributes to subordinate beings, seeing that none of His creatures *have any existence out of Himself*, notwithstanding He has gifted them with a conscious individuality. Our very persons and powers are to all intents and purposes still His, for all we have is in Him, and apart from Him we are absolutely nothing; in Him we move and act. And though it appertains only to a mind with infinite power as well as sufficient intellect to will geometrical solids into material atoms—though the Divinity has restricted the operation of our volition, so far as matter is concerned, to certain parts of our own individualities placed by Him under our command for that purpose, we are enabled at our own physical risk and moral responsibility to exercise to an extent appointed by Himself, the godlike attribute of modifying and beautifying nature. This is hardly the place to say so, but

the Creator and Preserver seems to have willed that nature shall be beautiful; impressing universal mind, when unendowed with reason great enough for its appointed work, with conclusions from His own reasoning communicated to His creatures under the name of instinct—one acts blindly upon a conclusion, the other knows why, having worked it out.

In taking this view of the creation and preservation of the universe, there will arise no misconception if we call force physical by reason of the material work done by it; and even if we speak of it as being inherent in matter, since it is from one atom of matter to another that force must be measured. And we shall understand both from the moral nature of force and from what has been said with respect to the relation of place that force operates through indefinite distances; now, as it is impossible to imagine the moral command of God to be bounded by any limit, we can dispense with the necessity for filling up the inter-planetary spaces with an all-pervading ether in deference to the allegation that "matter cannot act where it is not." We cannot allege the same thing of mind; and if we could, the mind of God would be everywhere in space. Nor can we imagine matter, as a creation of mind, to be capable of any performance impossible to the mind itself from which it was derived.

In conducting this argument no allusion has been made to *repulsion*, for the simple reason that no such force is required. What we call repulsion is not a force, but a fact due to attraction. A universal attraction of a material caloric or a material electricity among the atoms of matter is quite enough to separate them. It will remain for future efforts to trace these principles into special sciences; by affording which, and scattering light upon details, they will, as I have spent some years in ascertaining, exhibit the best proof possible of their own truthful derivation. To simplify a science is a sure way to advance it; but this does not mean either to cripple it, or to adopt into it mere mechanical expedients; while to advance the physical sciences as a whole demands the discovery of principles claimed by them all in common. If this system be true, it will, when the attempt is made, merge more or less in one another what are now regarded as distinct specialities; and so much I can promise for it that it can do.

In conclusion: this system of physics, although worked out on physical principles, conforms to the teaching of Revelation. The First Great Cause, who provided that word-pictures of His own Character should be displayed

for the foundation of man's faith in His existence, power, and goodness, has, for its corroboration, coupled with their exhibition the testimony of physical science. He has put it into our power to *know* by induction much which it would perhaps please Him better that we should be morally qualified to *believe*. For some purpose approved by His universal perfection—perhaps to put honour upon child-like confidence and trust—He has given Revelation to do for us what in the pride of reason we imagine it would be more dignified to do for ourselves; we would by the light of argument “see the print of the nails,” and by our own mental acumen put our “finger into the print of the nails,” and thus be sure that in crediting testimony we are not submitting to delusion. Well; to all is not given the same gift, and the best gift is not always that of our own choosing. He can only choose best who knows best; he knows the best whose experience is the least limited; and he cannot be said to have the most extensive experience who studies in the mind of God nothing but His intellectual Power.

The CHAIRMAN.—I have to ask you to give a vote of thanks to the author of the paper, and to invite discussion upon the views it contains.

Rev. C. A. Row.—I have given great attention to the matters discussed in the earlier or metaphysical portion of this paper, and I purpose to confine my remarks entirely to them. I am sorry that the author is absent, for I came prepared to ask him many questions, to which I should have been glad to hear some reply; for, though I have studied metaphysics for many years, I find in this paper many things to which I am altogether unable to assign any definite meaning. Some of the statements I cannot believe the author means me to accept in the ordinary sense as they stand. The fact is, he has entered upon the whole range of ancient philosophy, beginning with Thales and ending with Aristotle; and before you can consider any of those points which he has laid down as proved, you must discuss the whole ancient philosophy in its metaphysical character. When you read the old authors,—and let me take Plato as an example,—you find in many of the dialogues which enter into these subjects conclusions in which nothing is concluded. And there are many points in this paper, also belonging to ancient philosophy, which are quite beyond any of the powers of the human mind. Macaulay, in his essay on Lord Bacon, gives us an illustration of this, when he observes that Plato had a first-rate bow and a first-rate arrow, but, instead of going out to shoot mundane things, he tried to shoot the stars. Now, that, it seems to me, would apply to some of the observations in this paper. Mr. Laming says:—

“I begin by remarking that the only *nothing* it is possible for me to conceive is empty space, which I think of as boundless in extent, eternal in endurance.”

Now, Lewes, in his *History of Ancient Philosophy*, or Grote, in his *Plato*—I forget which—has observed, with great truth, that one fundamental error, lying at the root of these reasonings, is the assumption of “Nothing” as being an absolute entity—that nothing actually exists as nothing—and I quite believe that other observations founded upon that assumption lead to a vast amount of error in reasoning, and to endless inconclusiveness. I apprehend the author has fallen into exactly the same error as that which either Lewes or Grote charges against a number of these old metaphysical speculations, whether of the Ionic or of the Attic school,—in Plato’s *Dialogues*, and even in Aristotle’s *Metaphysics*. Now, according to Mr. Laming, in the passage I have read, empty space is nothing; but immediately afterwards he assumes it to be something. When the old Greek philosophers predicated a thing as non-existent, they predicated its non-existence as existing, according to Mr. Lewes’s view; and I think the same thing has been done here in the predication of the existence of nothingness——

MR. REDDIE.—I think Mr. Laming means the opposite, whatever construction his actual words may bear.

MR. ROW.—Then what does he apprehend space to be? Space, to my mind, is not an actually existing thing, but simply a subjective thing. It is a matter of very deep and important philosophical speculation; and it is impossible to say that it can be assumed as determined. Mr. Laming goes on:—

“Now, God is described as *ever filling* all space; for which we can conceive the qualification to be His boundlessness and eternal existence.”

Here we have space presented to us as actual extension, and then God is described as filling all space. Bear in mind that I am speaking in philosophical and not in popular language. Of course it is correct in popular language to say that God fills all space; but, philosophically, if space is extension, and God fills all space, it gives the idea of extension to God Himself. These are matters which are quite beyond the limits of the human understanding. The nearest approximation we can get is to say, not that God fills all space, but that He is present at every point of space in all His uncreated perfections. It is impossible to say that God fills all space without giving direct and positive extension to Deity. Mr. Laming proceeds to say:—

“Whenever, then, we observe created things to be in space, we must conclude that they are, together with ourselves, literally also *in Him*.”

Of course, if the Deity has extension, and all created and finite things are also in extension, it will follow that all finite things are contained in Him. The real difficulty of the whole subject, and that which the author endeavours to unravel, is how the Infinite has created the finite. But that is a difficulty which we cannot grapple with. The *modus* in which the Deity—the uncreated God—has actually evolved finite existence, is beyond all human conception.

Mr. Laming lays it down, then, that all created things exist *in God*, and he goes on to say :—

“That matter can exist in space—which we should be inexact in calling an immaterial thing, as it is a simple negation of *all* things, whether material or immaterial—is easy to be understood.”

Here is a great peculiarity. I cannot understand how space is “a simple negation of all things,” viewing it as a negation :—

“But to believe matter to be received into *intellect* or spirit is an incongruity, so long as we look upon matter as we now do.”

This language seems to me to assign extension to spirit. “Matter to be received into spirit” makes extension an attribute of spirit; whereas, according to my conception, the idea of spirit involves the negation of extension. We cannot get an idea of spirit if we attach extension to it. But here is something still more surprising:—

“We cannot imagine any mind to be tenanted by the actual hard solids of Newton’s system.”

I certainly cannot understand this desk getting into my mind, for instance. Of course the idea of it is in my mind, but that the actual desk itself should get there I cannot comprehend—

The CHAIRMAN.—It would be very inconvenient if it did. (Laughter.)

Mr. ROW.—Mr. Laming goes on; and this is the surprising part :—

“If, then, the creation be in God, we must prepare to believe it to be only a mental conception, however real and material it may seem to us; and that seeming reality we must account for.”

Now, this is very serious. We come at once to the theory of Berkeley and a vast number of previous philosophers—among the Greeks of the pre-Socratic school—who deny the existence of the material universe. Considerable portions of the Platonic system are also founded on the same principle. There are certainly very powerful reasons to be urged against the existence of a material universe; but, in spite of all the reasoning of Berkeley and others—in spite of all that may be found in Plato—I believe there is a material something in those objects which I see around me, and behind and above all the conceptions of those things which I have within the limits of my own mind. I do not deny the weight of the reasoning against this; but, in spite of all the arguments, I say that God Almighty has so formed our minds that we cannot avoid believing in the existence of external matter, even as an objective thing. We cannot help believing in the objective reality of matter, notwithstanding all argument to the contrary. Again, Mr. Laming says :—

“Mind is capable of forming and retaining geometrical conceptions; and there is no difficulty in concluding the power of the Almighty to be limited only by His will.”

He is now going to account for the creation of material things: and if he had been here, I would have asked him whether mind is capable of forming geometrical conceptions apart from ideas which enter through the senses:— I mean the finite mind, supposing it had no senses whereby it succeeds in forming those geometrical conceptions? I apprehend not. But the author says:—

“Now, men have minds, and each can form conceptions,—it may be of small geometrical spheres, which it truly imagines to be within itself in space.”

I do not know what the “it” refers to, and therefore I am not able to attach a meaning to this passage. Nor can I understand this:—

“Those spheres may be conceived to be either distinctly separate, or to so intersect one another that any number of them may be more or less compounded with each other.”

That seems to me to be a very indefinite expression. I have made some efforts to get a definite idea out of it, but I am sorry to say I have failed. Mr. Laming proceeds:—

“As in the case of our own mind, at every instant, to a finite extent, so the mind of God at the creation can be imagined to have occupied itself, to an infinite extent, with first conceiving such immaterial spheres, and then, with a sovereignty entirely His own, *commanding them never to penetrate or intersect one another, even in thought.*”

Now, it seems to me that that sentence is strangely inconsistent with the idea of the immutability of the Creator. It suggests that God occupied Himself at the creation in conceiving these material spheres. Then the phrase at the end—“even in thought.” Is that the case in geometrical spheres? This certainly wants explanation; and again I am compelled to regret the absence of the author of the paper. Again:—

“That irresistible command, which no *creature* has the power to issue or to question, would, to all intents and purposes, convert the geometrical spheres instantaneously into the hard resisting matter of Newton, existing as a *conception in the mind of God*, just as they had done while purely geometrical in character.”

It seems to me that the theory at the bottom of this is the theory of the old philosophers that there is one continual flux going on, everything joining in it. I can understand the theory that to the Eternal Mind there is no such thing as matter—that matter exists only to the mind of man, and that, after all, to a very limited extent——

Mr. REDDIE.—That is your own opinion?

Mr. ROW.—No, no; it is the opinion stated here by Mr. Laming——

Mr. REDDIE.—Then do you controvert it?

Mr. ROW.—It seems to me that it is an assumption which wants proving. Many of these points may be quite true, but I say, give us some proof of them before you call on us to believe. What is the precise relation of matter

to the Eternal Creator, and by what means He has brought it into existence, are points which are entirely beyond all human conception. If we dash our heads against such points, we shall simply damage our brains. Mr. Laming says further :—

“Created matter is, on this showing, still immaterial to all immaterial things, which have no bounding surfaces for them to rest against; and materially solid to all material things which have such surfaces.”

Now, that is so obscure that I am not prepared to assign any definite meaning to it. It seems to me to introduce confusion among all our conceptions, subjective and objective. Are we to believe that there is no such thing as objectivity? He goes on:—

“From this it follows that things are not what they are in themselves absolutely, but rather what they are in relation to something else.”

That proposition, taken by itself, asserts that there is no such thing as *ὄβσία* in existence, but everything is merely in a state of becoming *ὄβσία*. Ideas were no part of the material creation, according to Plato; but the material creation simply existed so far as it partook in those ideas which stand on a higher intellectual basis. According to this passage, then, there is no such thing as *ὄβσία*, but only a perpetual becoming. We can illustrate what we conceive to be a “constant becoming” by our notion of time. My notion of time is undoubtedly that it is not a present thing, but a thing constantly marking the past. That is a very fair conception of the view held by the old Greek philosophers, that there was no such thing as the existence of matter, but only the *γελνόμενον* or perpetual becoming—

MR. REDDIE.—You do not dispute the opposite, I suppose—that there is a substantive reality in material things. There is certainly a great deal to be said for the view that material things have no substantial existence; and it would be interesting if you advanced something on the other side of the question.

MR. ROW.—I would not undertake to do that. As I have already said, there are certain things around me which have certain qualities attached to them, and which may or may not have an absolute existence of their own as matter; but I say that God Almighty has so formed my mind that I cannot help believing in the existence of something objective in them—

MR. REDDIE.—Even Berkeley would admit as much as that; but the question is, *What* is that something which is objective?

MR. ROW.—We cannot reach that point. There is another curious passage in Mr. Laming’s paper:—

“The atoms of matter, *thus constituted*, have only *form, volume, and physical solidity.*”

That is the exact theory of Democritus, and also of Lucretius. And Democritus, for the purpose of creating the universe out of atoms, says, in

addition, that these atoms are impressed and controlled by fate or necessity. It is a curious thing to find the early theories of the old Greek philosophers still cropping up here. Then, in another part, it seems to me that the author represents that motivity, as a force, is capable of exhaustion. Of course, any physical force is capable of being exhausted in its effects ; but he appears to me to contend that moral force also is capable of exhaustion. My moral force, or the motive which produces, continues as strong as ever after it has been exercised—I mean, the effort I produce in realizing a result in motivity does not weaken the power or the moral force which I call into action.

Mr. REDDIE.—I am sorry that the author of the paper is absent to-night ; but I expected that from the beginning, as he is a great invalid and quite unable to move from one room to another unless he is carried. I also regret the absence of our usual chairman, from whom I expected we should have had some valuable and interesting remarks with reference to the author's treatment of the theory of the conservation of force or energy. The paper has already been criticised somewhat severely ; and I am bound to admit that it is open to a very great amount of criticism. And first I think the title is open to objection. Mr. Laming has entitled his paper, "On the Immediate Derivation of Physical Science from the First Great Cause." This language is evidently erroneous ;—the author means the derivation of things of which science takes cognizance, and not of our knowledge of them. But there is, in fact, a great looseness in the language throughout ; and there is a very great difficulty in dealing with the paper, arising from the author's use of words in a different sense from that in which they are usually employed. With regard to that part of the paper in which Mr. Laming treats of space, there can be no doubt that we have got into a certain conventional mode of speaking of space as if it were an entity—not merely in the sense used by Aristotle when he says that a man who predicates that a thing is nothing, therefore predicates for it a kind of existence as nothing ; but we certainly do all habitually speak of space in the way that the author of the paper does, when he says that "God is described as ever filling all space." I have no doubt we have all met with similar language in books that would pass current both amongst philosophers and theologians ; but it appears to me to be erroneous. I agree with Mr. Row that, in ordinary parlance, we may, with a sort of accuracy, say that God fills all space, meaning thereby that there is no place where He is not ; but then it is equally true that He is ever present at all places altogether, and in all His uncreated perfections. We cannot therefore predicate material extension of God without appearing to predicate parts as well. But there is a theological declaration expressly forbidding that. The very first of the Thirty-nine Articles declares that we are not to predicate body or parts of the Deity. Yet people do speak as if space were an entity : even Mr. Row, for example, talked of things "existing *in space*"—

Mr. Row.—But I do not maintain that space has an absolute existence.

Mr. REDDIE.—The words "in space" are merely superfluous. But I think the author's meaning is distinct enough on this point. He says :—

“Mind is capable of forming and entertaining geometrical conceptions ; and there is no difficulty in concluding the power of the Almighty to be limited only by His will. Now, men have minds, and *each* can form conceptions, it may be of small geometrical spheres, which it truly *imagines to be within itself in space.*”

There is some inaccuracy of expression here, but there seems to be no doubt he does not intend to speak of an actual existence, in thus alluding to space. When we come to the passage beyond, in which the author attempts (and, as I think, legitimately) to explain, or to endeavour to realize, how something material could come to be created out of nothing, I think we must not press him too hard. I quite agree with Mr. Row that in all probability men will never be able to understand the method in which God has created matter ; but still, with regard to the material things surrounding us, it is a legitimate exercise of man’s reason to endeavour to understand, so far as we can, how they came to be. Lord Bacon has told us that it is the glory of God to conceal a thing, but it is the glory of man to find it out ; and he speaks of man as being so incompetent to arrive at a thorough knowledge of the science of things that he considers the Deity is, as it were, almost playing with man as if he were a child on these subjects ; while man is continually baffled in his attempts to penetrate into the nature of even the very simplest things. When we try to discover how material things can have come into being from the act of an eternal, immaterial spirit, it is a difficult matter ; but perhaps not more difficult than to understand how we can get this solid table, for instance, by a pure spiritual conception, into the mind. On this point Mr. Row almost refuted himself ; for he admitted that his mind had nothing in it but impressions or ideas, and yet he had the impression of the solidity of the table in his mind, notwithstanding his difficulty to realize it. Berkeley does not deny the objective existence of things, or the existence of the external world, but only that they have a material substratum. He says their substratum is spiritual. He does not deny the existence of the table, or of anything else ; he merely attempts to account for the mode of their apparent existence. It is not a bad conception on the part of the author, then—it may be inadequate, but still it is ingenious—to suppose that the atoms of which we have heard so much from the ancient philosophers and from Dalton, although they are now a little at a discount in the philosophical world, were originally mere conceptions on the part of the Deity, as circles, triangles, and so on. Some of the atomic philosophers tell us that the atoms are round, and others that they are angular. Newton contended that all acids had their peculiar strong sharp flavour because they were made up of angular atoms which cut the tongue slightly. When Mr. Laming supposes that these atoms of matter are geometrical conceptions, to which the Deity gave a kind of existence by ordaining that they should not interpenetrate or intersect each other, that gives you solidity, and goes to solve the difficulty in understanding how anything solid which can resist any other thing may have proceeded from the fiat of the Eternal Spirit. But still it appears to me simpler and just as philosophical to suppose that all material things were

thus "created," or called into apparent existence, by the Word of God, without the intervention of imaginary atoms. For this theory is quite inadequate to account for all the varieties and beauties of visible nature. The beautiful colours of the rainbow, for instance, are as real things as this table. We cannot feel them, certainly, but in the dark we cannot see the table ; but we must all admit that the colours of the spectrum are as much a part of visible existence as that material hardness which resists the action of our material bodies. Mr. Laming states that these things exist not in themselves, or as they seem, but in relation to something else, and that on that showing created matter is still immaterial to immaterial things ; and in my opinion we have certain analogies which enable us to understand this. In the New Testament, for instance, we are told that when Christ appeared to His disciples after the Crucifixion the doors were shut, but we consider that appearance to be supernatural. But we do not suppose that a spirit would be deterred in its passage by doors. Take glass, again, which is a very solid material,—much more solid and compact in its body than a sheet of paper or many other opaque bodies,—yet light will penetrate through thick glass. If you admit that there is anything at all in light—any material thing, that is to say—you have it passing unmistakably through a solid body like glass. You cannot pass your hand through this table, certainly, but I have given you an analogy to show that spirit may pass through anything and everything. Every one who knows anything at all about light cannot fail to be struck with the fact that it does pass through such a perfectly solid body as glass ; which is not at all a porous material, but remarkably continuous in its composition, and a great deal more solid than many opaque substances which would not permit the passage of light. It is not, after all, then, a question of solidity or its absence. Analogies in the same way may be found in heat and cold, which will pass through almost anything, and in electricity, which passes with the greatest facility through solid conductors, annihilating both time and space in doing so, but which is thoroughly baulked when it comes in contact with some non-conductor, which it fails to penetrate at all. Mind, I am only partially defending the views of the author of this paper. I think it is legitimate and fair in argument to endeavour (even if baffled) to arrive at some understanding how and in what sense a material thing could come from an immaterial spirit. The author has also boldly attacked the doctrine of the "conservation of force." It is not perhaps very well known, and may be new to some of my hearers, that Professor Faraday, who may be said to be the author of the doctrine that force is always conserved and never lost, objected to the dogma of Newton that gravitation is a force which varies inversely as the square of the distance, precisely because that is inconsistent with the doctrine of conservation. If the force of attraction gradually fades away, as bodies recede from the centre of attraction, it is quite clear that that force is not "conserved," since it lessens. If the force is lessened to any extent at all, you cannot any longer maintain the "conservation of force." Professor Faraday did not, however, give up the idea of conserved force ; but he logically wanted to give up this dictum with

regard to gravitation; and his views were not well received by the Cambridge mathematicians, who seemed determined to maintain at all hazards what they had taught so long about the variation of the force of gravitation, and yet they inconsistently don't dispute the conservation theory. But if I were to accept some passages in Mr. Laming's paper I should be unable to know what to believe as to this theory of conservation. He says :—

“Force, then, operating physically at a constant distance, is never lost, as those who teach the ‘conservation of energy’ assert that it can be; nor is the immunity from loss under those particular circumstances by any means ‘conservation of force.’”

The force is not lost, but still, he says, we must not say it is conserved! I confess I cannot understand that. Surely, if it is not conserved it must be lost. He afterwards speaks—

“In disproof of the alleged constancy of energy or force under any form whatever.”

Before, he drew a distinction between force and energy, but here he uses them as convertible terms, and says his argument is in disproof of their alleged constancy. I do not understand that either; and the great fault of his arguments against the current theories of force appears to me to be simply that either he does not quite understand what the current theories are, or else he uses the language which we find in all dynamical works in a totally different sense. He has attacked the force of gravitation, and he uses an extraordinary phraseology, which it baffles me to put any meaning upon at all. He says :—

“Attraction may possibly move the effect towards its cause or the cause towards its effect,”—

and I do not know in the least what the meaning of that can be. Then he actually substitutes the one for the other, and confounds cause with effect, saying in one place that “the effect may be a little after the cause as a rule,” while in other places there is no difficulty (as I understand him to say) that “the one may be simultaneous with the other.” He further says :—

“For want of recognizing the several elements of cause, physical science has been involved in serious mistakes, being made responsible for what mechanical writers call accelerating forces, entirely unknown to nature.”

Now, no man who has seen a stone fall can profess to want knowledge of an accelerating force, as dynamical writers understand the term. Everybody knows that a stone sufficiently heavy not to be affected by the air falls with a constantly accelerated velocity. The reason the velocity is accelerated is because the force is constant, and that motion, once communicated, is kept up. The stone beginning to fall has to weigh down and pass through the atmosphere with its initial force of attraction, while ever new forces from attraction (still pressing it down) are added; and so we have, in every falling

stone, an instance of the "accelerating forces" which Mr. Laming says are "entirely unknown to nature"! I cannot understand how he can have brought himself to write such words. As I have already said, there is room for considerable criticism, and in some parts of the paper I cannot find the beginning, middle, or end of the author's meaning. In one passage he says :—

"The forces of gravitation, electricity, and caloric, or heat, are each so common that we may consider them to be acting in concert in insensible spaces intervening between the atoms in masses of matter."

In another passage he speaks of the "effect of caloric or heat being the same as gravitation in causing attraction"; and in a further passage he says :—

"In conducting this argument, no allusion has been made to *repulsion*, for the simple reason that no such force is required."

Required by what? Again I say I cannot understand his drift. He adds, "What we call repulsion is not a force, but a fact due to attraction"; whereas I have always understood that repulsion is the reverse of attraction. The spirit of the last two pages of the paper I quite understand, and I think I see what the author is aiming at; but I should be sorry to commit myself even to the approval of that part, owing to the mistiness of the language, and to the use of terms in a different sense to what we have all been accustomed to. It would be invidious, however, to go through the paper any further; and I may say that I think its merit chiefly consists in the fact that it has given us an opportunity of discussing such questions as whether space has properly an existence, or is only a mere negation, and as to whether the new dogma of the conservation of force is true.

Mr. WARINGTON.—With regard to the author's theory as to the origin of matter, let us carry it out to its legitimate extent, and see in what it involves us. In metaphysics it is especially difficult, and, indeed, almost impossible, except for those who are deeply versed in such studies, to see at once what a proposition involves unless it is traced out to its full extent. Mr. Laming tells us that all matter may have originated from the conception of something which should appear to be material in the mind of the Creator; that it has no existence out of the mind of the Creator at any time; that it is not material; that there has been a conception which has formed the pattern or type upon which what we regard as the material entity has been afterwards constructed; but that the original conception remains the only entity ever afterwards; and that that is the conception which exists only in the mind of the Creator. That is Mr. Laming's theory of the origin of matter. Then, I would ask, how do *we* become conscious of the existence of matter? It is not a thing which has any actual existence by itself,—it is not a thing which exists in my individual mind,—for it exists only as a conception in the mind of God. How, then, do I know that it exists? I can perceive matter—I cannot help perceiving it, for it is a part of my nature that I

should do so. Then what follows? Simply this, that God's conceptions of His material universe are a part of my nature. Therefore I, in fact, see things with my bodily eyes as God sees them with His mind. It does not require much logic to show that the conclusion involved is that I am a part of God's mind—

Mr. REDDIE.—I do not think Mr. Laming means to go to that extent.

Mr. WARINGTON.—He would not tolerate that extension of his meaning, perhaps, but I say that the theory requires that extension. I would submit that any theory which says that material things exist only as conceptions in the mind of God must, if expanded to its logical boundaries, land us in simple Pantheism—

The CHAIRMAN.—I do not think that that is what Mr. Laming intends.

Mr. WARINGTON.—No, I dare say not.

The CHAIRMAN.—Nor do I think his language admits that in theory.

Mr. REDDIE.—He has certainly said things which would contradict that view altogether.

Mr. WARINGTON.—Yes, but that only shows that he is inconsistent, for the doctrine admits of that extension. With regard to the origin of physical force, he says that it is only moral force altered in the particular respect that it becomes unchangeable. That implies that moral force is changeable—

Mr. REDDIE.—I think he means spiritual or mental force, not moral force in an ethical sense.

Mr. WARINGTON.—It does not make the slightest difference. If he means mental, it includes what we call, distinctively, moral force. But surely moral force is as unchangeable and as invariable as physical force. Surely moral force changes no more than, and is as absolutely bounded by definite laws as, physical force. There really does not exist that difference which the author seems inclined to make in this respect. Then he speaks of ourselves having the power of changing moral force into physical force. He says, when a man's mind wishes to raise a weight—the wish being the moral force—he puts forward the physical force which enables him to lift it; and therefore the one force is the same as the other, only changed to a certain extent in its form. But he forgets that a man's physical power is limited, while his moral power is unlimited. I can *will* to lift any force I please, and if moral force can be converted into physical force, my power should be as unlimited as my will. But that is not so. My physical power is totally distinct from my will and intention to do a certain thing: my will and intention simply direct the use of my physical power. And if a man stands in such a relation towards matter and force, this gives us no clue at all by which we can in any way conceive God's relation towards matter and force. Our will avails itself of matter and force already existing to the hand; His will calls things into existence. We have no power of that kind in our minds. It seems to me, therefore, that all comparison of our moral volition and physical force with God's is entirely beside the mark, because the analogy fails in its most essential point. Then as to the conservation of force. I have always understood

that the doctrine of the conservation of force meant that force could not be lost; yet we are told by Mr. Laming that "those who teach the 'conservation of energy' assert that force can be lost." If that is so, I shall give up the doctrine which hitherto I have been accustomed to hold. Then Mr. Laming says :—

"Motion is alleged to change into heat, but to produce heat is to establish dynamic force; whereas to produce motion, which is alleged to be correlative to heat, is to change dynamic into static force. Besides which, the allegation violates an axiom by imputing to a single cause two effects, each equal to itself; for it imputes to motion heat, on the one hand, equal to the motion, and, on the other, physical reaction equal to the energy which has caused the motion."

But those who hold the doctrine do not do that. They say, If you get motion as the result of your motive power, you get no heat; but if any portion of that motive power is resisted and unable to pass on as motion, it immediately appears as heat. Therefore, instead of imputing two effects to the same cause, each equal to it, the two effects are only equal to the original cause when taken together, that part which causes the heat not having caused any part of the motion. But if we were to discuss the various matters contained in this paper fully, I am afraid we should have to lay down all the foundations afresh from the very beginning.

The CHAIRMAN.—The subject is a very difficult one, and it has been somewhat imperfectly dealt with in the paper; but even imperfect papers are useful, if only for the purpose of laying down debatable matter for discussion. And of this we have had a good example to-night.

The meeting was then adjourned.

REPLY BY MR. LAMING.

THE paper I have had the honour to submit to the Institute has been deemed worthy of a searching criticism, which of itself, considering the profundity of the subject, is occasion for self-gratulation.

I have described God in popular language "as ever filling space," which is objected to by Mr. Row as imputing extension to Spirit; and he proposes to replace the expression by saying, more philosophically, that God "is present at every point of space." The lesson being thus exactly enunciated, he need no longer entertain the idea of extension as an attribute of God in common with all material things, and yet be able to conceive the Creator as having the creation in Himself, both its mind and matter, because all is in space, the nothing ever present with Himself. Mr. Row, however, adopting the popular language in the philosophic sense of "ever filling," proceeds to say, "If the Deity has extension, and all created and finite things are also in extension, it will follow that all finite things are contained in Him." Mr.

Row comes to the conclusion that "the real difficulty of the whole subject, and that which the author endeavours to unravel, is how the Infinite has created the finite;" and he regards it as "beyond all human conception." The subject need not be encumbered with the untrue supposition of the extension of spirit, though the suppression of that extension will only add to his difficulties a new one. I have said, "If, then, the creation be in God, we must prepare to believe it to be only a mental conception, however real and material it may seem to us, and that seeming reality we must account for." To me it is a mental conception in God's mind, transferred to my own in a manner I will presently indicate. Mr. Row "can understand the theory that to the Eternal Mind there is no such thing as matter—that matter exists only to the mind of man." He fails to see that the human mind conceives the materiality of things because it is associated with a material body, in which the distinctive characteristic of matter can be mentally perceived; nor does he even feel sure that God can conceive the existence of matter in the absence of a body. Mr. Row asks, of course with reference to man, "whether mind is capable of forming geometrical conceptions apart from the idea of the senses." It may be that it is not; but, if the senses be necessary to the conception, man has them always in readiness. It is enough for my theory that I know the human mind associated with the senses can have the conceptions; and reason tells me that God can be a geometrician without senses, which possibly may imply a similar faculty on a small scale in the case of man, made intellectual after the image of his Maker.

As I wrote about "intersecting spheres" only to emphasize their non-existence, the fact that Mr. Row has not made out my meaning will have led him into no error. He charges me with an utterance "strangely inconsistent with the idea of the immutability of the Creator," on the score that "it suggests that God occupied Himself at the creation in conceiving these material spheres." If I have rightly understood the charge, I must acknowledge my inability to comprehend Mr. Row's construction of mutability.

I come now to the observations of Mr. Reddie. If, as I believe, the derivation of things of which science takes cognisance is the derivation of science itself, my subject will have an appropriate title, and I may pass on to Mr. Reddie's comments on the text of my paper. I am gratified that he has understood it well enough to say, "When Mr. Laming supposes that the atoms of matter are geometrical conceptions, to which the Deity gave a kind of existence by ordaining that they should not interpenetrate or intersect each other, that gives you solidity and goes to solve the difficulty in understanding how anything solid which can resist any other thing may have proceeded from the fiat of the Eternal Spirit." For he evidently conceives a possible *modus* in the creation of matter which it was the preliminary object of my theory to point out. To show the organization of matter "into all the varieties and beauties of visible nature," to trace the whole architecture of physical creation from its first material foundation, could not be attempted in the few pages I laid before the society, my utmost endeavours extending no further towards that coveted revelation than to point to the moral will of

God made physical as the due sequence of His geometrical conceptions, by acting from minute to minute with measurable exactitudes suited to the variable relations of matter with respect to time and place. This second part of my doctrine was left in outline, and Mr. Reddie has mistaken its incompleteness for confusion. He represents me as attacking the doctrine of gravitation, and as assimilating it with heat ; whereas I teach that each of the two is the attraction of a matter *sui generis*, one enormously greater than the other, while I profess entire allegiance to the laws of Newton. I have satisfied myself, and so said, that gravitation has nothing in its nature more than any other attraction to entitle it to be called accelerating ; and Mr. Reddie, by adducing the language of dynamical writers, as they do that of Galileo, only perpetuated to the force one unnecessary isolation, just as in our own times Faraday wished, by getting rid of conservation, to give it another. Perfect simplicity—the only foundation for action worthy of Almighty intelligence and power—requires the resolution of all the exceptions supposed by science among general principles before we can rest satisfied our knowledge is unquestionably that of nature's truth. Such at least is the conviction on which I based my present investigation, and which I am far from seeing any reason to alter. Mr. Reddie is not sanguine with respect to profound fundamental discovery. He does not think "men will ever be able to understand the method in which God has created matter" ; and yet he is of opinion that to do so is "perhaps not more difficult than to understand how we can get this solid table by a pure spiritual conception into the mind." I do not believe that man is to be "continually baffled in his attempts to penetrate into the nature of even the very simplest things" ; nor do I think it has hitherto been always the case, of which the results of gravitation afford us an appreciable example, although doubtless it, and every demonstration deduced from premisses not at the root of physical causation, labours under a consequent disadvantage. There is, and must remain, a longing desire to know the cause of gravitation, as well as its laws, and the position that cause holds in the general scheme of nature ; but the want of that knowledge will not shake our faith in its having some place in nature into which it will be some day accurately fitted. It is reasonable to suppose that if we had only discovered nature's beginning long ago, we should not have failed, as we have done hitherto, in understanding generally "her very simplest things," for we might then have traced her step by step, as we do her gravitation, without ever parting company. We have now made a beginning, recommended by its simplicity, and I still see no interruption to onward progress ; this I think is made out in my original text.

Mr. Warrington has so misunderstood my theory of the formation of matter, and of its perception by the mind of man, as to imagine it makes some pretension to identity between the Divine and human minds. In this deduction of Pantheism he stands apart from my other critics, and I rejoice to believe he also will soon perceive that he has drawn his conclusion from mistaken premisses. The human mind comes into existence as one of God's creatures, with its capacity for conceptions just that which its Creator has made it, and

which we know is not great enough to read the mind of God respecting matter without some especial assistance from Him for that express purpose. On His own part God has imagined the magnitudes and forms of His geometrical spheres as the simplest of all geometrical conceptions, and given to each of them material extension by ordaining their reciprocal impenetrability, at the same time making it physical as well as material by causing it to operate on other material spheres with a constancy of action that makes all the actions comparable, and therefore measurable by one another. To a mind infinite in capacity all this is unquestionably practicable; but in order that our finite capacities may conceive materiality and the physical forces of matter, the human mind needs to be associated with an organism made up of matter and ruled by its forces. The material body is thus acted upon by external matter; and the associated mind comprehends the action by virtue of that mysterious union with its companion, of which the reasoning faculty is conscious. Instead, then, of there being in this process an arrogating to human nature of the attributes of Divinity, as Mr. Warington has believed, there is a simple recognition of the very distinction taught by religion, natural and revealed.

No opposition is made by any of my commentators to the doctrine of the immediate action of God's moral will in the physical direction of His material universe, which supersedes the prevailing idea of automatic powers created for the purpose in some manner impossible to be conceived. Mr. Warington seems to object only to the change of moral into physical force in the case of creature mind, where of course the change can only be regarded as enacted by God on our vice-regency and entire responsibility, extending to intention as well as to action, the latter being restricted within limits God has seen fit to impose. I think Mr. Warington's opinion will alter if he takes into consideration that were such a limitation not admissible on my theory, the circumstance might be urged as a great drawback to its probability.

I will only further add a few words relating to the reputed "conservation of force," to which my theory allows no quarter. The moral omnipotence of God is physical when it has made itself measurable by its action on matter, no action being the same under varying positions of matter with relation to one another. This is said to be the law of physical force denoting its power; to me it simply denotes the quantity of physical force established under given circumstances by moral volition. The physical force possible in the universe is unlimited, because it is the moral power of God acting in a measurable form to an extent varying from time to time with variable requirements of physical nature. Subject to measure in a physical form, according to the magnitude required under any particular condition of the universe, each force will have at that particular moment a definite total to which its amount of action or effect will be the reciprocal. The total attraction of gravity, taken as an example, is never the same under varying distances; and as much may be said of the electrical and calorific attractions. As in all the cases distances are subject to variation, so it must follow that the general total of force in the universe cannot be conserved—not even if the individual

forces be as causes indiscriminately satisfied with each other's effects, and, in addition, always vary inversely. That either gravity, electrical attraction, or calorific action should increase as another of them diminishes is taught by no *à priori* reasoning, and, as a fact, is unequivocally denied by every experiment so soon as it can be divested of mystery. Mr. Warington will be satisfied with fact in illustration. He remarks that the advocates of "conservation" teach that when two effects result from the same cause "the two effects are only equal to the original cause when taken together." Now, when we send two electrical currents from two equal voltaic batteries, instead of one, through a given conductor in a given time, we shall have of course a double current of electricity; but instead of merely that double effect of a doubled cause, we have, as admitted by Dr. Joule, a quadrupled calorific effect, the "conservation of force" seeming in that case to make two equivalents into six; as with gravity, the equivalents are increased from one to four by halving the distance. It may be instructive in more respects than one to explain that the voltaic experiment, in common with all others supposed to illustrate "conservation," resolves itself into a case of the equality of action and reaction: a double quantity of electricity, representing a quadrupled electrical force (as I have shown), acts on a given wire with a quadrupled electrical effect, producing a first physical equation; and the quadrupled electrical effect, as a heating cause, produces four equivalents of calorific effect, which is simply a second physical equation in the consecutive order of events.

The Chairman has remarked of the present view of the origin of nature that it presents a subject difficult to treat; and I have no doubt the difficulty of considering it has been in some degree increased by the insufficient manner of my dealing with it; but at the same time I venture to express my conviction that the doctrines I have endeavoured to make intelligible need only to be philosophically extended in all their bearings to justify generally the same amount of confidence I myself have in their truthfulness; and I am thankful to the Victoria Institute for allowing the discussion of a theory so entirely new.

[NOTE.—Mr. Laming's Reply, as well as his original paper, has been carefully read with his MS., and the proof-sheets of both were also revised by himself. I state this because of the difficulties I have felt with regard to the precise meaning of some of his sentences, and also with reference to some of his statements not specially questioned in the discussion: as, for instance, the remark he makes above, that "with gravity, the equivalents are increased from one to four by halving the distance," and (in a puzzling sentence, on p. 204) that Faraday wished "to get rid of conservation."—J. R., Ed.]