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ORDINARY MEETING, April 1, 1872.

THE REV. C. A. ROW, M.A., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed, and the following Elections announced :—

ASSOCIATES :—Rev. John George Francis Henry Knapp, A.C.K., Vicar of St. John's, Portsea ; William John Sheppard, Esq., 7, Addison Gardens, South Kensington, W. ; Mrs. Thomas Geldart, Bowdon, near Manchester.

Also, the presentation of the following works to the Library :—

"Proceedings of the Royal Society." Part 132. *From the Society.*

Baird's "Cyclopædia of the Natural Sciences."

From E. Haughton, Esq., M.D.

The following paper was then read by the Author :—

FORCE AND ITS MANIFESTATIONS. By the Rev. J. M'CANN, D.D., F.R.S.L., F.G.S., *Mem. Vict. Inst., &c.*

THE subject of the following paper may be thought, at first sight, not to harmonize with the objects for which this Institute has been established. It may be asked,—"What bearing has Force and its manifestations on the great truths revealed in Holy Scripture?" "How can a subject so exclusively physical be made to contribute its quota towards the defence of Christianity?" It might be replied that all truths are so connected together, that it is impossible to distort any one, without, in some measure, distorting the remainder. There are no parallel lines in the world of thought, all intersect somewhere; and, although the point of intersection may not immediately be discoverable, that it exists we may be well assured. Our Society has, therefore, wisely made it one object "to promote the real advancement of true science" by getting rid of "contradictions and conflicting hypotheses." One aim of the present paper is to assist in this work by exposing the unscientific assumptions, the contradictory language, the illogical reasoning

and conflicting hypotheses, that some scientific men have been guilty of, in reference to Force, Energy, and Motion. This alone, if satisfactorily accomplished, were worth an effort; still that consideration only would not have induced me to enter the lists against such men as Tyndall, Thompson, Tait, &c., while other, and more apparently practical matters were demanding my immediate attention. The hypotheses of "the Conservation of Energy," and "the Perpetuity of Motion," are, however, not mere abstract reasonings, devoid of interest to the moralist or the theologian; but reasonings, if such they may be called, that would land him where he by no means wishes to go. In Biology they lead to Evolution, in Theology to Pantheism, in Philosophy to Materialism, and in Morals to Necessitarianism. A very few quotations will at once make it evident that these are the views and purposes of those also who teach these hypotheses, that they are not blind to the ultimate issue of their own teachings, but rather, perhaps, this foreseen issue may be one cause of their earnestness. Be this as it may, we must not blame them if we remain blind to the character of the abyss in which they would plunge us, for their statements are distinct enough. Mr. Herbert Spencer writes,—"If it can be shown that the persistence of Force is not a datum of consciousness; or if it can be shown that the several laws of Force above specified are not corollaries from it; then, indeed, it will be shown that the theory of Evolution has not the certainty here claimed for it. But nothing short of this can invalidate the general conclusions arrived at."* Again, on page 246 he writes,—"The continuity of Motion, like the indestructibility of Matter, is clearly an axiom underlying the very possibility of a rational theory of Evolution. That kind of change in the arrangement of parts, which we have found to constitute Evolution, could not be deductively explained were it possible for motion either to appear or disappear." He elsewhere carries out the hypothesis to its legitimate issue, and maintains that thought is nothing more than converted heat, or chemical affinity; a mere mode of motion. On page 280 of the "Principles" we read, "Various classes of facts thus unite to prove that the law of metamorphosis, which holds among the physical forces, holds equally between them and the mental forces. Those modes of the Unknowable which we call motion, heat, light, chemical affinity, &c., are alike transformable into each other, and into those modes of the Unknowable which we distinguish as sensation, emotion, thought: these, in their turns, being directly or indirectly re-

* "First Principles," p. 488.

transformable into the original shapes." In complete harmony with the foregoing, we find Mr. C. Bray stating that "the airs that man has given himself, and his assumption of superiority over all his brethren of the sentient creation, are a little ridiculous, viewed in this light of the persistence of force."* If the following be not Pantheism, we are at a loss to know what Pantheism can mean :—"We find, then, but one thing in the world—Force; and what is that? Force and Power are the same, and Power we cannot separate from that source of all Power,—from God,—Power is God. We say 'the Power of God,' as if it could be separated from Him, or delegated; but this is entirely inconceivable. The only one thing we find anywhere is God." The following can scarcely be classed under any of the heterodox isms with which we are familiar,—it sounds startling in the extreme; still, if energy persists, and motion never begins nor ends, it is a logical consequence, and fair statement of a universal fact. "Heat and electricity are constantly passing off from the body; *so is mind.* We influence every one and every *thing* about us, and are influenced by them. *We photograph our mental states on all the rooms we inhabit.*" If this be true, the walls of some rooms must have strange pictures latent on their surfaces,—the photographs on our own, for example, must be of a very conflicting character, seeing how diverse are the mental states occasionally found here. It is not, however, our purpose here to expose what we think are fallacies in the above specimens of that which we cannot believe to be sound philosophy, but only to justify the introduction of this subject to the Society, and to show how it is that we can quote the words of Dr. Bence Jones as expressing our own sentiments when he says, "I hold that the clearness and breadth or dimness and narrowness of our ideas regarding matter and force must constitute a good or a bad foundation of all the knowledge we possess, not only in medicine, but in every other science."

2. Physical science is at present in so chaotic a state in reference to the nature of Force and its manifestations, and the utterances of physicists are so contradictory and confused, that it is difficult, if not impossible, to arrive at any well-defined statement of the general hypotheses they desire to enforce. The only possible course, therefore, is to examine their separate utterances regarding Force, Energy, and Motion; expose their errors as we proceed; contrast these with our own belief; and finally criticise the assumptions in which they mostly agree. This course may

* "On Force and its Mental Correlates," p. 38.

entail a certain amount of repetition, but the complexity of the subject seems to render it almost inevitable.*

3. The vagueness in the use of the term "force" is acknowledged by Dr. Tyndall in these words:—"But ambiguity in the use of the term 'force' has been for some time more and more creeping upon us. We called the attraction of gravity a force without any reference to motion. We applied the term 'force' also to that molecular attraction which we called 'chemical affinity.' When, however, we spoke of the conservation of force in the case of elastic collision, we meant neither a pull nor a push, which, as just indicated, might be exerted upon inert matter, but we meant the *moving force*, if I may use the term, of the colliding masses." Force is here, consequently, applied in two wholly different senses, so that the reasoning applicable to it in the former sense would not be applicable to it in the latter. His general usage of the word, however, indicates that he considers it as energy, or working power; he is at liberty to use it as equivalent to energy, if he wishes; but not at the same time to use it without any reference to motion whatever.

4. Mr. Justice Grove is more satisfactory when he states that "the term Force, although used in very different senses by different authors, in its limited sense may be defined as that which produces or resists Motion." Again he says, "I therefore use the term Force, as meaning that active principle inseparable from matter which is supposed to induce its various changes." He here distinctly allows that matter invariably possesses a power of producing or resisting motion, which power he names Force. If this power be "inseparable" from matter, it cannot be transferred from one atom of matter to another; motion may be transferred, but not the power to produce the motion; that must remain invariably an attribute of all matter, according to his own acknowledgment. Yet we find him writing in a previous paragraph that it is an "irresistible inference from observed phenomena that a force cannot originate otherwise than by devolution from some pre-existing force or forces." If he mean by this that material powers are not self-originated, but are the result of volitional power or powers, he is consistent with himself, and states what we believe to be a fact; but if he mean that material powers in exercise are, necessarily in all cases, the devolution of pre-existing material powers, he is contradictory, because if matter can devolve this power to other matter, it is

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* This subject has been treated in the London *Quarterly Review* for July, 1871, by the Rev. J. Moore, with his usual well-known ability, in an article on "The Heresies of Science," which ought to be earnestly studied by all who value Logic more than "Imagination" in Science.

separable from it, which he denies. True, he does not here use the word "power," in speaking of Force, but says "that which produces:" still he must mean power, because he does not believe matter or mind to be Force; but these are they that produce motion, and as they are not force, he can only mean that they possess the power to produce motion, which power is named Force. This is confirmed by another sentence, in which he says, "the term has a *potential* meaning, to depart from which would be to render language unintelligible."

5. Nevertheless, after having asserted that Force is a power, that it produces motion, is inseparable from matter, is an active principle, &c., he actually says that it is only an "abstract or generalized expression." These are wholly incompatible; a generalization cannot produce motion, and is not only separable from matter, but has no relation to it, being the product of mind alone. To call force a mere useful generalization, is to deprive it of all *potential* meaning, "and therefore to render his own language unintelligible;" he must consequently be understood as indicating by it "an active principle inseparable from matter."

6. Many writers agree with Mr. Grove in his statement that force is a generalized expression; that antecedence and consequence are all that can be predicated of phenomena, we adding nothing to our knowledge by the affirmation of power, or by saying that these phenomena are produced by something. Not to dwell on the fact that all their reasonings about the persistence of force, &c., are wholly inconsistent with this hypothesis, we feel at once its discordance with the utterances of consciousness. We are conscious of power in ourselves, the power to originate our own volitions. We cause, we produce, we call into existence that which but for our agency would not have existed. We are conscious that our volitions are not uncaused successive happenings in our mental history, but the immediate results of our own mental power. Power, therefore, is predicated of a conscious personal agent only. Hence it is that our first judgments of causation relate to ourselves originating our volitions. We are causes, our volitions are effects. All other effects produced by us are produced not immediately, as are our volitions, but mediately or instrumentally. Hence it is that our first judgment of secondary causation must refer to the relation between volition and some of its constituted sequents. Having gained the notion of power, in the consciousness of our self-personality, we then, in perfect accordance with a well-known law of thought, transfer this notion, first to our volitions, and ultimately to material realities. For example, before us is lying a quantity of gunpowder. Is not the con-

viction forced upon our minds that this substance possesses, by virtue of its constitution, power to produce certain effects?

7. But when power is predicated of anything but a person, we must never think that the power originates the effect or change, in the sense in which an intelligent agent originates his volition. We are, however, compelled to think that the volitions of agents supply the necessary *conditions* of the action of all secondary powers; and consequently all material changes, or exercises of power, must be referred back to the volition of an intelligent agent. We therefore define Force to be the power of originating or causing motion. Faraday seems to be, at first sight, in harmony with this when he says: "What I mean by the word 'force' is the source or sources of all possible actions of the particles or materials of the universe; being often called the powers of nature, when spoken of in respect of the different manners in which these effects are shown." This is capable of a great variety of meaning, accordingly as we understand the word "source." If by sources we mean volitions, in the sense just explained, he is correct; but if he mean, as we believe he does, pre-existing action only, he is not in accord with consciousness; for he would himself acknowledge that the will of God is the primary source of all possible actions; and, in accordance with that will, our volitions are sources also. He however says, "Force cannot act, then cease to act, then act, then cease to act, without being otherwise disposed of." Now, it is evident that force, according to his own definition, may act and then cease to act; for we can think the source of action either as producing action or as quiescent. We can think power either as exerted or as unexerted. We are therefore justified in affirming that motion may at any time be produced by matter, the necessary conditions being supplied; that the power to do this, called Force, has a real existence, and is not a fancy of the imagination, as Professor Tyndall would tell us, when he says that without imagination the "soul of force would be dislodged from our universe." If force be the soul of the material universe, it was not our imagination that placed it there, nor would it die though our imagination ceased to exist. Imagination may combine old experiences into new groupings; may from the quarry of memory draw the materials for a new building, but has no power to create both stone and structure. "The scientific use of the imagination" seems, however, to lead to very contradictory results, enough to sadly puzzle any student of physics, till he discover that they are only imaginary —the products of an imagination unscientifically misused. Dr. Tyndall, for example, teaches, as we have seen, that force is only an ideal thing—the product of a scientific use of the

imagination alone; while Faraday and others teach that the only actual existence is Force; matter, substance, and all the rest being the ideals. Professor Huxley crowns the whole, in the highest imaginative flight, by fancying that matter is not matter, and force is not force, but only "names for certain forms of consciousness"!

8. Some naturalists are never weary of sneering at philosophers and theologians, about the haziness of their theories, and the unscientific character of their teachings, and pointing to their own labours as the acme of perfection; but what have we here to induce us to forsake the old paths, and follow their guidance? One set asking us to believe that there is only matter, another that there is only force, and a third that there is neither matter nor force, but only consciousness. We beg to decline all their separate invitations for the reasons now to be assigned. After what has been said about Dr. Tyndall's hypothesis, we may pass on to the next, that Force is the only Existence. On this subject Faraday writes, "We know nothing about matter but its forces—nothing in the creation but the effect of these forces; further our sensations and perceptions are not fitted to carry us; all the rest, which we may conceive we know, is only imagination." He taught, also, that the ultimate atoms are only centres of force; or, in other words, that matter and force are one and the same. We must, however, be pardoned for saying that he seems exceedingly confused about the whole subject, because elsewhere he speaks of the "actions of particles." Now, it is an utter confusion of all language to speak of particles as immaterial: if we believe in particles we must believe in matter, for particles are particles of something; but to say that the something is force, would be a contradiction of terms. But even the very passage I have quoted overturns his own hypothesis; for if we grant, which we do not, that we know nothing of matter but its forces, still this allows that we do know the forces *of matter*, and so know matter by its forces. But we know matter by its qualities, as well as by its powers, especially by that of extension, which cannot be called a power. As Dr. Mayo wrote to Faraday, "The objection that silver must vanish if its forces are abstracted, may prove the necessity of forces to our conception of silver, but does not disprove the necessity of silver to our conception of its forces." To this we may add, that after the distinctive forces were abstracted, it might cease to exist as *silver*, but it would still exist as *matter*, possessing the quality of extension. Mr. Wallace takes up the strain, and strikes a higher note, affirming that "matter is essentially force, and nothing but force; is, in fact, philosophically inconceivable; and that force is will, and

nothing but will, and that the will of perhaps one Supreme Intelligence." He says, "It does not seem an improbable conclusion that all force may be will-force; and thus that the whole universe is not merely dependent on, but actually *is*, the will of higher intelligences, or of one Supreme Intelligence." We at once grant that the universe is the manifestation of the will of God, but is not that will itself, else it were God. He acknowledges that when we touch matter, we experience sensations of resistance, implying repulsive force; but what resists and what repels? According to him it is the will of God only: there is neither matter to resist, nor force to repel; there is nothing to touch, for God cannot be touched, and consequently there can be neither touch, repulsion, nor resistance; for God is a spirit, and these cannot be predicated of spirit. All material and all mental substances, in all their modes, are, according to Mr. Wallace, states of the Divine consciousness or will. Therefore no action can be wrong, for Divinity must be always right; no theory can be false, for Divinity must be always true. It matters not whether we believe in matter only, or in force only, or in will only; whether we be atheistic or theistic; whether we be followers of Moses or of Darwin, of Huxley or of his vehement partisans: we are all believing that which is absolutely true, for we are all the will of God; we are all one of God's states of existence. If this be not a fair inference, or rather unavoidable deduction, from Mr. Wallace's words, we will gladly retract when shown to be in error.

9. Very much in accordance with this is the teaching of Mr. C. Bray, who in his work on "Force and its Mental Correlates," says (p. 47), "Our faculties make us acquainted with qualities or attributes without ourselves, and we assume that these must be the qualities or attributes of *something*, and we have called it Matter; we have feelings and ideas, and we equally assume that they also must belong to something, and we call it Mind; but there is in reality nothing to which these mental and physical attributes belong,—they exist *per se* as force and its correlates. *There is nothing underlying phenomena—phenomena are correlates of force, and force is all.* When we speak of qualities, we indicate only how we are affected by force external." It does seem a very natural assumption that a quality is the quality of something. Mr. Bray acknowledges that we know qualities and attributes, but denies that they belong to anything; or, in other words, denies that they are qualities or attributes,—asserts, in fact, that we are acquainted with the non-existent. For to say that there is a quality, but nothing to possess a quality, is to deny the existence of the quality, as such. Again, he says, "We have feelings;" but there is no one to whom

the feelings belong. Who, then, are *we?* How can we "have," if we do not exist?—and Mr. Bray says we do not, for force is all. Had he said we *are* feelings, and feelings are force, and force is all, he would have been consistent; but, as it is, his language is meaningless. "Force is all;" that is the assumption; consequently, we are not we, for force is not personal—feelings are not feelings, for force is not conscious—ideas are not ideas, for force is not reflective—mental attributes are not mental attributes, for force has no mind; and so on with almost any quality or attribute that could be named. And this is the vaunted science of the nineteenth century, before which Moses must hide his diminished head!

10. Again he writes,—"We find, then, but one thing in the world—Force; and what is that? Force and Power are the same, and Power we cannot separate from that source of all power—from God; Power is God. We say 'the power of God,' as if it could be separated from him, or delegated; but this is clearly inconceivable. The one only thing we find anywhere is God." It does not in the least follow that because we speak of the power of God, power can therefore be separated from God; we mean that it is an attribute of God, but is not itself God. When we speak of the thought of a man, we do not thereby imply that the thought may be separated from the man, even while he communicates it to others; and still less do we mean that the thought is the man.

11. According, however, to Mr. Bray, "Force is all," and God is all. Consequently, Force and God are convertible terms. Force might be substituted for God in all worship, and all religions. His language, however, is so confused and contradictory, that it would be impossible to construct any consistent system from it, or rather it might be quoted in support of any conceivable system. In one place, he says that force is all; and then on the next page he speaks of "every atom pulling at every other atom." In one place he says there is nothing underlying phenomena, and yet again speaks of an intelligent substance, which substance is atomic, which atoms are force. Such writing, while it does not need refutation, does need exposure.

12. The utterances of Professor Huxley on this point are not much more satisfactory, although they do cut away all the ground from Materialism, properly so called. In his lecture on Descartes, he says,—"When the Materialists stray beyond the borders of their path, and begin to talk about there being nothing else in the universe but matter and force, and necessary laws, and all the rest of their 'grenadiers,' I decline to follow them. I remind you that we have already seen clearly and distinctly,

and in a manner which admits of no doubt, that all our knowledge is a knowledge of our states of consciousness. 'Matter' and 'Force' are, so far as we can know, mere names for certain forms of consciousness. . . . . Thus it is an indisputable truth that what we call the material world is only known to us under the forms of the ideal world; and, as Descartes tells us, our knowledge of the soul is more intimate and certain than our knowledge of the body. If I say that impenetrability is a property of matter, all that I can really mean is that the consciousness I call extension, and the consciousness I call resistance, constantly accompany one another. Why and how they are thus related is a mystery. And if I say that thought is a property of matter, all that I can mean is that, actually or possibly, the consciousness of extension, and that of resistance accompany all other sorts of consciousness. But, as in the former case, why they are thus associated is an insoluble mystery."

13. The Professor, in the first place, here confuses knowledge and consciousness. As Mr. Moore expresses it,—"When the conscious certainty which accompanies a given thought is determined by the constituted laws of intelligence, that thought is a knowledge." We know matter, force, extension, and resistance as externals to self, but we are not conscious of them. We are conscious only of thoughts, feelings, and volitions. It does not follow that our knowledge of soul is more intimate than our knowledge of body, because we are conscious of self, but not of matter; or because the material world is only known to us under the forms of the ideal world. Our knowledge of matter, with its powers and qualities, is as certain as our consciousness of self, because both are equally determined by the constituted laws of intelligence. I have as much right to deny the existence of self possessing the power of willing, as I have to deny the substantial existence of matter possessing the power called Force; that is, I have no logical right to deny either.

14. Professor Huxley's reasoning would land us in the purest idealism, absorbing matter, force, and even God himself; but a true philosophy of consciousness will save us from this most unscientific and undesirable result.

15. There may be some excuse for all this haziness of thought if Mr. Spencer's supposition be true,—that force, as the "ultimate of ultimates," is especially inscrutable. No doubt, force in its ultimate nature is inscrutable, but not more so than any other power in existence. The only explanation we can give is, that they are all the result of the will of an Almighty Creator. But Mr. Spencer, like Professor Huxley, seems to confuse the facts of consciousness with the affirmations of our neces-

sary judgment, when he says,—"All other modes of consciousness are derivable from experiences of force; but experiences of force are not derivable from anything else." So far from this being the fact, experiences of force are not modes of consciousness at all: consciousness of power is one of its modes; but this precedes judgments in reference to "space, time, matter, and motion," and is not derived from them. He is nearer the mark when he says that "Force, as we know it, can be regarded only as a certain conditioned effect of the unconditioned cause." As a power of matter it is conditioned by the laws of matter; that is, by the rule of action of a voluntarily conditioned, but absolutely unconditioned lawgiver, or first cause. When these conditions are supplied, the power is exerted; when they are withheld, the power remains unexerted.

16. The next fallacy we meet with in this investigation is that force and motion are the same,—that the terms may be used indiscriminately. Light, heat, electricity, &c., are called physical forces; but they are also called modes of motion. This is too evidently the general teaching of the present day to need either proof or illustration. But it is fallacious; because, although force is a condition of motion, it cannot be resolved into motion. Force and motion are equally conditional. The original condition of force is volition; the condition of motion is force; but the conditions of a phenomenon must not be confounded with the phenomenon itself. This, however, is one of the commonest errors of our present physicists. For example, Mr. Grove says that "Sound is motion;" but, as Mr. Moore well points out, "Sound is not motion, but sound. A logical definition of sound is impossible. Mr. Grove forgets that each thing is itself, and not something else. We allow that the vibration of a sounding-board is a constituted condition of the existence of sound. We also admit that the undulations of the atmosphere, or of some other medium, are necessary to our perception of sound." But we are as fully justified in asserting that the form of the undulation is sound as that the motion is. Motion is motion, and not force, although it is the result of force.

17. Mr. Grove further observes that "we now so readily resolve sound into motion that to those who are familiar with acoustics the phenomena of sound immediately present to the mind the idea of motion,—*i. e.*, motion of ordinary matter." The latter portion of this is quite correct: knowing the conditions of sound, when we hear any, there arises to the mind, by the ordinary laws of association, the idea of motion; but that is not by any means resolving sound into motion. When I eat an

orange, if not wholly absorbed by the delicacy of its fragrance, I may think of a ship; because in an island where they do not grow, a ship is a necessary condition to the presence of an orange; but would any one ever dream therefore of saying that an orange was a ship, or a ship was an orange? In both cases there is equally a confounding of things that differ.

18. He also says that motion is the most obvious of all the affections of matter; but force, as force, is not obvious at all. Again, he says, "Visible motion, or relative change of position in space, is a phenomenon so obvious to simple apprehension, that to attempt to define it would be to render it more obscure." Yet he does define it as "relative change of position;" but what is it that is changed in position? We cannot predicate change of position of force alone. If there be motion, it must be motion of something; but force is not a thing. If we say that motion visibly manifests the exercise of force, all is clear; but when we confound force with motion, we are lost in a chaos of words.

19. Mr. Spencer attempts to overturn our definition of Force by stating that motion, so far from being distinctly conceivable, as Mr. Grove says, is altogether incomprehensible, and adduces a very peculiar illustration to prove his point:—

20. "A body impelled by the hand is clearly perceived to move, and to move in a definite direction; there seems at first sight no possibility of doubting that its motion is real, or that it is towards a given point. Yet it is quite easy to show that we not only may be, but usually are, quite wrong in both these judgments. Here, for instance, is a ship which, for simplicity's sake, we will suppose to be anchored at the equator with her head to the west. When the captain walked from stem to stern, in what direction does he move? East is the obvious answer; an answer which for the moment may pass without criticism. But now the anchor is heaved, and the vessel sails to the west with a velocity equal to that at which the captain walks. In what direction does he now move when he goes from stem to stern? You cannot say east, for the vessel is carrying him as fast towards the west as he walks to the east; and you cannot say west for the converse reason. In respect to surrounding space he is stationary; though to all on board the ship he seems to be moving. But, now, are we quite sure of this conclusion? Is he really stationary? When we take into account the earth's motion round its axis, we find that instead of being stationary he is travelling at the rate of 1,000 miles per hour to the east; so that neither the perception of one who looks at him, nor the inference of one who allows for the ship's motion, is anything like the truth. Nor, indeed, on further consideration shall we find this revised conclusion to be

much better. For we have forgotten to allow for the earth's motion in its orbit. This being some 68,000 miles per hour, it follows that, assuming that time to be midday, he is moving, not at the rate of 1,000 miles per hour to the east, but at the rate of 67,000 miles per hour to the west. Nay, not even now have we discovered the true rate and the true direction of his movement. With the earth's progress in its orbit, we have to join that of the whole solar system towards the constellation Hercules; and when we do this, we perceive that he is moving neither east nor west, but in a line inclined to the plane of the ecliptic, and at a velocity greater or less (according to the time of the year) than that above named. To which let us add, that were the dynamic arrangements of our sidereal system fully known to us, we should probably discover the direction and rate of his actual movement to differ considerably even from these. How illusive are our ideas of motion, is thus made sufficiently manifest. That which seems moving proves to be stationary; that which seems stationary proves to be moving; while that which we conclude to be going rapidly in one direction, turns out to be going much more rapidly in the opposite direction. And so we are taught that what we are conscious of is not the real motion of any object, either in its rate or direction; but merely its motion as measured from an assigned position,—either the position we ourselves occupy or some other. Yet in this very process of concluding that the motions we perceive are not the real motions, we tacitly assume that there are real motions."*

21. I affirm that all the motions mentioned here are real motions, and not mere illusions, or apparent motions. They are, doubtless, motions in different directions, but not the less real on that account. It might be difficult to determine at any given moment the absolute positions of the ship, captain, and earth, in reference to some particular far-off world; but that difficulty is the result of their each moving at the same time. The captain, while walking the deck, may keep the same position relatively to an object on shore; but had he not been moving on the ship at the same time the ship was moving, on a moving earth, that relative position would have been at once altered. Mr. Spencer in his illustration makes very clear how difficult it would be to ascertain the rate at which any one of the objects moved, or the actual direction; but the fact of a real motion in some direction and at some rate is beyond all controversy. It is, no doubt, impossible to understand why a

* "First Principles," p. 54.

body moves, if we ignore the will of God in the matter; but it is equally impossible, for me, at least, to understand, how any one can deny the fact.

22. Another term which may be briefly noticed before passing on is "Energy." This is sometimes spoken of as Force, at others as Motion, and again as Working Power. It is made to mean any or all of these; but usually it implies motion or working power; and in this sense we shall always refer to it. Whatever may be the views of most of our modern physicists on these minor points, they are generally united in upholding the great doctrine of the Conservation of Energy,—a doctrine which has been called one of the greatest discoveries of the nineteenth century,—a doctrine which has a very pretentious appearance at first sight, but which, when touched by the spear of sound logic and careful science, dwindles into a bundle of vague and unwarranted assumptions. The doctrine stated in its simplest form is, "that the sum of actual and potential energy in the world is constant."

23. The first assumption is that, motion, or energy, never begins. Thus Mr. Grove writes (p. 26), "With the perceptible phenomena of motion the mental conception has been invariably associated, to which I have before alluded, and to which the term force is given, the which conception, when we analyze it, refers us to some antecedent motion." Now, the mental conception of force does not refer to any antecedent motion, but to the power of originating motion. The statement here, however, is,—no motion without previous motion. Tyndall teaches the same, regarding it as a self-evident truth that "the cause of motion must itself be motion." He also asserts that "we can make no movement which is not accounted for by the contemporaneous extinction of some other movement." Yet, in opposition to this, he speaks of necessary as distinct from spontaneous action; the transformation as distinct from the creation of force. Dr. Bence Jones writes ("Croonian Lectures," p. 37), "According to modern ideas, the different forms (of energy) are so related to one another that none can be lost, and none can be produced except by passing into or out of some other form of energy." And Mr. Spencer, in still stronger terms, writes, "To think of motion as either being created or annihilated,—to think of nothing becoming something, or something becoming nothing,—is to establish in consciousness a relation between two terms, of which one is absent from consciousness, which is impossible. The very nature of intelligence negatives the supposition that motion can be conceived (much less known) to either commence or cease."

24. In reply to all this, we would ask why motion must be the

only cause of motion? I cannot imagine a reply; it seems a mere assumption, being unsupported by observation, as we shall see. What is the previous action in a case of "spontaneous action," or what the pre-existent force in a case of the "creation of force"? If Professor Tyndall confine his statement to necessary motion, we agree with him that we must seek for *some* cause antecedent to the motion, but not that the cause must be itself motion. We must, in a word, seek for an ultimate cause that is not motion,—for a power that can spontaneously move the not-self, itself remaining at rest; that is, we only explain motion when we refer it back to the will of God, or a sentient creature, who originated it. Mr. Spencer might also write as he does if motion were a substantial existence. He then, indeed, could say that to think of motion beginning would be to think of nothing becoming something; but when motion is only change of place of substance, to speak in this way is to misuse language. It seems strange that a scientific man should do so, for any one may, with the greatest ease, conceive motion both as commencing and ceasing. But not only is it a conceivable thought, it is also an observed fact, that motion begins. There is, for example, lying before me a heavy book, nicely balanced on the edge of the table; the slightest touch of my finger causes it to fall to the ground; and, striking other things as it descends, they also all fall with it. Before I touched the book, it and all the others were at rest, so far as the surrounding objects were concerned. I, in causing the fall, did not expend any appreciable muscular power, for contact was almost sufficient, and yet in the fall what motions were manifested? Where were they before the ponderous literature came crashing to the ground? Or take the well-known illustration of the ignition of gunpowder. There is a mine ready for explosion; a train is lying beneath my hand; I lower my finger and thumb half an inch, bring a spark into contact with the train; presently a terrific upheaval, and a mountain rolls like water into the valley beneath. How little was the motion that caused all this—the lowering of a finger half an inch; how great the motion thus produced, and yet we are to be told that the commencement of motion is inconceivable and untrue.

25. "Ah, yes," say our friends, "that is true, but you are not taking into account the potential energy stored up in the gunpowder before the spark was applied, the potential energy was great in amount, the kinetic or actual energy but little, but after the explosion the kinetic increased in the same proportion as the potential, or latent, decreased." This sounds plausible while we use the mystic word energy, but as it is motion with

which we are at present concerned, we shall use that word instead. The explanation then is this, that the amount of latent and actual motion before the explosion, was exactly equal to the amount after. That if we express the amount of latent motion before, by 9, and the actual by 1, we must, after the change, express the latent by 1, and the actual by 9. The phrase "latent motion" may appear so strange as to cause it to be doubted whether we are at liberty to use it. We must remember, however, that motion, energy, and working power are understood as interchangeable terms by most of the writers of whom I am speaking. Professor Tyndall, while calling heat a mode of motion, speaks of latent heat, that is a latent mode of motion. Latent motion, therefore, is motion at rest, remaining motion still. The apprehension of this is somewhat difficult, if not impossible. Power in exercise and power latent are perfectly comprehensible, but motion that is motionless is quite a different conception, if it may indeed be called a conception. Mr. Grove, in controverting the hypothesis of latent matter, in the material theory of heat, rightly asks, "Is not 'invisible light' a contradiction in terms? Has not light ever been regarded as that agent which affects our visual organs? Invisible light, then, is darkness; and if it exist, then is darkness light." In like manner I ask, is not motionless motion a contradiction in terms? Is it not rest? And if it exist, then is rest, motion? If rest and motion be one and the same; if matter always possess latent motion, when it has not actual, then, indeed, the explanation is sound,—the origination of motion is an absurdity. But if latent motion be not motion, but rest, then the explanation is the absurdity, and motion has a commencement. The statement that "throughout the universe the sum of these two energies is constant," has been shown by Sir John Herschel to be a mere truism, "whether expressed in so many words, or by saying that the potential together with the actual energy of the system is invariable; or, again, in other words, that when certain changes have taken place in the relative situations of the parts of the system, what it has lost in actual it has gained in potential energy." This must be evident to all; for if we are at liberty to say that the energy which has disappeared as actual still exists as potential; and that which comes into manifestation as actual, previously existed as potential, it follows as a matter of course, that the sum of the two must be always the same.

26. Putting aside this fiction of the hypothetical measurement of the unknown by the elimination of the known, the conservation of energy, motion, working power, is at once seen to have no existence. As Sir John Herschel says,—"No such conservation in the sense of an identity of total amount of energy

at all times and in all circumstances, in fact, exists." Having once assumed that motion never commences, another assumption naturally follows, *i.e.*, that motion never ceases. It may be lost to perception or measurement, may wholly change its modes, pass away from the earth altogether, but through space it will act for ever. Mr. Grove, in reference to this subject says,—"The term 'perpetual motion,' which I have not unfrequently employed in these pages, is itself equivocal. If the doctrines here advanced be well-founded, all motion is, in one sense, perpetual. In masses whose motion is stopped by mutual concussion, heat or motion of the particles is generated; and thus the motion continues, so that if we could venture to extend such thoughts to the universe, we should assume the same amount of motion affecting the same amount of matter for ever." There is no evidence possible that will justify us in extending such thoughts to the universe, and the assumption might be at once discarded. Perpetual motion we believe to be as baseless in a cosmical, as it is in a mechanical sense. The reason, however, why it is so tenaciously maintained is clearly stated by Mr. Spencer, and is seen to be not for the sake of the hypothesis in itself, but because it helps to support the theory of evolution. His words are,—"The continuity of motion, like the indestructibility of matter, is clearly an axiom underlying the very possibility of a rational theory of evolution. That kind of change in the arrangement of parts, which we have found to constitute evolution, could not be deductively explained, were it possible for motion either to appear or to disappear." It has already been shown that it is possible for motion to appear; we have now also to show that it is possible for it to disappear. Allowing for the moment that it cannot disappear, or rather cannot cease to be, on earth, can it pass beyond earth's limits and exist in space? This is possible, if space be occupied by matter, but it is not possible if space be a void. It is not needful for our present purpose to enter into any metaphysical subtleties regarding the nature of space, but only to ascertain as far as possible whether it be filled with matter, in however attenuated a form, or not.

27. That it is so occupied is asserted in the plainest terms by Professor Tyndall, and the properties of the universal substance stated. Of it he says, with, apparently, every confidence that he is describing something having a real, and not merely an assumed existence, "The luminiferous ether fills stellar space; it makes the universe a whole, and renders the intercommunication of light and energy between star and star possible. But the subtle substance penetrates farther: it surrounds the very atoms of solid and liquid substances." All

bodies can receive, according to the Professor's notion, motion from this ether, and communicate motion to it. Ether, therefore, he affirms to be a material substance, less dense than that with which we are usually familiar, and capable of assuming the modes of motion called heat, light, electricity, and magnetism. All this sounds as dogmatic and assured as though it were a well-ascertained fact, instead of being an effort of the scientific imagination, to add a necessary supplement to a favourite theory.

28. We find Mr. Grove decidedly dissenting from it, because he believes it an inadequate explanation of the phenomena it was invented to explain. He thinks light, for instance, "results from a vibration or motion of the molecules of matter itself, rather than from a specific ether pervading it." And as regards heat, he says,—"That the phenomena presented by heat, viewed according to the dynamic theory, cannot be explained by the motion of an imponderable ether" (p. 167). Again, he writes (p. 168), "An objection that immediately occurs to the mind in reference to the ethereal hypothesis of light is, that the most porous bodies are opaque; cork, charcoal, pumice-stone, all very porous and very light, are all opaque." The natural objection to Mr. Grove's theory is, that if these forces be the result of molecular action, the space between the sun and earth must be a plenum, filled with matter. This he supposes it to be, the matter consisting of the atmospheres of the planets, very much attenuated, but sufficiently dense to transmit these molecular movements. But even this he acknowledges to be an assumption, in more modest and philosophic words than those used by Professor Tyndall. He says,—"At the utmost, our *assumption*, on the one hand, is, that wherever light, heat, &c., exist, ordinary matter exists, though it may be so attenuated that we cannot recognize it by the tests of other forces, such as gravitation; and that to expansibility of matter no limit can be assigned. On the other hand, a specific matter without weight must be assumed, *of the existence of which there is no evidence*, but in the phenomena, for the explanation of which its existence is supposed. To account for the phenomena, the ether is assumed; and, to prove the existence of the ether, the phenomena are cited. For these reasons, and others above given, I think that the assumption of the universality of ordinary matter is the least gratuitous." Each is, therefore, an assumption, and a gratuitous one, but that of the ether the most so; and on this most gratuitous assumption the notion of the continuity of motion and the persistence of energy is based.

29. But Mr. Grove is not by any means alone in his objec-

tions to these assumptions. Mr. Spencer argues very strongly against both, and arrives at the conclusion "that matter acts upon matter through absolutely vacant space" (p. 60). And in opposition to it, Dr. C. F. Winslow writes in stronger terms still. He says,—"There was probably never a grosser error introduced into physical science than the ethereal theory, and its influence in retarding solid progress . . . . has been greater than at first appears." "All opinions upon the conditions of infinite space are the merest hypotheses; and in the midst of conjectures, that would be the most probably correct which presumed space to be a perfect vacuum."*

30. The fact that a mna of Dr. Tyndall's very high character and culture can permit himself to affirm so positively what are merely shadowy conjectures, should teach all to weigh very accurately every scientific hypothesis, and would amply justify us in saying that we are not called upon to discuss the persistence of energy, while so important an element in the discussion is so confused and undecided. Prove a universal plenum, and even then the continuity of motion is only rendered possible; but till that is done, we are warranted in asserting its impossibility, and that this grand discovery of the nineteenth century is not a discovery at all, or even a fact.

31. It may be objected by some that the decrease in the periodic time of Encke's comet almost demonstrates the existence of such an ethereal medium. Undoubtedly the decrease of the time is a fact; but the explanation was only a suggestion by Encke, who was not aware of any other force that could act in the interplanetary spaces. M. Faye has, however, shown that this hypothesis is, if not wholly untenable, at least very improbable. He attributes the decrease to solar repulsion; and we think he proves his point very satisfactorily. It is not necessary to give here all the steps of his reasoning; it will suffice to state the general conclusions at which he arrives, showing, as they do, that even Encke's comet does not overturn our former objections to this medium. "This theory," he states, "puts in action only known forces: the attraction of the sun, — that which the comet exercises on its own particles, the heat of the sun, and the repulsion due to this heat." Again, "My last work had for its object to remove all doubts on this subject in showing that the resisting medium could not exist, but on condition of circulating round the sun according to the laws of Kepler . . . . and that its action was not constantly resistant, as M. Encke supposed." He also states most truly, "That it

* "Force and Nature," pp. 36, 37.

is right not to accept, in the system of the world, any but known forces, or forces susceptible of being verified experimentally when in the supposed mode of action."*

32. There is, however, no actual necessity for carrying our investigations to the extreme limit of the terrestrial atmosphere, for on the earth's surface motion ceases, if not wholly, at least partially, which is sufficient for our purpose. To show this I need only quote the authority of Sir John Herschel, who says, "In the collision of inelastic bodies, *vis viva* is necessarily and invariably destroyed. The destruction may be total, or may fall short of totality in any proportion, according to the directness of the impact and the proportion of the moving masses; but whenever contact occurs between such bodies, *vis viva* disappears, and, once lost, is gone for ever." † In the face of such statements and facts as the foregoing, to talk of the conservation or persistence of energy is a mere waste of words.

33. I must not, however, forget that Dr. Tyndall denies this position of Sir John, and says, "It was formerly universally supposed that by the collision of unelastic bodies force was destroyed. Men saw, for example, when two spheres of clay, or painter's putty, or lead, were urged together, that the motion possessed by the masses prior to impact was more or less annihilated. They believed in an absolute destruction of the force of impact. Until recent times, indeed, no difficulty was experienced in believing this, whereas at present the ideas of force and its destruction refuse to be united in ordinary philosophic minds." ‡ No new experiments, it will be observed, have been made to render the former belief untenable. All the known facts are as they were, but the exigencies of of a system require denial, and therefore the annihilation must be denied. No word has been uttered to shake Sir John's position, except to exclude his mind from association with those philosophic ones that think with Dr. Tyndall. But even at the risk of being classed amongst the readers to whom his "Fragments" have been given, *i.e.*, the "Unscientific People," we would remind

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* "Ainsi cette théorie ne met en action que des forces connues, l'attraction du soleil, celle que la comète exerce sur ses propres particules, la chaleur du soleil et la répulsion due à cette chaleur." (p. 353.)

"Mon dernier travail avait pour but de lever tous les doutes à ce sujet ne montrant que le milieu résistant ne pouvant exister qu'à la condition de circuler autour du soleil suivant les lois de Kepler, et que son action n'était pas constamment résistante, comme le supposait M. Encke." (p. 354.)

"5°. Il convient de n'accepter, dans le système du monde, que des forces connues, ou des forces susceptibles d'être vérifiées expérimentalement jusque dans le mode d'action supposé." (p. 704.)—"*Comptes Rendus*," 1860, vol. i.

† "Familiar Lectures," p. 465.

‡ "Fragments of Science," p. 12.

him that we do not wish to unite the ideas of force and its destruction, but of motion and its cessation, which, in our unphilosophic minds, are very closely united.*

34. We must do Mr. Spencer the justice of saying that he uses in one place the phrase "persistence of force" with a meaning differing widely from the continuity of motion or energy, but with a meaning shared, I will venture to say, by no other writer on the subject. "Thus by the persistence of force," he says, "we really mean the persistence of some power which transcends our knowledge and conception. The manifestations, as occurring either in ourselves or outside of us, do not persist; but that which persists is the unknown cause of these manifestations. In other words, asserting the persistence of force is but another mode of asserting an unconditioned reality, without beginning or end." As the only reality answering to this description is God, Mr. Spencer asserts, and in this we are at one, that amid all changes, all beginnings, and all endings, there is one great Reality, the same yesterday, to-day, and for ever, the "I AM." But to call God's unchanging existence the persistence of force is not the ordinary usage of language. It would be well, however, if all students of nature remembered the great fact, that the one force of the universe is the will of God, and that though heaven and earth may pass away, one jot or tittle of that will can never pass till all be fulfilled.

35. From what has been already advanced, it will be at once evident that the Conversion of Forces is an important element in the hypothesis we are combating. It is very clear that motion ceases to exist as light, heat, or sound; but, if it still exist as motion, it must be in some other mode. One mode called by one name,—as heat, for example,—becomes another mode, we are told, called by another name, such as light. We must understand clearly that it is conversion, and not condition, which is insisted on, at least by Dr. Tyndall and others. One force being the condition of the existence of another force, is a very different thing from one force becoming another force. The former we readily assent to; but about the latter we are in very considerable doubt. It may be true; but we think it still needs further proof. We are, however, in this safe position in

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* While we are compelled to differ from Dr. Tyndall on these theoretic points, we would express our unqualified admiration of his great abilities as an experimenter, and our sincere gratitude to him for making known the results of his investigations, in language so beautiful, clear, and precise as to captivate while he instructs; and win students to the study of nature, who, but for him, might have gone to the grave caring nothing for God, and less for His works.

regard to it, that, while the doctrine of the conservation of energy demands the doctrine of conversion, the doctrine of conversion does not necessarily entail that of conservation. The justly-celebrated experiments of Dr. Joule on the "Mechanical Equivalent of Heat" are usually quoted as demonstrating this conversion in the clearest manner. They are recorded in *Philosophical Transactions* for 1850. It is manifestly impossible for me to detail here the experiments there described; but he feels himself justified in stating the following conclusions:— "1st. That the quantity of heat produced by the friction of bodies, whether solid or liquid, is always proportional to the quantity of force expended; and 2nd. That the quantity of heat capable of increasing the temperature of a pound of water (weighed in vacuo and taken at between 55° and 60°) by 1° Fahr., requires for its evolution the expenditure of a mechanical force represented by the force of 772 lb., through the space of 1 foot." The experiments, from a scientific point of view, are very beautiful; but the inferences, from a philosophical point of view, are not so conclusive. I cannot, however, state my own conceptions better than Mr. Moore has done for me in his own words:—

36. "*The question how much mechanical work can be done by a given quantity of heat is far from settled.* Now, to the physicist the downward motion of the weight is so much 'mechanical energy,' the heat produced so much 'work done.' To the philosopher, on the other hand, the *motion* of the weight is not energy or force at all, but simply an *effect* determined by the earth's force of gravity, while the action of the heat is another effect. The whole series of effects, beginning with the descent of the weight, and terminating with the heat generated, the philosopher refers to a specific action of the force of gravity. This force he views as distributed, each effect expending a portion of the force. The physicist regards the heat produced as transformed mechanical energy or motion, while the philosopher sees in this not the conversion, but the correlation of two physical forces, the action of gravity supplying the condition of the action of the heat previously existent, though latent, in the water. To the physicist the descent of the weight viewed in relation to the heat is *a cause*. To the philosopher this motion, viewed in the same relation, is not a cause, but *a condition*."

37. Mr. Grove, in his well-known work on the "Correlation of Physical Forces," seems somewhat contradictory in his utterances, and appears to confuse correlation with conversion. His definition of correlation is sound; he says it is "a necessary mutual or reciprocal dependence of two ideas, inseparable even in mental conception; thus, the idea of height cannot exist

without involving the idea of its correlate, depth; the idea of parent cannot exist without involving the idea of offspring." But, notwithstanding this, he almost immediately after says it is "a necessary reciprocal production." It is manifest that the idea of parent cannot exist without the idea of child, and that consequently they are correlates; but it is equally manifest that they are not reciprocally productive, for while the parent produces the child, it would be difficult for the child "in its turn" to produce the parent: it may become a parent to another child, but it cannot produce the parent from whom itself has descended. According to Mr. Grove's own definition, the imponderables may be, in certain cases, the condition of each other's existence; but they may not become each other. He again confounds production and conversion when he says, speaking of heat, light, &c., "that either may produce, or be convertible into, any of the others." Production is not conversion; the parent produces the child, but surely he is not converted into the child. A seed of corn produces a full head of corn, but it is not converted into it. But his language on this point is so confused, he at one time making distinctions without differences, and at others confounding things that differ, that it is impossible to arrive at any distinct conception of the nature of his own belief. It seems, however, to partake more of the nature of conversion than of correlation; but in spite of that, we have sufficient grounds to justify the assertion that while the physical forces no doubt, in certain cases, condition the existence of each other, there is not sufficient evidence to enable us to say that they are convertible into each other.

38. The theory of the Dissipation of Energy is held by Mr. Moore to be inconsistent with that of its Conservation. But here I am reluctantly forced to differ from him. The theory is, that while one mode of motion produces certain other modes, such as electricity, electricity can reproduce motion, but not the exact amount of the original motion. Some has been rendered incapable of reconversion, because it has become heat, and been radiated by earth into space, and thus lost for all practical purposes, or, as it is called, dissipated. Still the theory of conservation is theoretically consistent, inasmuch as, although allowing the departure of the motion from the earth, it asserts its continuance in the ethereal medium filling space. While, however, allowing all this, we are hereby taught that "conservation of energy" in reference to the earth, really means nothing more than that energy is conserved, till it is finally lost; for Professors Tait and Thomson tell us that, in consequence of the energy of all the planets eventually losing its kinetic form, they must creep in age by age towards the sun to a fiery end. But

even the sun must grow feeble and old in time, spend all his kinetic energy, and die, as his planets have died before him. While differing completely from Sir William as to the mode in which the final renovation of all things is to be accomplished, we are rejoiced to find that in the belief as to the fact of "new heavens and a new earth," we are agreed. "Thus," he states, "we have the sober scientific certainty that heavens and earth shall 'wax old as doth a garment,' and that this slow progress must gradually, by natural agencies which we see going on under fixed laws, bring about circumstances in which 'the elements shall melt with fervent heat.' With such views forced upon us by the contemplation of dynamical energy and its laws of transformation of dead matter, dark indeed would be the prospects of the human race if unillumined by that light which reveals 'new heavens and a new earth.' "*

39. The next assumption, and the last to be noticed, is assuredly the most startling of all,—that physical force may be converted into, or may persist as, mental force; that motion may become thought or feeling. The other conversions may be understood, whether assented to or not, because there is some congruity between them: heat into light, electricity, or magnetism is plausible, even if not actual; but this other is a conversion, at which the veriest revivalist must stand aghast. That the thoughts of a Paul, Plato, or Newton should be, after all, only modes of motion; only the force that roasts a herring, doing a somewhat different work, is slightly humiliating. But this matters not: if it be true, we must gulp down, as best we can, our vanity, and swallow the unpalatable fact. But can a man be found who states it as a fact? Yes, the Rev. Baring-Gould, although, we believe, a somewhat high Churchman, says it is a fact in his able work on the "Origin and Development of *Religious Belief*." About the last book in the world where we would have anticipated such a doctrine. He defines force as "that which produces or resists motion;" but this definition he never adheres to,—evidently confounding force and motion, he blends Grove and Tyndall together so as to confuse both. He immediately adds, "In physics, light, colour, heat, &c., are modes of force;" but he clearly means modes of motion. This is confirmed by what follows, where motion only is referred to. "Light is," he says, "a modification of force. According to the theory now universally accepted, it consists of a vibratory motion of the particles of a luminous body propagated in waves which flow in at the pupil of the eye, and, breaking

* *Good Words*, 1862, p. 606.

upon the retina at the back, transmit their motion along the optic nerve to the brain, when they announce themselves as consciousness of light by resolution into an idea" (p. 21). It seems somewhat difficult to resolve this into an idea. Waves of light announce themselves as consciousness of light: that is, the waves are conscious of themselves, and announce themselves,—as what? Not as conscious waves, but as consciousness, or not as waves at all; in other words, they do not speak the truth. This savours more of darkness than of light, but let that pass. The next question is, to whom do they announce themselves? As we are not told, we may presume it is to the other arrivals from the sun or stars, or perchance even to the conscious moonshine that may have accompanied them. The mode of the announcement is by resolving themselves into an idea! How this will achieve their object we are dull enough not to see: if there is to be an idea, it must be a noisy one, that all may be made aware of the new arrival. And so, what was a wave before it entered the brain, becomes, the moment it enters that wizard's home, at once consciousness and an idea!

40. What juvenile has not longed for the time of pantomimes, that he may revel in all the glories of the transformation scene; but these are nothing compared with the transformations of perpetual occurrence in the theatre of the brain. Hear Mr. Baring-Gould once more:—"Sound is the undulation of the air (?). The force applied by the finger to a harp-string flings the air into agitation, and the ripples sweep in at the ear, vibrate on the tympanum, and are thrilled to the auditory ganglion, *where they transform themselves into a musical idea*" (p. 22). As sound leaves the harp-string it is only an aërial ripple, but within the brain it, the ripple, is transformed into a musical idea. No, I beg its pardon, it is not transformed; the act is a voluntary one, it transforms itself. I most sincerely wish these ripples could be reasoned with, that I might persuade them to transform themselves into some other ideas, for at the present moment the musical ones are excessively irritative, coming as they do from a German band, and not one of the ripples seems certain in what musical idea it ought to rest. Professor Stokes, of Cambridge, recently spoke of scientific conjecture as being very different from true science, and if Mr. Baring-Gould has not supplied us with the former, we must despair of finding it. It is, however, we are glad to say, counteracted by much genuine and true philosophy, found in other portions of his scholarly volumes.

41. Mr. Spencer, as we have seen already (§ 1), holds not only that motion, &c., is convertible into thought, but that thought may be reconverted into motion. A certain motion is,

for example, transformed into sound by the firing of a gun, it enters my brain, performs a mathematical demonstration, passes on, and is next heard of as the striking of a lucifer-match! Yet notwithstanding these assumptions which directly negative personality, he argues strongly in favour of personality (p. 64) against the sceptic who denies it. But it seems impossible to hold at one and the same time this belief, and that of sensation, emotion, and thought being not the functions of a person, but mere transitory modes of motion.

42. But, if emotion be indeed a mode of motion, although the modes vary, the amount must be always the same, especially when the emotion can be re-transferred back into its original state. That such is a fact may be assumed, but can never be proved till some instrument be constructed capable of measuring the velocity of thought. It has been done by Joule, as we have seen, in reference to motion and heat; but who shall do it in reference to emotion and affection? Apart, however, from measurement, are we in the least justified in assuming that the amounts are equal, speaking from Mr. Spencer's point of view? He says, "No idea or feeling arises save as the result of some physical force expended in producing it." But take a case by which to test this. Let us suppose that of a widowed mother hearing of the death of her only son at sea. She looks at certain black strokes on paper: the only physical force expended is the slight wave motion that passes from the paper to her eye; but the mental emotion is something terrible—something that convulses the whole frame, and whose effects are felt for years afterwards. To speak of this great heart sorrow, that silvers the hair and bows the head, as the mere change of a mode of motion, is wholly futile. It, indeed, originates motion in the brain and whole system, but is not itself originated by motion. The same is seen still more clearly, if possible, as Dr. McCosh points out, where no physical force is expended at all, as when we begin to reflect on the actions of the past, and are, if they have been wrong, scourged by the agonies of remorse, till, as before, the whole frame quivers beneath the lash.

43. Professor Parker, of Yale College, tells us, as proof of the conversion of motion into mentation, that "experiments have shown that ideas which affect the emotions produce most heat in their reception;" "a few minutes' recitation to one's self of emotional poetry producing more effect than several hours of deep thought." But this does not prove his point: it only shows that we are more affected by emotional poetry than by reflective thought, and consequently the mind acts more energetically on the brain; but, as before, the heat follows the emotion, and does not precede it, as required by the theory. That there is

a very close connection between mind and brain all allow: a certain condition of one may be always accompanied by a certain condition of the other. Nay, more: a particular state of brain may condition a certain state of mind, or the reverse; but that is all we can acknowledge. How this conditioning is accomplished we know not, any more than we know how any one phenomenon conditions any other. All here is mystery, and can only be referred to the will of Him who said, "Let there be light; and there was light."

44. The theory would also give to matter a power denied both to man and God. Man, we are told, cannot guide the forces of nature; neither can God, and therefore prayer to Him is asserted to be a folly; but matter is perfectly competent for the task. We need not stay to show that this is an inference from the doctrine of which we have been speaking; it is directly asserted by Professor Huxley in his "Introduction to the Classification of Animals." "This particle of jelly," he says, "is capable of guiding physical forces," so as to give rise to the wondrous structures of the animal world. Jelly guides—oh, wondrous jelly!—that transcends the power of the highest intellect! We would, if we dared, ask him for an explanation; but as Dr. Beale well observes, "He speaks so authoritatively about *fact* and *law*, that one scarcely dares to venture to beg for an explanation of anything Mr. Huxley has affirmed." In reply to Professor Huxley's assertion, I cannot do better than again quote from the same well-known author, whose words on this subject must have far more weight than mine:—"1. Living matter is not jelly; 2. Neither jelly nor *matter* is capable of *guiding* or directing forces of any kind; 3. The capacity of jelly to guide forces, which Professor Huxley says is a *fact* of the profoundest significance to him, is not a *fact* at all, but merely an assertion."*

45. The strongest argument, however, against the theory is, that it is directly opposed to every utterance of consciousness. If consciousness assert one thing more definitely than another, it is the existence of self; it is that we are not modes of motion, or of any force whatever; that we are not feelings, sensations, thoughts, but persons who feel, and think, and will. This is felt by our opponents, and consequently Mr. Bray does his best to dethrone the veracity of consciousness from its regal position in the mind.† I need scarcely say he does not succeed, and the very necessity of attempting to do it renders his system "*ab initio* false, and unworthy of refutation."

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* "Protoplasm," by Lionel S. Beale, M.B., F.R.S., p. 72.

† "Force and its Correlates," p. 27.

46. Man, therefore, is not a mere automaton; the helpless plaything of every mode of motion with which he may be brought into contact; the transmitter of heat, electricity, and magnetism from matter, through himself, as thought, on to matter again, in its former modes; but he is an intelligent agent, conscious, and responsible, having the power to originate voluntarily his own volitions, which have no congruity whatever with the phenomena of matter, compelled by his very constitution to assert the existence of an extra-mental world, of which, however, he is not conscious, but of the existence of which he is as well assured as he is of his own existence; capable of originating motions in that material world which, after many a change perhaps in velocity or mode, ceases to be motion. This power of originating motion being called force—matter also having the power of producing motion, but not in the same sense as an agent does it—and whatever possesses this power is never without it, powers of matter and mind being as inseparable from them as are their qualities. In this sense I affirm the "Persistence of Force" as strongly as I deny the "Conservation of Energy."

The CHAIRMAN.—I am sure we shall all join in the vote of thanks to Dr. M'Cann for his able and interesting paper. I regret that, on account of the state of the weather, there are comparatively few present, for the question is one which involves some of the most important matters to which human thought can be directed. It embraces four distinct subjects, namely, Physical Science, Mental Science, Metaphysical Science, and important questions of Logic. It may be remembered that one of these subjects was treated of on one of the evenings when Mr. Bradlaugh was present. As the subject is of much importance, I hope that it will be well taken up this evening. Should any strangers be present, they are invited to join in the discussion.

Dr. E. HAUGHTON.—It would assist me a little if Dr. M'Cann will kindly explain the last sentence of his paper.

Dr. M'CANN.—The persistence of force means that the power to originate motion is always possessed; the motion itself always begins and ends.

Dr. HAUGHTON.—But the phrase, "conservation of energy" does not necessarily mean the conservation of motion.

Dr. M'CANN.—That is the point I wish to establish.

Dr. HAUGHTON.—It is held that energy may exist as potential energy, and not as actually moving anything.

Dr. M'CANN.—That is the very point I have referred to in the paper. I speak of potential energy.

Dr. HAUGHTON.—With respect to the last sentence of the paper, as to the conservation of energy, I confess that it is not, even now, quite clear to me. The doctrine, as put forth in the paper, differs from what is accepted ordinarily, and I think there does seem to be a want of fixity in the terms used,

and fixity of terms is a necessity when a new thought has to be adapted to an old language, and really this word "energy" is one that was only advanced, as it were, the other day. The word "force" is an old word, and one we are all accustomed to; but we have here the new word "energy," used in an entirely different sense from what used to be its meaning; and it seems to have been employed because some confusion was found to arise in the use of the old word "force." My own view of the subject is that force is an inherent property of matter, like the affinities which all things possess. What is called chemical affinity is only one kind of affinity. I think that affinity is perhaps the most universal term by which to express the forces. It may possibly include gravitation, and the reason why two bodies approach each other may be that they have affinities causing them to attract each other; for when the magnet attracts an atom of iron, the attraction is not all on one side. The magnet has the power of attraction; but the little piece of iron attracts the magnet as truly as the magnet attracts the particle of metal. In like manner, when it is said that the sun attracts the earth, it is equally true that the earth in a proportionate degree attracts the sun. In fact it may be said generally that all particles of matter have an attraction for all other particles of matter. This of course deals with masses. If you go to chemical affinity, there must be that degree of propinquity which brings molecules within the range of their mutual action. You cannot deprive any body or any substance of its affinities. Oxygen will attract carbon, and so on, and certain combinations will be formed by all the different chemical elements which have affinities for each other. These are inherent properties which they cannot lose. The conditions may be altered, but the affinities cannot be altered. This is a point on which Dr. M'Cann agrees with me; but with regard to the conservation of energy it is really very difficult to grasp the subject at all so as to form a clear idea of it, for it may be said to be almost in its infancy. We have been shown that the greatest intellects of the age, some of whom are alluded to, have actually been guilty of great confusion of thought, or at all events, of language. It does not seem to be always the case that confusion of language is at the same time confusion of thought. In a work entitled "Habit and Intelligence," by Mr. Murphy, of Belfast, the writer accuses Mr. Justice Grove of some want of precision in his language, and quotes a passage in which Mr. Grove asserts that gravity, or motion of some kind, was transmitted or converted into chemical affinity, and he apologizes for saying this by telling us that he does not mean to accuse Mr. Grove of confusion of thought, because the nomenclature of the subject is not understood, and people do not always think of using the right word exactly in the right place. These two words "force" and "energy" are so like each other in the way they are used, that it is very hard to employ them without making mistakes. For instance, the only source of energy is force, and yet energy cannot always be reconverted into force. Gravity, which always exists between masses of matter, is force, this may give rise to energy; but when an object set in motion by gravity reaches the earth, the force of gravity remains, whilst that form of energy

and of causing motion have both equally disappeared. Gravity is the inherent liability or disposition of masses to attract other masses. You cannot convert electricity or heat into chemical affinity, or any other inherent property of matter; but potential energy may be transferred,—one body having more at one time, and another body having more at another time. What now appears as heat may appear at other times as electricity, magnetism, or light. All these at times are forms of energy, and one must not confound energy with force, so as to get into an inextricable labyrinth.

The CHAIRMAN.—Can you give us a definition of those terms?

Dr. HAUGHTON.—Dr. M'Cann says, force is that which causes motion, and energy is that which does work; but I think the definition is wrong at starting, and, if so, it is quite impossible that the deductions can be accurate. If we speak of the force of Nature having its origin in certain affinities, then they can only cause motion when the requisite conditions for motion are present. If there were a stone on this mantel-piece, and I were to draw the support away, there would be motion. There was as much attraction of gravitation in the earth towards the stone before this was done as at the time the support of the mantel-piece was withdrawn; but the mantel-piece kept the stone in its place. The motion, therefore, only takes place under certain conditions, so that force is not always that which causes motion: it is that which is capable of causing it under certain conditions. Then, again, the statement that energy "does work" is equally faulty. Energy does not always do work, because, if you have two forces equally balanced,—*e.g.*, if you have the two trays of a pair of scales suspended with equal weights, you have no motion. But if you lift one of the weights, the other immediately begins to move, and the energy which was potential becomes actual, the energy being in the weight all the time. Indeed, everything would be in constant motion throughout the universe if it were not for this fact, that the different forces of Nature tend to balance one another. If I might venture to depreciate in any degree the tone of the paper we have just listened to, and which I admire on the whole, I would say that I do not think sufficient appreciation is shown in it for the real progress Science has made. I think we have got into a very grand train of thought, which must have the effect of leading us on to the most advanced state of progress. The origin of the great modern conception we are now here to discuss, was due to Count Rumford, about seventy years ago, when he discovered in the boring of cannon that heat was a form of motion. I do not know whether he did this by way of experiment, but he thought he would utilize what he was doing in a scientific point of view, and accordingly adapted vessels of water containing thermometers, so that the heat generated by the boring of the cannon could be communicated and measured. He carefully arranged his machinery in such a way that it was quite evident that the only source of the heat was motion—that there was no other source from which the heat could be derived but motion. His demonstrations of this fact were unanswerable, and he is the true author of the contribution to Science that heat is a mode of motion. He proved that the heat was really obtained out of the motion, and

that the motion was converted into the heat. This was the first push which the scientific ball received in this direction. When you have once established the fact that heat, one of our forces, is a mode of motion, the conclusion that most of the other forces may have a similar explanation seems almost irresistible. The only thing to be added is, that some of them seem to be inherent and others seem to be acquired. A body may be more or less electrized: it may be in a highly electrical condition, or it may be in a condition giving no manifestation of electricity. But oxygen cannot have more or less affinity with nitrogen—its combining number is always the same. It has always the same amount of attraction for nitrogen, carbon, or sulphur, at one time as at another, so that it is an inalienable property. Many of those faults of language that have been alluded to are really explicable on the assumption that the terms we use in talking of such highly metaphysical notions as force or energy are not yet settled; and it will take a good while before a settlement of the language to be employed will be obtained.

The CHAIRMAN.—But is it not possible to reason on the matter under these circumstances until the terms are settled accurately?

Dr. HAUGHTON.—Every man must know what he means himself when he uses a particular expression. We fancy we differ very often, because we use the same word in a different sense from our neighbours. Some people manage to agree about things for the sole reason that they are using the same terms; and although they have come to different conclusions, they believe them to be identical. But I confess there is a good deal of metaphysics about all this. I would next refer to the criticism of Professor Huxley in this paper. Let it be understood I do not go in for Huxleyism: I am a strong opponent of Huxley's views. I quote from section 44:—"The capacity of jelly to guide forces, which Professor Huxley says is a fact of the profoundest significance to him, is not a fact at all, but merely an assertion." Now this is quoted from Dr. Beale. Taking the literal meaning of the words used, this is probably a fair exception to take to the use of the words; but I fancy that when Huxley talks of jelly he means protoplasm, or what Beale would call bioplasm, —that is, organized matter, and not common jelly. And it is pretty well admitted by all physiologists of any position, that there is organization in the case referred to: the jelly itself is plus the organization; that is, there is a directive power which is capable of guiding, and which does guide. Let us take a physical illustration. How is a candle made? The grease is poured around the wick into a mould, and it takes the form of the mould—it cannot take any other. In this sense the mould guides the material used. But let the matter be organized. When the forces of Nature begin to operate, the organized matter produces certain results different from what would have taken place had the matter been unorganized. Living matter, therefore, does guide forces in that sense, because it is constructed and organized (as I believe by Divine Intelligence) in such a way that the forces of Nature, which have their source in a creative fiat, may produce certain results by acting upon it, which could only be produced in matter previously prepared and having a certain constitution. That is the view I have taken in an article which I

published in the year 1862. There is nothing novel in the idea that there is but one force in Nature, and that is an expression of the will of God. It is, however, very hard to be original on any of these subjects. There may, perhaps, be two persons working out the same idea at the same time, and they may possibly arrive by independent routes at the same point. In that case, each may think the other has copied him, whereas, in point of fact, nothing of the kind has taken place. Mr. Murphy's book (which I have mentioned) is full of information and close reasoning, and is, I think, more thoroughly philosophical than Herbert Spencer's book. My own notion is that what is called potential energy is simply affinity having a certain amount of tension. If you fasten an indiarubber cord as a spring to a door, when you open the door you stretch the spring, and the tendency of the spring is to draw the door to again; but it had no such tendency until it was stretched. Before the door is opened, the force possessed by the cord is in abeyance, and when the strain of the opened door is not too powerful, it becomes actual energy or motion; but you require to put the motion into it by putting it on the stretch. When different substances have strong attraction for each other, it is just because there has been a tension of the affinities; and I think that this principle of "affinity" will explain almost any of the other principles which underlie and produce the great phenomena of Nature.

Rev. T. M. GORMAN.—I desire to make a few remarks on certain points which appear to be of primary importance in connection with this subject. And, in the first place, I would observe that so long as the terminology of the subject remains in its present vague and unsettled state, the speculations of physicists must continue to be fruitless. In order to arrive at a clear and distinct notion of force, we must proceed on the sure path of experimental fact and rational knowledge, and, by means of these, ascend by degrees to One who is the origin and spring of all force. A careful study of the phenomena, and a slight effort of the reason, lead to the somewhat startling conclusion that force, as such, is not createable by man. Nor are heat and light. The truth of this conclusion will appear evident the moment we consider that these terms are employed to denote various kinds of activity. Mere activity cannot be created. Apart from some real substance, it is a pure abstraction. Substances which are susceptible of modification are createable, and have been created. And here I wish to say a word in reference to what must appear, on reflection, to be a most fallacious form of expression, which has obtained a considerable degree of currency among men of science in the present day, and which has an evident bearing upon the subject before us. I refer to the phrase "living matter." While one may easily admit that there is a loose sense in which we may use the term, it must at the same time be obvious that, taken strictly, such a phrase begs the question at issue. What can be meant by the life of matter? Matter, as such, is dead. Nature, as such, is dead. Life is something within, above, superior to, altogether distinct from, matter.

Rev. C. GRAHAM.—May I take the liberty of asking the last speaker

whether I rightly apprehend him as stating that activity in man, and in all spiritual beings, is from above ?

Mr. GORMAN.—Yes. No created being has life in itself. The Deity alone has life in Himself. Man, for example, is merely an organized receptacle of life.

Mr. GRAHAM.—If the assertion be that the power of activity comes from above, I accept the statement ; but if it be meant that the activity itself comes from above, then all human actions must be good ones.

Mr. GORMAN.—May I explain ? When the divine influx descends into our minds, it flows into an organ or receptacle of life, *the soul*, which is by nature in a state of evil. The inflowing life becomes modified, according to the nature and character of the recipient. The evil is not in the inflowing life, but in the already perverted will and understanding which receive it. Thus, it is the same life that flows into man and angel ; but it is modified according to the form and state of the recipient. In like manner, in the natural world, the heat and light of one and the same sun flow into a grain of wheat and into the seed of the deadly nightshade, and, owing to the difference of the recipient form, there results, in the one case what contributes to sustain life ; in the other, a narcotic poison.

The CHAIRMAN.—We are going a little too far from the subject of the paper.

Mr. GRAHAM.—I think we are nearly agreed. Having made these observations, I deem it right to say that I am exceedingly thankful to the author of this paper for the way in which he has brought the subject before us. I regard it as a very able paper; but could wish the author had entered more into the moral aspect of the question, because I think that that is the most important aspect in which we can view it, and I think also that the generality of reflecting people, and more especially those who believe that the subjects of morality and righteousness are the highest we can keep before our minds, would be greatly interested to find the question treated from this point of view.

Mr. PHIPPS.—Although a stranger, I may perhaps be permitted to observe that to me one of the most interesting parts of the paper we have heard is that which speaks of the permanency and non-permanency of motion. It is an old argument that motion of heavy matter once established must needs go on for ever, because although it may communicate motion to something else, and that something else may do the same thing to another something, the motion that is communicated must go on for ever. I should like to know whether the author of the paper conceives that the objection to the permanency of motion, when once established, is the difficulty of saying what infinite space is filled with. I gathered that the difficulty arose from the ignorance in which we are upon this subject, some saying that space is filled with a fine ether, while others conceive it to be a vacuum.

The CHAIRMAN.—The real difficulty of dealing with this paper is that it involves important principles of Physical and Metaphysical Science, of a high

order, and important questions of logical definition, which we have not sufficient time to discuss in their entirety. One thing is obvious on the most cursory perusal of many modern works; that our physical philosophers—men who are great in their own sphere of thought—are in the habit of trespassing on domains of metaphysics, mental philosophy, and logic, which they have never studied; and thus they invest their utterances on these subjects with the halo of their well-earned reputation as Physicists. But a high reputation in one line of thought is no guarantee for ordinary correctness in another. Mr. Darwin's high reputation as a naturalist has certainly not prevented him from exhibiting himself weaker than other men when he has attempted to deal with questions which properly belong to Moral Science. But with respect to the paper and the discussion on it: it is evident that we greatly need a definition of some kind, which will enable us to attach a consistent meaning to the term "Force;" and that our want of it involves us in hopeless confusion. At present we designate two things, while differing in their conception, by the same term—"physical force" and "mental force." As long as we do this, how is it possible to avoid confusion of thought? The one is an idea derived from certain phenomena in external nature; the other from our consciousness of our own voluntary agency. When two trains run into one another, we have an example of physical force. When a great orator persuades a Parliament to do the very contrary to that which they intended to effect, we have an example of mental power. But the two acts differ from each other by the entire interval which separates matter from mind. Yet it is not uncommon to hear "mental forces" and "material forces" spoken of as if they were the same thing—nay, it is even asserted that they can correlate into each other. This confusion of thought has enveloped much of the reasoning on this subject in a complete fog; so that we are in danger of missing our road in places with which we are entirely familiar. The use of this and of several other kindred terms is at present in a state of hopeless confusion. It is really high time that some system of definition should be adopted which will enable us to know what we are talking about. At present even eminent physical philosophers use the term *force* in different senses, and when they apply the same term to denote certain powers of the mind, our confusion becomes inextricable, acrimonious discussions ensue, and after all it turns out that instead of striking at each other, we have been striking at things wholly different, and that the whole has resulted in nothing but a wasteful expenditure of valuable power. How is it possible that any reasoning can end in a useful result, when one man is talking about one thing, and another about a thing quite different. This loose use of language involves us in endless contradictions. Take for an example the use which is made of the word motion. What does it mean? Surely, if it has any meaning at all, it can only mean change of position in space. It is that obvious thing which we see every day before our eyes. But we hear people talk of *latent motion*, or *stored-up motion*, as though, when the motion of a body ceased, there was not an end of

the motion altogether. Surely, when a thing ceases to move, the motion ceases to exist. What is meant by such expressions as latent or stored-up motion is a force or power which, after a certain thing has ceased to move, is capable of setting it in motion again; but if we use terms after this fashion, how is it possible to reason accurately? So I apprehend the term potential motion, if translated into simple English, must mean that a certain thing which is not in motion is capable of being set in motion. No doubt the subject of motion may be made to involve many most serious metaphysical difficulties—shall I say puzzles—as the most ordinary acquaintance with ancient philosophy proves. It is perhaps better to give up all attempts to define the subject metaphysically, and to be content to use the term as it daily appears as a phenomenon before our eyes. But it is far from uncommon to speak of certain mental states as though they were motions likewise. To do so may be well enough for popular purposes; but if we are dealing with subjects scientifically, the only result is to make our confusion worse confounded. I would submit that the states in question cannot with any propriety be denominated motions, except metaphorically. What common idea is there when I say, I have been deeply moved by a tragical story, or I have been carried on at the rate of fifty miles an hour in a railway carriage? I own that I am also often sadly puzzled by the use of the term "energy." It seems to me difficult to assign any definite meaning to it, unless we mean by it the active state of a thing, as different from its passive state—a thing doing something, as distinct from a thing doing nothing—*action* as contra-distinguished from *passion*. But I think that I have both heard and read of "energy," which is not "energy" in any of these senses. Now, "energy" which has ceased from an active state, and passed into an inactive one, seems to me to be "energy" no longer, but to have become something else. I am, therefore, quite unable to understand what such a term as "potential energy" means, except that it is one specially invented for the purpose of producing confusion of thought. What I presume is really intended is, some power which can set a thing acting again after it has ceased to act. But if this is the real meaning, why not express it in perspicuous language? One portion of the paper to-night—perhaps its most important portion—has not been touched upon in the discussion, as to whether it is, or it is not, possible to convert material forces into mental states; or, in one word, whether so much material force can correlate into so much mental power. I think it unquestionable that a number of the most absurd propositions have been uttered on this subject. It is broadly stated by a number of writers at the present day that all the phenomena of mind are merely different forms of so much material force. The multitude of absurd statements uttered on this point, if not very serious, would be very amusing. Just fancy what our friends would call the force of so much self-sacrifice correlated into so much electricity! I believe that sound is often spoken of as a mode of motion. Its material vehicle unquestionably is, but sound itself consists of two factors, a material apparatus and a perceptive power of the mind, and if either of them is wanting, what we call sound cannot exist. There is a good deal on the

last page of the paper which requires careful consideration, and it would have been desirable if we could have discussed some of these points separately, instead of having to run over a large amount of human knowledge in a single evening.

Dr. M'CANN.—As the different speakers have, for the most part, agreed with my paper more or less, there is not much for me to reply to. Most of them have referred to its wide scope. My answer is that the fault is necessitated by the subject treated of. It is affirmed that almost everything is force—that matter is force, mind is force, morals are force, and spirit is force; and therefore if everything be force, while treating of force I am compelled to speak of everything. One speaker mentioned a want of admiration for the results of science as conspicuous in my paper. If it be supposed that I am not an admirer of the researches and results of science because I do not give more prominence to my views in regard thereto, I have only to regret that such a conclusion should have been arrived at. I would here refer my audience to a note which I have added to section 33 of my paper, where I say:—

"While we are compelled to differ from Dr. Tyndall on these theoretic points, we would express our unqualified admiration of his great abilities as an experimenter, and our sincere gratitude to him for making known the results of his investigations, in language so beautiful, clear, and precise as to captivate while he instructs, and win students to the study of Nature, who, but for him, might have gone to the grave caring nothing for God, and less for His works."

I would add, that I yield to no man in my admiration for science and its results; only I did not wish to go into matters that were not absolutely necessary in preparing a paper, which I think you will say is quite long enough. The term "energy," to which the first speaker referred, is, I think, an unfortunate one, and I do not see the necessity for it; because when we use it we mean motion. The word "motion" conveys a distinct idea; whereas the term "energy" does not. When the first speaker referred to the "conservation of energy," and the "persistence of force," I told him that I simply meant, that the necessary qualities or powers of matter were always there. Force is the power to produce motion: that is the definition I give of the term.

The CHAIRMAN.—But not in a mental sense?

Dr. M'CANN.—The origin of the idea of the power to produce motion is from original consciousness. The same speaker rather objected to my quotation respecting Professor Huxley in reference to jelly guiding physical forces, and he went on to argue that organized matter, or protoplasm, guided forces in the same manner as a mould guided the tallow of which a candle is made. If that is all, I do not think there is much guiding in the matter: the first and principal guide in that case is the hand that makes the mould, and that done, the matter must fill the mould according to the form the mould gives it. What has been said about dead and living forces I think I may pass over. With regard to what has been stated about the moral aspect of the question,

I have only to reply, that I could not enter more fully into that part of the subject than I have done, as I felt it was, in the first place, necessary that the physical foundation should be laid down, so that the moral aspect of the question would afterwards be the more easily grasped. If I had written a longer paper, I might have gone into that part of the question, but I felt that I had made it quite long enough. Then I have been asked whether I thought space was filled with matter or not? and the way in which I understood the question was, that if space were filled with matter, the continuity of motion was a possibility, but not a necessity; and if space were a void, the continuity of motion became an impossibility. I do not think it necessary to discuss that, because motion ceases before we get to the boundary of our own material atmosphere. It may be that some of you here present think I have used new words rather dogmatically. I can only say that the words I have employed are only intended to bring out my ideas as clearly as possible, with the view of having the subject properly discussed. The conception of the persistence of force is a very valuable one in reference to the correlation of forces, because it shows how intimately connected are all the physical forces of the universe. Here no lines intersect, but all converge towards one point, the great Force of the universe, Whose will manifests itself in the possibility of other forces, and their phenomena, with the mysteries of which we are not yet acquainted.

The Meeting was then adjourned.