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"Physiological Metaphysics." By President Porter, D.D., M.D. *From the Author.*
"Present Rights and Duties of Science." Principal J. W. Dawson, LL.D., F.R.S. *Ditto.*
"Princetown Review." *Dr. Dawson, F.R.S.*
"Why am I a Christian?" By W. R. Bradlaugh, Esq. *From the Publisher.*

Also Pamphlets from J. Coutts, Esq., Rev. R. Douglas, Rev. G. W. Dalton, the Bishop of Haiti, and the Rev. G. Sexton, D.D.

The following paper was then read by the Rev. T. M. Gorman, M.A., the Author being unavoidably absent.

SCIENCE AND MAN: being Critical Remarks upon Prof. Tyndall's Presidential Address, delivered before the Birmingham and Midland Institute. By NOAH PORTER, President of Yale College, United States.

PROFESSOR TYNDALL has the reputation, and deservedly, of being one of the most brilliant expounders of modern physics among living Englishmen. He is clear and condensed, vivacious and eloquent. It were hard to say whether insight or imagination, method or diction, has the most to do with his success. Though his themes are limited, he rarely repeats himself. The order of his thoughts is usually novel, and his illustrations and language are always fresh and varied. For these reasons he is always welcome as a lecturer, and he rarely disappoints his hearers. He shares with Prof. Huxley the honour of having demonstrated, each in his own

way, that a discipline of classical culture, or of early literary studies, is by no means essential to the training of an effective popular speaker or lecturer upon the severest topics of science. We say each in his way, for the excellencies of Prof. Tyndall and Prof. Huxley are unlike—Prof. Tyndall being strong in illustration, ornament, and suggestiveness, while Prof. Huxley excels in directness, simplicity, and force.

The specialty of Prof. Tyndall, as is well known, is that department of physics which includes the kindred agents of light, heat, and electricity. Prof. Huxley is eminently a physiologist—both human and comparative. Neither of the two, however, confines himself to the specialties named, especially in their popular lectures and addresses—both being more than usually fond of following out the suggestions of physics and physiology in respect to the nature of the soul, the progress and destiny of man, and the origin and end of the physical universe. In plain English, both these gentlemen are very fond of teaching the public metaphysics and theology after what they please to call the methods and conclusions of physical science. We do not altogether blame them for this. The desire and effort show a generous recognition of other phenomena than those which are included within their own departments, and the rooted conviction that all truth is one, and therefore it is impossible that any science of nature should conflict with the other forms of scientific truth, or offend any rational conviction. Prof. Tyndall has appropriated to himself a somewhat wider field of discussion than Prof. Huxley, having discussed very frequently the method of scientific inquiry with a sagacious appreciation of the problem, and with commendable, if not always consistent, sagacity in solving it. From the metaphysics of induction, he has very naturally proceeded to discuss the nature and essence of the soul, and has consequently yielded to the further impulse to inquire what science teaches concerning freedom, morality, immortality, prayer, and God. All this has been done under the impulse of an implicit faith in what he calls science. His confidence concerning his mastery of what he calls the known and the analogies which it suggests in respect to the unknown—his predictions of what is the inevitable tendency of modern thinking in respect to every one of the topics named, and the eager haste with which he seeks to place himself among the foremost of its heralds—are contagiously exhilarating even to the looker-on who neither accepts his data nor his inferences. How much more must the lecturer himself enjoy the glowing excitement with which he sweeps along his triumphant course and the responsive enthusiasm of his confiding and admiring

audiences. It is not surprising, as from year to year he grows more confident in his psychological and theological faith, and is more and more aware of the power which he wields, that he should take occasion as often as once a year to announce with befitting eloquence and ardour the advances by which the thoughtful men of the age are fast proceeding towards the mastery of the universe by scientific thought after truly scientific methods. On the 1st of October last he gave one of these confessions of his faith before the Birmingham and Midland Institute, of which he is President. It was characterized by his usual gracefulness in the introduction, and by his never-failing ingenuity in the development, and by more than usually startling frankness in the conclusion. In reading such a discourse we very naturally ask, of what topic does it treat? We confess that this is a question which it is not easy to answer. It might almost seem at first that it treats *de omni scibili et quibusdam aliis*, so wide is the range of subjects which it passes in review. It will be safe to say in the author's own words that he begins by asserting "that it is now generally admitted that the man of to-day is the child and product of incalculable antecedent time. His physical and intellectual textures have been woven for him during his passage through phases of history and forms of existence which lead the mind back to an abyssmal past," and that he concludes with the equally confident assertions: "Thus following the lead of physical science we are brought without solution of continuity into the presence of problems which as usually classified lie entirely outside the domain of physics. To these problems thoughtful and penetrative minds are now applying those methods of research which in physical science have proved their truth by their fruits. There is on all hands a growing repugnance to invoke the supernatural in accounting for the phenomena of human life; and the thoughtful minds, just referred to, finding no trace of any other origin, are driven to seek in the interaction of social forces the genesis and development of man's moral nature. If they succeed in their search —and I think they are sure to succeed—social duty will be raised to a higher level of significance, and the deepening sense of social duty will, it is to be hoped, lessen, if not obliterate, the strife and heart-burnings which now beset and disfigure our social life." The terminus *a quo* is evolution as an admitted fact of the widest conceivable application. The terminus *ad quem* is a rounded scientific theory which excludes all faith in the supernatural and any possible scientific occasion for God; involving as a corollary, the development from society of all the relations and sanctions of moral obligation. This

faith is fitted to elevate practical morality and to deliver social life for ever from its strifes and hatreds. All these positions except one had been asserted or implied in Prof. Tyndall's previous deliverances. The only advanced position which he takes in this discourse is the very familiar dogma of Hobbes, which has been transfigured by Herbert Spencer, that moral distinctions are created or evolved from social relations and are sanctioned by social forces. "But if this is all that is new in this address, why notice it at all? We have had enough of all this at Belfast and on other occasions, and the staple of such reasoning has been so often used that it is becoming somewhat threadbare." But this does not follow. Prof. Tyndall never repeats himself. If his logic is in principle unchanged, the form in which it is presented always varies. Every time he rises to argue on these extra-physical themes, he adduces what he considers new facts, and employs fresh and novel illustrations. He invariably aims to strengthen the most familiar and oftenest used chain of argument by some links freshly forged. Moreover, he is sensitively alive to what the men of these times are thinking of; so sensitively, that he cannot rest content with old arguments, if new ones are required. He is too ingenuous not to confess, or at least not to betray, his sense of the weakness of some of the positions which he had previously taken, and too ingenious not to attempt to strengthen them. The occasional discourses of so sensitive and frank a thinker as he, are also in a sort the outspeaking of what is going on in the minds of scores and hundreds of men who want the honesty or the opportunity to speak their minds as freely as he speaks for them. What is more to the purpose, they declare the secret misgivings and the more than half-formed creed of multitudes of younger men who know not how to answer the reasons of an argument from the conclusions of which they shrink. These are the reasons why we think it worth while to subject this eloquent discourse to a careful examination. We shall do this with the same frankness which our excellent friend, the author, always exhibits, and we hope with equal fidelity to the scientific spirit by which he is animated.

We observe before the argument begins, a little skirmishing, the design of which is not at first view very obvious. In speaking of the dependence of the individual upon the forces of the past, Prof. Tyndall says that Boyle regarded the universe as a machine, but Mr. Carlyle prefers to regard it as a tree, and adds: "A machine may be defined as an organism with life and direction outside, a tree may be defined as an organism with life and direction within." This language seems novel. Can a machine be an organism,—and an organism with

life? Surely the common speech of Prof. Tyndall has made him forget his philosophy. It seems a pity that his German studies did not suggest to him the well-worn definition from Kant,—from whom he is somewhat fond of quoting commonplaces—that "an organism is that in which the parts and the whole are respectively means and ends."* How marvellous that this commonplace and yet fundamental conception of physiology should have been so strangely misconceived, through the apparent haste of Prof. Tyndall to give, as he does, in the next sentence, an atheistic turn to his very inadequate conception of what an organism is. "I close with the conception of Carlyle. The order and energy of the universe I hold to be inherent and not imposed from without—the expression of fixed law and not of arbitrary will." In this also, he forgets the patent truth that in the judgment of the great majority of scientific thinkers an organism in its very conception implies intelligence without itself. His confusion of mechanical with organic relations is still more apparent, as he traces the growth of scientific theories from vague anticipations into verified discoveries and fixed methods, and concludes with the remark, which is least of all true in respect to the science of organized existence, that "the interdependence of our day has become quantitative—expressible by numbers—leading, it must be added, directly into that inexorable reign of law which so many gentle people regard with dread."

In one aspect, as we have said, the intent of these preliminary movements is not very obvious, but in another it is clear that they are designed to prepare his hearers for the conclusion to which he directs every position of his subsequent argument—that the universe of matter and spirit, including as he concedes the phenomena of moral conviction and feeling, as also of religious emotion and religious faith, is in every process and manifestation subject to no other than mechanical laws.

Thus far the movements have been preliminary. The author begins the argument proper with a theme very familiar to himself, viz.: the correlation of physical forces. He traces the growth of this theory from the first felicitous conjecture

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* "Ein organisches Product der Natur ist das in welchem alles Zweck und wechselseitig auch Mittel ist." *Kritik der Urtheils-Kraft*, § 66. To understand the complete significance of this phraseology, the reader must bear in mind that Kant denies that a work of art, *i.e.*, a machine of any sort, can properly be said to be organic or organized. In this doctrine most scientists would agree with him.

to the demonstrated conclusion. He illustrates it by the relations of heat to mechanical work and their mutual interchange, in examples with which the readers of his other essays and lectures are entirely familiar. He considers next the analogous interchange of decomposition and combustion in the use of the galvanic battery for chemical results—illustrating by several examples the truth that chemical elements, say hydrogen and oxygen, which are united in combustion at one point in the circuit, are liberated in exact equivalents at the other. Having taken two steps in his argument, he essays a third, and suggests that the same process under similar laws may go on in the body of man. Having demonstrated that heat is interchangeable backwards and forwards with mechanical energy in mathematical equivalents, and that combustion involving heat is in like manner interchangeable with chemical decompositions, he abruptly asks: "Is the animal body then to be classed among machines?" The friction wheel or the galvanic battery only distributes force—transferring it from one point to another, and varying its manifestations to the senses—but never creating it. Does the animal body do anything more? "When I lift a weight, or throw a stone, or climb a mountain, or wrestle with my comrade, am I not conscious of actually creating and expending force?" The ingenuity of thus putting his case is altogether admirable. It is as though he had said: the question whether the body is or is not a machine must be decided by the question whether it is capable of generating muscular or mechanical energy. The man who asserts that it only transfers force must own that it is a machine—the man who denies that it is a machine must hold that it can of itself generate, *i.e.*, originate, muscular force. The tyro in logic would recognize the possible fallacy which may lie in the major premise of Prof. Tyndall's disjunctive syllogism. Even did he know little about the subject matter, he might at least be wary enough to say: I am not prepared to say that A is either B or C, for it may possibly be either B, C, or C + D. That is, the human body may be something else than either a generator or a transmuter of force—it may perhaps perform other offices than a friction wheel or a galvanic battery. Whether Prof. Tyndall does not himself concede this a little further on, we shall ask in due time. But Prof. Tyndall having shaped his major premise to suit himself, proceeds to discuss the minor premise by asking whether the human body originates, *i.e.*, generates, mechanical force. He answers his own question by an elaborate and varied series of illustrations, all of which are designed to show that mechanical force and heat and chemism (chemical attraction) are related to one another in

the human body precisely as in the use of the friction wheel or the voltaic battery, *i.e.*, that eating and breathing are simply more refined forms of combustion and decomposition with which heat and motion are correlated. "All this points to the conclusion that the force we employ in muscular exertion is the force of burning fuel and not of creative will." "The body, in other words, falls into the category of machines." "The matter of the human body is the same as that of the world without us, and here we find the forces of the body identical with those of inorganic nature. Just as little as the voltaic battery, is the human body a creator of force. It is an apparatus exquisite and effectual beyond all others in transforming and distributing the energy with which it is supplied, but it possesses no creative power." We have no disposition to dispute this. We concede that so far as *the production of muscular power* is concerned and its transmutation into heat, all this may be true. We question very much, indeed, whether the experiments have been conducted with mathematical exactness, or whether the laws have been formulated with scientific precision or, as Tyndall phrases it, whether "the interdependence" between the several factors has "become quantitative—expressible by numbers." But making nothing of this, and conceding that the law of conservation and correlation of muscular force operates as Prof. Tyndall contends, we cannot but inquire whether the human body performs no other offices than these two, *i.e.*, whether all the functions of life are resolvable into digestion, breathing, walking, climbing, and lifting weights? Prof. Tyndall himself, it would seem, more than half suspects that his machine does something more than transmute force by eating and breathing. When he says: "Thus far every action of the organism belongs to the domain either of physics or chemistry," he bethinks himself that the nerves have something to do with the application and direction of force, if not with its generation. These are sensor and motor. But these do not create force—they do not originate energy—they simply *direct* it, "as Mayer says, with *admirable lucidity*, as an engineer by the motion of his finger in opening a valve, or loosening a detent can liberate an amount of mechanical energy almost infinite, compared with its exciting cause, so the nerves acting on the muscles can *unlock* an amount of power out of all proportion to *the work done by the nerves themselves*. The nerves, according to Mayer, pull the trigger, but the gunpowder which they ignite is stored in the muscles. This is the view now universally entertained." We pass over the concession that has inadvertently dropped from the lips of our author, that work of some sort is done by the nerves themselves, which he had not noticed, and

certainly had not shown to be the accumulation or transmission of some occult transformation of heat. We simply observe that according to Tyndall and Mayer and all the scientific world, a special function is accorded to the nerves—over and above any which the correlation of forces can illustrate, under mechanical law in the machine or chemical decomposition in the battery—and this is a function of directing—*i.e.* of liberating and detaining muscular force—which is illustrated by lifting a valve, or pulling a trigger. It were far better illustrated, as it seems to our unsophisticated minds, by the power of a band or gearing to carry motion in a machine, or of wire to transfer potential motion or potential heat in a battery. It is very evident that when Prof. Tyndall began his argument which was to prove that "the body falls under the category of machines," and that as a machine it generates no force, he does not seem to have thought of any other function as possible except the two, of generating or transforming force. Not seeing that his animal body, his *homme machine*, does through the nerves perform the additional function of directing or transferring force, that is of determining when and where it should act, it is not surprising that he meets this indefinitely conceived demand by the convenient image or picture of a valve, a detent in a machine or a trigger in a musket. He ought to have bethought himself, and corrected the premises of his disjunctive, and instead of asserting, the animal body either creates force or transforms force, he should have said, the human body either creates force or transforms force or also directs force. Then in order to prove that it is a machine, he must prove that it directs force through the nerves, by either mechanical or chemical agency. This last he does not attempt to do. He does indeed assume that nerve substance is wasted by use, and implies that heat is probably evolved in nerve activity, and illustrates this by a rod of antimony rendered sensitive by electrolysis as it carries forward heat and smoke from one end to another. From this he would doubtless leave us to infer that the nerves like the muscles never act, except under the general conditions of correlation. But in all this there is not the slightest attempt to explain by what mechanical process the nerves *direct* or *transfer* motion. He does indeed tell a somewhat long story about experiments which show that the process of movement or affection in the nerves, sensor and motor, to and from the brain, requires an appreciable lapse of time, so that a second must elapse before a whale seventy feet long would feel a wound in his tail, but he is sublimely unconscious of the fact that the new function of shifting motion, by valve, detent, or trigger during this second, makes the machine a little more complicated than he had at

first supposed. But this slight difficulty not having occurred to him, the animal body is accepted as a finished machine, which is now ready for the "kindling of consciousness," which he confidently anticipates may turn out to be a more refined form of heat evolved by mechanical laws. With this impression, he marches boldly up to the new line of inquiry, which relates to the connection between this machine and a highly poetical or idealized force, sometimes called the soul. To say nothing of these little difficulties, which have hindered us from going forward with him at the rapid pace which he has assumed, there are others which compel us still to follow him *haud passibus æquis*. We are not satisfied that he has disposed of sundry other questions which may be asked in respect to the "animal body." Conceding that in breathing and eating and muscular action, this body is a machine or a voltaic battery, and not insisting on the peculiarity of the function by which the nerves transfer or liberate motion, which Prof. Tyndall has scarcely recognized and imperfectly explained, we hold that this body performs other functions, which the doctrine of the conservation of force does not at all account for, and which are not proved to be mechanical by Prof. Tyndall's argument, or the analogies which it suggests. We need only refer to these. This body grows by a peculiar method, through cellular accession from within, from living food, making thereby new and peculiar tissues in great variety. Many of these tissues become organs which are capable of secreting special fluids or substances, which themselves pass by an orderly succession into the various permanent substances of the body. Each organ secretes that which finally returns to itself, increasing its bulk, following its form, and fitting for its function. These parts grow after a plan, which is general in likeness of form, size, and symmetry, so far as it is common to all living bodies, special so far as it is peculiar to each species, and individual so far as it is fitted to each individual. Not any one of these effects has ever been accounted for by the joint operation of any known mechanical or chemical laws, much less by their sole or separate activity; least of all with the slightest approximation to that mathematical rigour which Prof. Tyndall contends is the indispensable requisite of scientific certainty. All that can be said has been said by Prof. Tyndall, that so far as heat and muscular activity are concerned, there is probable correlation between the two—that in living matter as truly as in inorganic matter, the combinations in growth and the decompositions of waste are chemical in their ingredients and chemical in their relations. This is not surprising—did not the living body consist of materials which obey mechanical and chemical

laws, this body would so far not be material. This is not at all in question, and so far as a correct conception of an animal body is concerned, it is superfluous to argue the point. What is in question is whether this body is capable of no other functions than these, not whether it is a machine or a voltaic battery, but whether it is not something more. The question is not whether so far as it is material it is subject to material laws, but whether it is not also a living body, and what forces, relations, and laws this conception implies.*

What is most surprising is, not that a certain class of scientific men do not see this distinction, but that so many insist in one breath that no scientific theory can be accepted which is incapable of mathematical formulization and experimental verification, and in the next breath adopt a theory of life on a mechanical and chemical basis, the laws of which they do not profess to have formulated in numbers, nor to have tested the alleged facts by experiment. Prof. Tyndall insists that "the interdependence of our day has become quantitative—expressible by numbers"—and that where law cannot be formulated by numbers there is no science. We insist that if under this definition, Psychology, Morals, and Theology are excluded from the domain of science, Physiology should be excluded also, and yet the whole doctrine of development,—with heredity and its variations and integrations, and all the nomenclature by which the soul is demonstrated to be but a higher potency of matter, and personality to be an ideal fiction, and God an entirely superfluous hypothesis—is derived from the very operations of life, scarcely a single one of which if tried by the criterion in question has been scientifically fixed or formulated.†

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* Since writing the above, we happened to open the often-read discourse of Du Bois Reymond, of Aug. 14, 1872, *on the limits of the knowledge of nature.* On page 26, speaking of a supposed ideal knowledge of the physiological processes, analogous to our actual knowledge of astronomical movements and laws, he says:—In that case, "muscular contraction; glandular secretion; electrical pulsation; optical illumination; ciliary movement; the growth and chemism of plant-cells; the impregnation and development of the egg; all these *now hopelessly dark processes* would then be as transparent as the movements of the planets." It would seem that these processes are no longer dark to Prof. Tyndall's illuminated vision.

† Prof. Tyndall asserts, not infrequently, with unqualified positiveness, that sciences cease where mechanical relations cannot be mathematically determined. He objects to any scientific recognition of the phenomena of spirit, in such language as this:—"If we are true to these canons we must deny to subjective phenomena all influence on physical processes. Observation proves that they interact, but in passing from the one to the other we meet a blank, which mechanical deduction cannot fill." He seems to over-

But leaving this consideration and conceding for the moment all that Prof. Tyndall violently and unscientifically assumes, viz.: that the animal body is a machine—let us follow him up to the line where its supposed relations to the soul begin. We accept the case suggested by himself: "An aërial wave, the energy of which would not reach a minute fraction of that necessary to raise the thousandth of a grain through the thousandth of an inch, can throw the human frame into a powerful mechanical spasm followed by violent respiration and palpitation." We give the illustration which he quotes from Lange. 'A merchant sits quietly in his chair—he reads a letter, it makes him spring to his feet, he calls his carriage, gives orders in haste to all his clerks and servants—rushes on Change, buys, and sells, and signs a few papers, and in a half-hour has saved his fortune from wreck; he comes back, and throwing himself into his chair says, now I can breathe.' "This complex mass of action, emotional, intellectual, and mechanical, is evoked by the impact upon the retina of the infinitesimal waves of light coming from a few pencil marks on a bit of paper." "What caused the merchant to spring out of his chair? The contraction of his muscles. What made his muscles contract? An impulse of the nerves which lifted the proper latch and liberated the muscular power. Whence this impulse? From the centre of the nervous system. But how did it originate there? This is the critical question." It is indeed the critical question. And how does Prof. Tyndall answer it? We should first inquire, how does he ask it? for it is important to notice that as with lawyers so with philosophers it often happens that the way in which they phrase their questions reveals the answers which they expect or desire, and in some sort compel. Prof. Tyndall does not deny that other phenomena come in beside those of the ordinary nervous, digestive, and breathing mechanism. He admits that terror and hope, sensation and calculation, with possible ruin, all succeed one another between the impact on the retina and the lifting the latch which releases the reaction that proceeds from the centre of the nervous system. But he assumes that whatever is the nature

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look the fact, that tried by this test, physiology itself, as conceived by the great majority of its devotees, is as little a science as psychology. His own conjectures that the animal body is a machine, are as far from any mathematical formulization as the not dissimilar theory of Descartes. The psychological theories of the school of Herbart are more solidly and consistently mathematical than are the headlong guesses of Prof. Tyndall's physiology. Tried by Tyndall's test, the new chemistry is also in some danger of being pronounced unscientific. See Du Bois Reymond.—*Ueber die Grenzen des Naturerkennens*, pp. 4, 5.

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look the fact, that tried by this test, physiology itself, as conceived by the great majority of its devotees, is as little a science as psychology. His own conjectures that the animal body is a machine, are as far from any mathematical formulization as the not dissimilar theory of Descartes. The psychological theories of the school of Herbart are more solidly and consistently mathematical than are the headlong guesses of Prof. Tyndall's physiology. Tried by Tyndall's test, the new chemistry is also in some danger of being pronounced unscientific. See Du Bois Reymond.—*Ueber die Grenzen des Naturerkennens*, pp. 4, 5.

of these phenomena they are caused by the impact of the undulating light upon the responsive retina, that this imparts another impact to a somewhat causing terror, which in its turn by another stroke or impact is transformed into hope, till at last the latch is lifted and the muscular power is set free. This assumption concerning all these processes resolves them into mechanism and subjects them to the law of necessity. It takes for granted that whatever the soul may be, whether it is a set of friction wheels or a voltaic battery, whether brain or a poetical expression for an ideal x, its phenomena are caused at first by the impact of a material object and follow in succession according to mechanical necessity. The proper attitude to assume is of protest against every such assumption and the language which asserts or implies it. The true and wary philosopher will say just at this point, I do not accept your version of these intervening phenomena, they are in no sense evoked by the object striking upon the man, but they are performed by the man with reference to the object. It is not the letter which strikes its impacts upon the man, but it is the man who reads the letter and thereafter acts in calculation and hope until the latch is lifted and the muscular motion is set free. We know that this view is very strange to Prof. Tyndall's method of philosophizing and is fatal to all his conclusions, but in our view it is true to the facts, and we must protest against this stealthy if it be an unconscious way of disguising the facts by the mode of asking the question, Whence the impulse and how did it originate, that directs or liberates motion in the various methods so vividly described? This is indeed the critical question. It is none other than whether there is any other agent than matter, and whether the agent, be it material or aught besides, acts according to mechanical laws and under mechanical necessity? How does Prof. Tyndall answer this question? He remarks first of all, "The aim and effort of Science is to explain the unknown in terms of the known. Explanation, therefore, is conditioned by knowledge." This truth he proceeds to illustrate by the story of a German peasant, who, when he saw a locomotive for the first time, having never known any other than animal power, after long reflection solemnly said: *Es müssen Pferde darin seyn:* There are horses inside! The story in Prof. Tyndall's opinion illustrates a deep-lying truth. It strikes us that the deep-lying truth which Prof. Tyndall finds in it admits of an application of which he was not fully aware or he would scarcely have introduced the story. Had the peasant known no other locomotive power than that by horses, he had reasoned wisely, provided the peculiarity of the effect was not fitted to awaken

the suspicion that there were more things in heaven and earth than were dreamt of in his philosophy. Otherwise his confident dogmatism should be ascribed to his stolid incapacity or his narrow positiveness. We certainly see no objection if Prof. Tyndall feels none to his recognizing in the peasant the ideal of a true philosopher and placing himself by his side, as one who like him can only interpret the unknown by the known. When Prof. Tyndall insists that all the functions of the animal body can be explained by mechanical or galvanic agency, he seems to us to say, *there are horses inside.* Motion, and heat, and breathing, and eating are the forces which I recognize and believe in, and these are the only forces which I accept. Were the German peasant told of steam and its expansive power, of its capacity of quick generation by heat and of condensation, and were there shown to him the steam boiler and the furnace—he would doubtless say, the force and the laws of which you speak are both to me unknown, and I can only explain the unknown in terms of the known. Similarly when the attention of Prof. Tyndall is directed to the activities of spirit he replies, all these are practically unknown to me, for I believe in nothing except the mechanics of friction or the voltaic battery. That is to say, if we know or could know anything about terror, and hope, and calculation, and resolve, and all the other phenomena that were evoked between the first impact of the light and the reaction on the muscles—we might explain the intervening phenomena, but inasmuch as we cannot, we must assume that they do not exist. They are to Science a set of unknown quantities, which have no claims to be scientifically recognized and can neither explain other phenomena nor be explained themselves. Prof. Tyndall by his subsequent concessions is far less excusable and far less philosophical than his associate philosopher. For Prof. Tyndall is frank enough to say that there are *peculiar* phenomena (he does not say there is a force) such as terror, hope, sensation, calculation, etc., which are associated with or attendant on the molecular motions set up by the waves of light in a previously prepared brain. But he denies that there is any causal connection between them. He rejects the explanation given by Mr. Bain, once partially admitted by himself, that the two are objective and subjective sides of the same phenomenon. He repeats, however, his position that the reason why we cannot unite them in a causal connection, is that while we can form a coherent picture of physical processes, as the stirring of the brain, the thrilling of the nerves (a new idea), the discharging of the muscles (previously the lifting of a latch), we can form no picture of a molecule producing a state of consciousness or

of a state of consciousness acting on a molecule. Physical science offers no justification for either of these connections, the ordinary canons of science fail to extricate us from our difficulties, and therefore we conclude that there can be nothing but *horses inside the locomotive*. Even the facts, as terror, hope, calculation, &c., are almost as difficult to seize as the idea of the soul as their cause. But "if you are content to make your soul a poetic rendering of a phenomenon which refuses the yoke of ordinary mechanical laws, I for one would not object to this exercise of ideality."

The reader will be able by this time to form some idea of what Prof. Tyndall intends, when he says that the phenomena of the soul, the soul itself, the possible action of matter on the soul and of the action of the soul upon matter are facts and phenomena which are scientifically unknown. They are unknown because they cannot be pictured to the mind, *i. e.*, united in a mental picture with one another or with physical facts. If by picturing the soul or the mind is intended that it cannot be pictured as occupying space and as affecting the bodily senses, *i. e.*, cannot be imagined as material substance, this is true; but if it is contended that the mind cannot be pictured as the mind finds itself in its own operations, then it is untrue, and that it is untrue is affirmed by Prof. Tyndall himself every time in this discourse he says I see, or know, or remember, or believe. If he means that he cannot picture the mind as acting, we reply he can picture the acting of the mind as truly as he can picture the acting of the body. If he attempts to picture what he means by force, whether galvanic or mechanical, he will find this as difficult as when he attempts to picture mental force. If he cannot picture mind as acting on matter, or matter acting on mind, no more can he picture matter acting on matter. If he says that he knows nothing about mind, and that therefore psychical existence and psychical action cannot be used to explain any phenomenon because this would be to explain the unknown by that which is more unknown, he refutes himself every time that the word *to know* escapes from his lips. The brilliant essay by Prof. Tyndall himself On the Scientific Uses of the Imagination and the many sagacious and brilliant remarks which he has made from time to time upon the processes and grounds of Induction are themselves decisive evidences that many phenomena in his own mind have been well considered by himself and causally connected. The entire Theory of Modern Science, in which he so much glories, and which in so many respects he so well understands and expounds so skilfully, is an exposition of the operations of an agent within that body, which for the sake of

scientific consistency he calls a machine. If this agent or force within is nothing more than an idealized abstraction, this abstraction discoursed most eloquently from the chair of the Midland Institute. Again: If we know nothing about the knowing process or the knowing agent, then what confidence have we in what it knows of matter? If physical science and its methods are to furnish bounds to what we know and to impose law as to how we are to know it, then we know something about the spiritual activity which we call knowledge and the agent which exercises its functions. To say that the only species of existence which this agent can know is matter and its laws, and that every kind of activity which we can explain must be explained by material relations, or the so-called methods of physical science, is to beg the question to begin with, but in the very terms in which we beg it we assume that that function which we call knowledge has supreme authority and gives law and authority to itself and the science which it creates.

But here Prof. Tyndall takes another step in advance. He graciously concedes to those who desire to do so the liberty to think and speak of the soul as the poetic rendering of peculiar phenomena when abstractly conceived, provided only that they will admit that in all these phenomena it obeys the law of necessity that rules in the world of matter. This, indeed, is the last point which he makes, and upon this he dwells at very great length. He introduces the discussion by saying: "Amid all our speculative uncertainty, there is one practical point as clear as the day—namely, that the brightness and the usefulness of life, as well as its darkness and disaster, depend to a great extent upon our own use of this miraculous organ," *i.e.*, the brain. This means, that whether we are spirit or no it is certain we are brain, and what we are and what we become depends upon the use or abuse of this organ. But does not this imply that we are free,—for if we are not free how can we be responsible? Here "we stand face to face with the final problem; it is this,—Are the brain and the moral and intellectual processes known to be associated with the brain * * * subjected to the laws which we find paramount in physical nature?" To this inquiry he gives the following as his answer, in a rambling series of remarks, which we shall seek to follow and condense as best we may.

First, he observes, that Fichte recoiled from the thought of necessity in a well-known volume which records the struggle between his head and his heart. His recoil was so violent that rather than subject man to nature he made nature subject to man, creating nature out of the free actings of the spirit.

But all men do not share in this recoil of Fichte. Even Bishop Butler teaches that, so far as human conduct is concerned, the theories of free will and necessity bring us to the same practical issue. But even free will cannot imply the production of events without antecedents. Free will must be consistent with reasons. And, on the other hand, the voice of this united assembly would say that I can lift my arm if I wish to do so. The wish then, or, if you please, the man is the decisive element. But what and whence is the wish or the man? At the starting of this question Prof. Tyndall falls back upon the axiomatic affirmation with which he began. "As stated at the beginning of this discourse, my physical and intellectual textures were woven for me, not by me. Processes in the conduct or regulation of which I had no share have made me what I am. Here surely, if anywhere, we are as clay in the hands of the potter." The age finds each man to be the product of all the ages before—it will make of us what the combined forces of all the present can make out of that past added to this present. Robert Owen's doctrine that man is the product of circumstances was correct if you count the past circumstances along with the present. Every court of justice makes allowances for hereditary tendency to insanity. An acute governor of one of the largest prisons in England informed Prof. Tyndall that he should divide all prisoners into three classes—the good, who ought not to have been convicted—the hopeful, who under more favourable training may be moulded to something good—and the hopeless, who might as well be "put compendiously under water," as tortured with punishment of any kind. The observations and testimony of such men with individuals are, however, of little significance compared with Darwin's speculations, which have at last convinced even "the clerical world" that "the progenitors of this assembly," when traced very far into the past, "could not be called human." These changes, to which each generation adds its slender contribution, are owing to what we in our ignorance are obliged to call "accidental variation," and secondly, to a law of "heredity in the passing of which our suffrages were not collected." That the process is one of amelioration is ascribed by Matthew Arnold to "a power not ourselves which works for righteousness," "when with characteristic felicity and precision he lifts the question into the free air of poetry, but not out of the atmosphere of truth." But does not this law of progress under hereditary influences give free sanction to crime by removing all exposure to punishment? Not in the least. Society says frankly to the unfortunate inheritor of irresistible proclivities to evil: We must imprison or hang you that we may give greater energy to

the tendencies against evil, if not in you, at least with other men, even though we accept with Darwin the doctrine of accidental variation as well as of fixing environment. "Practically, then, as Bishop Butler predicted, we act as the world acted when it supposed the evil deeds of its criminals to be the products of free will. We even continue to preach, for the preacher's words of enlightenment and courage and admonition enter into the list of forces employed by nature for man's amelioration," as the speaker himself remembers to have been helped by George Dawson thirty-two years ago, as he exhorted to industry and self-control "when he made himself the mouthpiece of Nature, which secures advance by the encouragement of what is best." Last of all, will not all religious or theological influences be enfeebled by this theory? will not society be given over to demoralization and crime? Not in the least, for even George Holyoake, avowed Atheist as he is, preaches against low views of life, and incites to the higher ends and aims of civilization and character. It is, however, a serious mistake to suppose that theologic belief has been a very potent element in working for man's amelioration. Very many fundamental differences of character "depend upon primary distinctions of character which religion does not remove." Faraday, whom he describes in a passage of elaborate eulogy, added since the address was originally written, though depending upon his Christian and even his Sandemanian tenets for his spiritual life and comfort and peace, was singularly like Charles Darwin, "who neither shared the theologic views nor the religious emotions which formed so dominant a factor in Faraday's life." "Facts rather than dogmas have been the ministers" of the power not ourselves working for righteousness, "hunger and thirst, heat and cold, pleasure and pain, sympathy, shame, pride, love, hate, terror, and awe;" and yet "it cannot be denied that the beliefs of religion, including the dogmas of theology and the freedom of the will, have had some effect in moulding the moral world." "Granted; but I do not think that this goes to the root of the matter. Are you quite sure that these beliefs and dogmas are primary and not derived—that they are not the products instead of being the creators of the moral nature?" In support of this view he refers to Carlyle, and quotes a familiar passage from one of Emerson's poems, both to the effect that religious faiths and rites are the products rather than the creative factors of man's moral nature. He ventures to ask: "Does the song of the herald angels, 'Glory to God in the Highest, and on earth peace, good-will towards men,' express the exaltation and the yearning of a human soul, or does it describe an optical—

acoustical fact—a visible host and an audible song?" "If the former, the exaltation and the yearning are man's imperishable possession." "If the latter, the belief in the entire transaction is wrecked by non-fulfilment."

This finishes the argument, if argument it may be called. The conclusion is summed up as already quoted: Thus, following the lead of physical science, we are brought without solution of continuity into the presence of problems which, as usually classified, lie entirely outside the domain of physics. To these problems thoughtful and penetrative minds are now applying those methods of research which in physical science have proved their truth by their fruit. There is on all hands a growing repugnance to invoke the supernatural in accounting for the phenomena of human life, and the thoughtful minds just referred to, finding no trace of evidence in favour of any other origin, are driven to seek *in the interaction of social forces the genesis and development of man's moral nature.*" The careful reader will observe in these concluding words the affirmation for the first time in any of Prof. Tyndall's writings, of the tenet that moral distinctions are the product of social agencies. That he must of necessity hold this opinion was clearly enough to be seen by any one who follows the logic of Atheistic Evolutionism, to which Prof. Tyndall professes that he has been led with so many other thoughtful minds by scientific necessity.

We have endeavoured to trace the successive steps by which Prof. Tyndall declares that he has been led to these conclusions. We have carefully stated his points, that we might candidly judge of the logical coherence and convincing force of the facts and analogies by which, "following the lead of physical science," he has been brought first to face these problems, and then to solve them in these appalling answers:—Negatively there is no spirit, no freedom, no God, and no immortality, and positively the scientific and practical explanation of the past and the promise of the future lie in a blind force working under the law of progress for man's amelioration, as the result of whose workings the idea of moral good is in due time developed, in whose name law is administered without justice. Morality as a social product creates religion which rules by relentless force without personal sympathy. As the result of the new solutions of these old problems, according to "those methods of research which in physical science have proved their truth by their fruit," we are told that "social duty will be raised to a higher level of significance, and the deepening sense of social duty will, it is to be hoped, lessen if not obliterate the strifes and heart-burnings which now beset and disfigure our social life."

The argument which we have analyzed consists of four divisions. Of these divisions the first recapitulates the history and evidence of the conservation and correlation of force in the domain of physics. In this argument Prof. Tyndall is at home. His statements are clear, his examples are pertinent, and the experiments are manifold. We will admit that the argument is decisive, without interposing a single one of the exceptions which we should reserve, were the case to be tried before another tribunal. The second division is that in which he argues that the animal body is a machine, which is controlled by those forces and only those forces, and obeys those laws and only those laws, which are found in the inorganic sphere. This argument seems to us obviously defective, in that it omits many of the phenomena which are most characteristic of the animal body, and transfers analogies from one physiological function to another, with an intellectual haste and audacity which are utterly foreign to the methods of physical science, or indeed of any science, whether pure or applied. The third division declares that all those phenomena commonly called psychical should be treated by the scientific man as utterly unknown—as incapable themselves of being explained by any other than material forces and laws, and of being stated in any other than figures of poetic ideality. This position he does not argue. He simply begs the conclusion, and not only this, but he dishonours science itself by this very assumption, because he dishonours the agent which is the creator of science, and by its own sovereignty is the lawgiver of science, imposing upon its own work the methods of procedure, and declaring the manifold services, Prof. Tyndall himself being witness, which theory, inquiry, imagination, and experiment have contributed towards its triumphs. Moreover he asserts that the soul though potent and sovereign in these creations, is nothing but an idealized abstraction; although when he forgets his theory, he himself gives fervent and eloquent testimony to the spiritual light and comfort and peace of his great teacher Faraday, and the simple and sturdy honour of "Mr. Charles Darwin, the Abraham of scientific men—a searcher as obedient to the command of truth as was the patriarch to the command of God." The fourth division consists of the rambling and somewhat incoherent argument, which we have endeavoured to condense, upon the higher themes of man's responsibility to himself, his fellow men, and to God. In all this part of the discourse there is not the slightest suggestion of the methods of induction or experiment, such as are pursued in physical science. There is not a single example of those analogies which open to the sagacious interpretations of scientific genius

glimpses of a brilliant speculative theory. The author gathers the scraps of his readings and the shreds of his reflections in literature and theology, and sets them forth with no force except such as startling paradoxes always obtain when they fall from lips as eloquent as those of this attractive speaker. All recognition of the methods of physical science seems to have departed from his memory. The four divisions of the argument are held together by the foregone conclusion of the author that the devotee of science may recognize nothing in the universe but matter and fate and evolution, and requires for the explanation of the existence and history of this universe neither intelligence nor goodness.

In the first of these divisions Prof. Tyndall writes as a *Physicist*. As a Physicist, he never fails to be clear, consistent, and eloquent, even when he is not convincing. In the second, he is a *Physiologist*. Here he is limited in his recognition of vital phenomena, and committed to the foregone conclusion that life can be explained by mechanism. In the third, he is a *Psychologist*. In this rôle, he is a sturdy materialist in his reasonings and a poetical abstractionist in his concessions. In the fourth division he is a *Moralist, Metaphysician*, and *Theologian*. As a Moralist he accepts the hard theory of Hobbes as made flexible by Darwin and Spencer. As a Metaphysician he is a fatalistic Evolutionist with a dash of imaginative optimism. As a Theologian he is a sentimental Atheist or an imaginative Agnostic. In each of these several capacities he dexterously shifts from one phase to the other of his sensitive many-sidedness of opinion and phraseology, according to the varying needs and aspects of his argument and his audience.

We have read many things from Prof. Tyndall, with sincere admiration for the sagacity of his insight, the skill of his expositions, and the splendour of his generalizations. We must confess that in the perusal of this address our admiration has passed into wonder and our wonder into astonishment. If this is science, then science has ceased to be scientific. No man has insisted more energetically than Prof. Tyndall upon the necessity of mathematical formulization to fix whatever laws are surmised, and of rigid experiment to test and confirm the most plausible of generalizations. In this address, he seems to us to have forgotten to exemplify the first article of his own philosophic creed and to have wholly failed to apply the tests of experimental verification.

As we have read the occasional addresses of Prof. Tyndall with unabated interest, and noticed that they have usually represented the results of the meditations of his summer

holidays, we have learned to conceive of them as the romantic essays of an imagination surcharged with the ferment of philosophical speculations and kindled to a midsummer excitement by the glow of his inward fervour. We have been more than once reminded of similar utterances of the philosophic Hamlet as he also mused upon Science and Man.—" I have of late foregone all custom of exercises and it goes so heavily with my disposition, that this goodly frame the earth, seems to me a sterile promontory, this most excellent canopy the air, look you, this brave overhanging firmament, this majestical roof fretted with golden fire, *why it appears no other thing to me, than a foul and pestilent congregation of vapours!* What a piece of work is man! how noble in reason! how exquisite in faculties! in form and moving, how express and admirable! in action how like an angel! in apprehension how like a god! the beauty of the world! the paragon of animals! *And yet, to me, what is this quintessence of dust?*"

In common with many others in this country we have not only admired Prof. Tyndall as a philosopher, but have been delighted with him as a kindly and courteous gentleman, and welcomed him as a friend. The friendly interest which we still retain for him only deepens our regret that he should have been misled so far as to mistake the brilliant analogies of a teeming imagination for the sober verities of scientific truth.

The CHAIRMAN.—I am sure all will unite in returning thanks, both to the author of the paper, and to Mr. Gorman who has so ably rendered it. Any remarks may now be offered.

Rev. Prebendary ROW.—I do not propose to discuss this paper at length, but I think I may say that we cannot be too much gratified when men like Professor Tyndall plainly speak out their sentiments. When their arguments are disguised in the metaphysics with which many Germans, and some Englishmen, such as Herbert Spencer, have rendered us familiar, the controversy is raised to a height considerably beyond the level of ordinary minds; but when they are brought down to the clear statements of Professor Tyndall much trouble is saved. If a great man of the last century—I allude to Dr. Johnson—could be present here to-day, there is little doubt but that he would have dealt with Professor Tyndall's theories in a very summary manner. He would have said: "Sir, you are talking gross nonsense." In the present case we have the great advantage of having these things clearly placed before us, and we find that the end and object of atheistic, pantheistic, and agnostic philosophy, is to reduce man to a machine mentally, morally, and spiritually. It is of great benefit to have these things thus stated plainly, because there is a certain faculty called common sense against which this philosophy is certain to be hopelessly dashed to pieces. Sir, we

are told that you and I have come here to-night because we cannot help it—that each one of us is simply compelled to do so by an irresistible necessity. That is a statement which not a single one of us can be induced to believe by any amount of human logic. I will give you an illustration of this. Some years ago I gave a lecture in Bradlaugh's Hall on the subject of human responsibility. We have on such occasions a discussion. Well, an atheist got up to answer me. He proceeded during about ten minutes to argue that he had come there and mounted that platform under an overwhelming necessity, which he could not help; that I in like manner was under an overwhelming necessity to go there and lecture, and that the audience had gone there under similar circumstances. Now I found that there was no occasion to expend more than five or six sentences in answering him, because the whole of the auditory turned round and laughed in his face. I am not quite sure that it would not be judicious in such cases to follow the general principle which the late Lord Melbourne laid down: whatever his defects, he was certainly a very shrewd, worldly-wise man. When an objectionable or stupid proposal was started, he was in the habit of saying: "Cannot you leave the thing alone?" I think we might almost say the same with regard to Messrs. Huxley, Tyndall, and others, and follow this good advice, and leave these men to commit moral and intellectual suicide; for that is really what it comes to. There is not a single sentence which Professor Tyndall has uttered in the speech here referred to which does not absolutely contradict the principles he is laying down. Let us take the passage which is given in this paper, on page 93, and upon which he dwells at great length. "Amid all our speculative uncertainty, there is one practical point as clear as the day, namely, that the brightness and the usefulness of life, as well as its darkness and disaster, depend, to a great extent, *upon our own use* of this miraculous organ," *i.e.* the brain. It seems, then, according to Professor Tyndal, that there is a *we* who use the brain. Yet, according to the same authority the brain is myself. It is therefore absurd on his principles to talk of the use we make of the brain. If we are nothing but a chain of conscious impressions linked together by an irresistible necessity, we must go on grinding out results for ever, which we cannot help grinding; but in asking us to accept such a theory he invites us to part company with our consciousness and our common sense. Are we to believe that all the activities in the city of London on this very day are nothing but a number of series of inevitable necessities? It is impossible to believe this by any amount of logic he can adduce in support of such a proposition. The great danger to be encountered is this. Professor Tyndall has a great scientific reputation, but here he is dealing with questions he has never studied any more than I have studied the special scientific questions with which he deals. He proceeds to utter before promiscuous auditories a set of oracles on questions which he has never studied. The auditories whom he addresses, for the most part of semi-educated people who go to hear him in consequence of his high character in matters of physical science, are apt to forget that

he is as ignorant as they are on most points of mental and moral science. They accept him as a great authority, and thus a great deal of nonsense is swallowed by a large number of people as scientific truth. I don't see how it is possible to meet him in this respect, except by sending a body of lecturers after him. For my own part, I think great advantage might be derived if a set of caustic tracts were published, taking up these questions. The only way of dealing with these matters is to appeal to the hard facts of every-day life ; if this were done, I say that, whatever powers of reasoning on logic or science Professor Tyndall might bring to bear upon this question, he would commit a moral and intellectual suicide in attempting to prove that he himself is simply impelled by overwhelming necessity to contradict the great facts of consciousness (cheers).

Mr. D. HOWARD.—I have heard this paper with a rather special interest, because the great fact of its being written by a man, and a very able man, living in the full freedom of American thought, which some of us may think verges on licence, gives it a special interest. The accusation might be brought against most of us that we are too fond of our old ways, and not prepared for the new truths which these preachers, of what I suppose they would consider a new revelation, would give us. It is perfectly true that most of us do not desire a new revelation, but would rather say that the old is the better ; but if there could be a free unbiassed field for anything quite new, I think you would find it on the other side of the Atlantic, where there is no prejudice in favour of the old, but, if anything, an over-prejudice in favour of the new. This, I think, does give a special value to the full, able criticism which we have here of Professor Tyndall's paper. To find how thoroughly his novelties are no novelties at all to able thinkers on the other side of the Atlantic, to find that there is nothing that can turn a clear head living amidst all the activity and novelty of American thought, is a very satisfactory thing, and one well worthy our attention in dealing with this question. I must say that I do most fully agree with the reply made so ably by Mr. Row, that it is better to leave Prof. Tyndall to himself. It is undoubtedly one of the painful facts of the present time, that there should be so much of atheistical thought amongst us, but yet it is not new. It is the same old story ever since thinking began. There is one thing which is most astonishing, and that is, how a man of Prof. Tyndall's abilities, and with all the premises before him, can come to such utterly false conclusions. There is only one interpretation of this that occurs to my mind, and that is fatal to Prof. Tyndall's whole theory. It is that he will not see. One of the most extraordinary things, even in material science, is the remarkable power of the will to abuse the judgment. A man cannot and will not believe on the clearest evidence what the doctor tells him about his own health. He will not believe the evidence of his own senses as to some great catastrophe. He will not believe that ruin has come upon him. What does this show ? If thinking is a mere function of the brain, do we find that phenomena are obstinate, do we find that our balances cannot and will not turn for no reason whatever ? I never

found it so in my limited experience. We find one thing, namely, that material forces act invariably, we find that the mind will not act as it ought to do. The unbiassed man sees a thing perfectly clearly which the biassed cannot and will not see; and this shows that there is something more powerful than the function of the brain. The immaterial, undefined, unscientific will acts, after all, more powerfully than the material brain, and I can only say that the obstinate refusal of some of these great scientists to see how utterly unscientific they are when engaged upon theological questions, is one of the most curious proofs that there is a will, and that that will is utterly contrary to the mere physical laws, because it has an utter want of that reason which is found in the material world.

Mr. J. Enmore Jones.—After reading this paper yesterday I thought, Why is it that Prof. Tyndall has taken the views he has expressed? I knew that he was reared at the feet of Robert Owen. I knew he was chemical tutor in Owen's educational establishment in Hampshire. What a lad gets into his brain when a lad, often continues right through his life. I therefore feel that his theological views having been saturated, as it were, into his very life's core by Robert Owen, who was, you know, an atheist for a considerable time; that may have influenced him in his thinkings and his doings. At the same time I cannot find fault with Tyndall, because he is a splendid examiner of the materials which the Creator has created. Tyndall is doing a mighty good, and if we will attend to what he is discovering, I have no doubt but that we shall perceive he is laying a foundation which will be of great use to the Church. In future time this will be seen. I do not see that the paper proves anything.

Rev. C. L. Engström.—I should like to say a few words upon one point. I think that Prof. Tyndall has warred against good sense. Suppose I held his views and were arguing with one who held the views I really hold, I should be bound to say, "You who believe that the world has not existed more than a few thousand years, must regard the instincts which are in yourself as implanted from without; but I, who hold the world to have existed for endless years, must see that every universal instinct in the human heart or mind must have grown up from an agreement with the phenomena surrounding it; and therefore, whenever I find such a universal instinct as a belief in God or a belief in free will, I, holding the development theory, must regard this as not implanted by some being for injurious purposes, but as the result of my nature having been brought, during millions of years, into exact accordance with surrounding facts. And therefore, every universal instinct, including belief in God and belief in free will, is, if the development theory be carried to its fullest extent, shown to be absolutely and necessarily true."

Rev. J. Fisher, D.D.—I regard this as a very important paper. It has been said that Dr. Porter has proved nothing; but I hold that he has proved a great deal. I think that the secret with regard to Prof. Tyndall's launching out into various branches of philosophy, metaphysics, and theology, and making such sad blunders, is that it arises from what is

brought out in the second page. The paper eulogises both Tyndall and Huxley, one as physicist and the other as a physiologist. It cannot be too highly commended in this respect. They are quite at home in their proper departments. Prof. Tyndall is clear in physics, but in no other thing which he throws out. Here is what the paper says: They have "the honour of having demonstrated, each in his own way, that a discipline of classical culture, or of early literary studies, is by no means essential to the training of an effective popular speaker or lecturer upon the severest topics of science." One has embraced physics and the other physiology, and this is the reason why they go so far astray upon these points. Had they studied in Oxford or Cambridge, or in any other of our universities, they would have had both more modesty with regard to those who labour in other departments of literature, and would not have made so many mistakes in their own. Had they studied logic under Whately, or in some other school where they would have been trained in a similar way, they would have made better definitions, they would have used more precise language, and they would have reasoned from true premises, and would have drawn full and true conclusions. But their definitions are all wrong. We have been told (page 90) that we should protest. I think we may join in the protest at page 82, where a definition is given of the human body as a machine. A definition should include the whole. A machine is not an organism. An organism has life, and grows. The definition, therefore, is wrong, and the premises are wrong. How, then, can they bring forth truth from such premises and such definitions? I think it is the early training of these men that has been defective. They have gone into matters they have never studied. They have literature and theology and wrapped them round their science, thinking that all must be science, all must be physics, all must be physiology.

Mr. E. R. Gayer.—There is just one sentence in this very able paper to which I must take objection. It is on the top of page 93: "If this agent or force within is nothing more than an idealized abstraction, this abstraction discoursed most eloquently from the chair of the Midland Institute on the 1st of October." I think the writer has made a mistake in introducing this sentence. This, it appears to me, is no answer to Prof. Tyndall's position. It is precisely the same, to go back to Dr. Johnson, as the answer Dr. Johnson thought he had given to Berkeley, when he told him if he only went and knocked his head against the wall he would soon perceive whether it was a solid or not. That was perfectly absurd, and showed that Dr. Johnson did not understand the Berkeleian theory. This, I say, is equally absurd. The true answer would be, "If you say that mind and soul are mere abstractions, how can you show that these batteries and forces, and different things of the realistic properties of which you speak, are not abstractions also"?*

* Mr. Gayer, in his speech, added :—"The only other objection that occurs to me has reference to two words on page 87, where Prof. Porter says his body

Rev. Mr. GORMAN.—I rise with some hesitation and diffidence, in the absence of the writer of this paper, to say a few words on the principal question, which has been put before us with so much skill and fairness. The last speaker, it seems to me, has not quite clearly caught the precise point of Professor Porter's reasoning. The argument is plainly a *reductio ad absurdum*, exactly similar in its purport to what I must regard as the very conclusive answer of Dr. Johnson, to which reference has been made. No one is bound even to try to understand flimsy and unintelligible hypotheses such as that of Bishop Berkeley, or any other form of visionary idealism which manifestly contradicts the plainest dictates of common sense. To this principle of common sense, against all forms of unreasonable speculation, every one has the right of appeal as the last resort. The principle which Professor Porter evidently had in his mind was the seemingly simple, but really most profound saying of Bishop Butler—"abstractions can *do* nothing." And this is, in fact, the principle which lies at the root of the whole discussion. To any mind that has firmly grasped it, the exposure of Professor Tyndall's fallacies becomes a very easy matter. His speculations, for the most part, as soon as he leaves his own peculiar line of study, are nothing but abstractions—the most empty of abstractions, woven together dexterously, under the influence of a fervid imagination. They have nothing to do either with a rational psychology or with philosophy in general, much less with the sacred mysteries which lie within the sphere and dominion of theology, the queen and mistress of all the sciences. It cannot be too often repeated in commenting on the eloquent and highly imaginative lucubrations of that class of physicists of which Professor Tyndall is a type, that from the point of view of mere physical science, it is, to say the least, unbecoming, if it be not an impertinence in them, to speak magisterially upon questions which lie entirely outside the field of their special studies. If it seem good to them to ascend to the higher level of intellectual and spiritual thought, they are bound to assume the truth of those rational first principles and axioms which all wise men, in ancient and modern times, have agreed to accept as starting points in the study of the deepest problems of nature and life. As soon as they do this there will be some hope of our coming to an understanding with them. Our controversies will then have a chance of ceasing to be what, for the most part, they have

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grows by 'cellular accession from living food.' By the way, I am not quite sure whether it is Prof. Tyndall or Dr. Porter who says this; but whoever it is I cannot understand it. Unless a man live solely on oysters or cheese, I cannot understand how this is to be explained." To this Dr. Porter replies :—"To relieve my critic from the imagined necessity of being driven to the necessity of living solely 'on oysters and cheese,' by the logic of his interpretation of the phrase 'cellular accession from living food,' I would say that by *living food* I meant food, or pabulum, which by the action of a living agent has been prepared to be assimilated in 'cellular accession,' and in that sense made *living*."

hitherto been, mere logomachies. As long as certain physicists choose to remain on the low naturalistic level which they have so persistently occupied in the past, we must say to them that any rational notion of the very existence of a purely intellectual and supernatural order of things, must from the nature of the case remain, for them, a sheer impossibility. Controversy, under such conditions, is little else than wildly beating the air. I acknowledge with all due respect the high value of the definite formal teachings by men of science, who by their labours and achievements within their own line of study have proved themselves entitled to confidence. I am willing to use what powers and opportunities I possess to learn from them what they have to teach of new and true. But the opinions of these men outside their own sphere have no special value. That some distinguished physicists should show deep and bitter hostility to what all Christians regard as most sacred, is as deplorable as it is astonishing. But it would not be candid on my part to suppress the strong conviction I have long entertained, that many leaders in physical science who are manifestly, whether they know it or not, the ardent devotees of principles which necessarily lead to mere naturalistic atheism, have been more or less driven into this strange frame of mind by the pseudo-theology which for so many centuries to the present hour has usurped the name and place of Christian truth. I do not hesitate to assert that the clergy and other religious teachers have much to answer for in this respect.

PRESIDENT NOAH PORTER'S REPLY.

I BEG leave to express my thanks to the gentlemen who have commented so kindly upon my critique of Professor Tyndall's address at Birmingham, and to ask their attention to a brief explanation of what I did, and what I did not, propose to accomplish in writing it.

I did not propose to discuss any matter which was not furnished by the discourse itself, least of all to write an exhaustive disquisition upon the Professor's philosophical or theological theories, or the mischievous tendencies of either, but to confine myself to the positions taken in the discourse itself, and to subject its statements of fact, its suggested analogies, and its logic to a close, though courteous criticism. The methods of reaching the truths of physical science ought by this time to be capable of definite statement, and of decisive application to the important questions which are at present so earnestly discussed. Professor Tyndall has himself given to these methods special

and earnest attention, and he would be the last man to complain when his own logic and inferences are tested by them.

It seems to me also that argument and criticism should be more largely used than they have been by Christian theologians and philosophers in their well-meant and much-needed efforts to arrest the progress of the Atheistic ways of thinking, which at the present day are at once so plausible and so superficial, so arrogant and yet so unscientific. I am confident that in my own country, the most effectual method to oppose these tendencies is to subject them to a candid, yet thorough scrutiny, to concede every position and somewhat more than a truly scientific thinker would venture to maintain to assert, and to expose every failure of experiment or logic with a fearless spirit. Simple protestations or denunciations, however earnest and fervent, will avail little against those solid squares of self-complacent agnosticism and denial, into which so many teachers of science have succeeded in gathering their disciples. But sharp and penetrating arguments are powerful agents when uttered in a candid and truth-loving spirit.

I think we have some advantage in this country, in that to a considerable extent thus far our higher institutions of education and research have recognised the scientific study of nature as a means of culture equally important with the study of the humanities, and have aimed to train their pupils in both directions after the methods which are appropriate to each. Theologians and scientists are for this reason forced to consort with one another on an equal footing, and often in familiar relationships, except so far as new theories and methods of education have separated them by the establishment of special schools and colleges that are limited to mathematical and physical culture. Notwithstanding these advantages, we are beginning to experience serious evils from strong tendencies to intellectual separation and alienation on the part of both theologians and scientists. So long as both parties are forced to plead the cause of truth, whether it be theological or scientific, at a common tribunal, so long shall we be able to teach and to learn from one another.

I take great pleasure in saying that Professor Tyndall is a personal friend whom I have had the pleasure of meeting as the guest of our college, and that he has acknowledged in a most cordial manner the courtesy as well as the severity of my criticisms. While as a scientist, in some of his moods, he moves me to wonder, as a poet and a man he seems to me not infrequently to utter the sentiments of one who ought not to be far from the kingdom of God. The pupil who could so beautifully describe, and so fervently respond to the child-like prayer of his great master Faraday has the stuff in him into which may yet be kindled a rational and fervent faith upon the altar and within the sanctuary of true science.

APPENDIX.

THE *New York World*, of December 4th, 1878, in a leading article upon President Porter's paper, makes the following remarks [ED.]:—

"A little more than a year ago Professor Tyndall delivered an address before the Birmingham and Midland Institute, of which he was president, and in it—according to his custom of conveying to his audiences not only facts, but the deductions therefrom which seem to him legitimate—he presented the conclusions to which he had been led through his study of nature. To this address Dr. Noah Porter, the distinguished president of Yale College, replied on Monday last in the Victoria Institute, in London, in a paper which will be found elsewhere in to-day's *World*. Dr. Porter touches the most sensitive part of scientific men who speak beyond absolute knowledge, and in doing so lashes over the Professor's shoulders many a writer who sees in matter promises and potencies as fair as those of which Mr. Tyndall caught an apocalyptic vision in his celebrated Belfast address. From the doctrine of the correlation of the physical forces, Professor Tyndall had deduced the conclusion that the order and energy of the universe were inherent, and not imposed from without—'the expression of fixed law, and not of arbitrary will'—so that all which exists, whether spiritual, mental, moral, or material, is subject simply to mechanical laws. The human body, according to the views of Professor Tyndall, is a mere machine, and therefore cannot generate force. This position is opposed by Dr. Porter, on the ground that within the human body the nerves perform work additional to any that is implied in either the generation or transformation of force, and that that work is seen in their additional function of directing force to the accomplishment of certain ends. In other words, he brings his argument to bear directly on the question whether, when the human body is considered as an entirety, something is not found acting within it in a way which shows that it is not simply a machine, but a living body, some of whose functions must lead us to believe that it is in part governed by something which is not matter, nor belongs in the category of the correlated forces, nor is a resultant of them all or of any of them—in short, whether mind and matter do not exist as separate entities, and the former does not act upon the latter within the compages of our flesh. Besides this, if, as Professor Tyndall is fond of insisting, strict science is now impossible unless the relations between phenomena can be expressed quantitatively and in numbers, he who holds that the body is simply a machine is bound to show that its laws can be expressed and formulated mathematically—a position which no physiologist now dreams of attempting to maintain, since, as Du Bois Raymond said six

years ago, we are still 'hopelessly in the dark' in regard to many if not most physiological processes.

"The points thus made against Professor Tyndall are, therefore, that by his own definition of science there is no science of the intricate workings within the body, and that he has drawn conclusions in regard to man which are not justified by the present state of our knowledge. By failing to take into consideration the undoubted power of directing force which resides in the nerves, he has also avoided the really difficult and much disputed question concerning which materialists are at variance with men who hold that the capability of directing the muscles to certain ends, which is so obvious in man, does not reside in the matter of which the muscles are made, or that the nerves are mere 'valve openers' to supply the muscles with force. The statement that emotions like fear and terror are caused simply by the physical impact of light coming from fearful objects upon the retina, is, in Dr. Porter's view, but an assumption, and in joining issue with Professor Tyndall, he holds—justly as it seems to us—that emotions arise not from external objects, but from the mind of the man who contemplates them. Still further, the mind may contemplate itself within its own order, and must therefore be conceived of as existing as really as anything, the image of which can impress it through the eyes.

"Men of science are certainly not to have the whole round of man inclosed within the boundaries of physics and physiology without bold opposition on the part of people who believe that metaphysics are not sheer moonshine, and outside of metaphysics they have of late received severe blows from men who fight merely with the weapons afforded them by logic. Whatever may be thought of the ultimate merits of the case on other grounds than those of logic, it seems that at present Professor Tyndall has decidedly the worst of the argument."