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JOURNAL OF
THE TRANSACTIONS
OF
The Victoria Institute,
OR
Philosophical Society of Great Britain.

EDITED BY THE HONORARY SECRETARY,
CAPTAIN FRANCIS W. H. PETRIE, F.G.S., &c.

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Society, not confined to London, nor to England, for our members are doing good earnest work in our Colonies, in the United States of America, and in foreign countries in different parts of the world. We have proceeded all through with our object the *Major Dei Gloria*, and with our text, that which cannot be repeated too often,—namely, that between the Scriptures rightly interpreted, and the facts of science rightly understood and fairly weighed, there can be no possible discrepancy; that if there be any apparent discrepancy, it arises either from the Scriptures being misinterpreted, or the scientific conclusions being improperly drawn. Our President is one of those scientific men who are able to grasp this great truth—to hold the belief that there may be two books written by the same hand—the Book of God and the Book of Nature, the latter written in one language and the former in another, but the truths they convey one and the same, as proceeding from one and the same Author. This text we have always had before us, and the result is to be seen in the present condition of the Institute. We return you our most sincere thanks.

The PRESIDENT then delivered the following Address :—

ON the present anniversary, which is the conclusion of my first year of office as President of this Institute, I propose to address a few words to you bearing on the object of the Institute, and on the spirit in which, as I conceive, that object is best carried out.

The highest aim of physical science is, as far as may be possible, to refer observed phenomena to their proximate causes. I by no means say that this is the immediate, or even necessarily the ultimate, object of every physical investigation. Sometimes our object is to investigate facts, or to co-ordinate known facts, and endeavour to discover empirical laws. These are useful as far as they go, and *may* ultimately lead to the formation of theories which in the end so stand the test of what I may call cross-examination by Nature, that we become impressed with the conviction of their truth. Sometimes our object is the determination of numerical constants, with a view, it may be, to the practical application of science to the wants of life.

To illustrate what I am saying, allow me to refer to a very familiar example. From the earliest ages men must have observed the heavenly bodies. The great bulk of those brilliant points with which at night the sky is spangled when clouds permit of their being seen, retain the same relative positions night after night and year after year. But a few among them are seen to change their places relatively to the rest and to one another. The fact of this change is embodied in the very name, planet, by which these bodies are desig-

nated. I shall say nothing here about the establishment of the Copernican system: I shall assume that as known and admitted. The careful observations of astronomers on the apparent places, from time to time, of these wandering bodies among the fixed stars supplied us, in the first instance, with a wide basis of isolated facts. After a vast amount of labour, Kepler at last succeeded in discovering the three famous laws which go by his name. Here, then, we have the second stage; the vast assemblage of isolated facts are co-ordinated, and embraced in a few simple laws. As yet, however, we cannot say that the idea of causation has entered in. But now Newton arises, and shows that the very same property of matter which causes an apple to fall to the earth, which causes our own bodies to press on the earth on which we stand, suffices to account for those laws which Kepler discovered,—nay, more, those laws themselves are only very approximately true; and, when we consider the places of the planets, at times separated by a considerable interval, we are obliged to suppose that the elements of their orbits have slowly undergone slight changes. But the simple law of universal gravitation, combined, of course, with the laws of motion, not only leads to Kepler's laws as a very close approximation to the actual motions, but also accounts for those slight changes which have just been mentioned as necessary to make Kepler's laws fit observation exactly. We are inevitably led to regard the attraction of gravitation as the *cause* which keeps the planets in their orbits.

But it may be said, what is the difference in the two cases? Is not the law of gravitation merely a simpler mode of expressing the observed facts of the planetary motions just like the somewhat less simple laws of Kepler? What right have we to introduce the idea of causation in the one case more than in the other?

The answer to this appears to be that in the one case, that of Kepler's laws, supposing them to be true, we have merely a statement of what, on that supposition, would be a fact regarding the motions of the planets, whereas in the other case the observed motions are referred to a property of matter of the operation of which in other and perfectly different phenomena we have independent evidence.

I have purposely omitted to mention the important difference between the two cases, which lies in the circumstance that Kepler's laws require correction to make them applicable to long intervals of time, whereas the law of gravitation shows no sign of failure; because, even if the former had been perfectly exact, however long the interval of time to which

they were applied, I doubt if they would have carried with them the idea of causation.

To take another simple illustration, let us think of the propulsion of a bullet in an air-gun. We speak of the motion of the bullet as being *caused* by the elasticity of the compressed air. And the idea of causation comes in because we refer this particular instance of motion to a property of gas, of the existence and operation of which we have evidence in perfectly independent phenomena.

It is thus that in scientific investigation we endeavour to ascend from observed phenomena to their proximate causes; but, when we have arrived at these, the question presents itself, can we in a similar manner regard these causes in turn as themselves the consequences of some cause stretching still further back in the chain of causation? If the motion of the bullet in an air-gun be caused by the elasticity of the compressed air, can we account for the elasticity of a gas? If the retention of the planets in their orbits be due to the attraction of gravitation, can we explain how it is that two material bodies should attract one another across the intervening space?

Till a time well on in the present century, we could only take the elasticity of gases as a fact, and deduce the consequences which flow from it. But the researches of Joule and Clausius, and Maxwell and Crookes, and others, have accumulated so much evidence in favour of the general truth of the kinetic theory of gases, that we are now disposed not to rest in the elasticity of gases as an ultimate property beyond which we cannot go, but to regard it as itself a consequence of the molecular constitution of bodies, and of the motions and mutual collisions of the ultimate molecules of a gas. Respecting the attraction of gravitation we have not at present made a similar advance. Speculations, indeed, have not been wanting on the part of those who have endeavoured to account for it. But none of these so fits into the known phenomena of Nature as to carry with it a conviction of its truth. Yet there is one indication that though we cannot at present explain the cause of gravitation, yet it *may* be explicable by what are called second causes. The mass of a body is measured by its inertia; and, though we commonly think of a body of large mass as being heavy, and though we compare the masses of two bodies most easily and accurately through the intervention of weight, yet the idea of mass may be acquired, and means might easily be suggested by which the ratio of the masses of two bodies might be experimentally determined, without having recourse to gravi-

tation at all. Now, according to the law of gravitation, the force with which a given body attracts another at a given distance is strictly proportional to the mass of the latter. If we suppose the attracting body to be the earth, and the attracted bodies to be in one case a brass weight, and in the other a piece of marble, it follows that if they make equilibrium when placed in the pans of a true balance—I make abstraction of the effect of the buoyancy of the air—their masses are strictly equal, and, accordingly, that weight is a true measure of mass. But there is no reason *à priori*, so far as with our present knowledge we can see, why this should be so. We know that if the bodies in the scale-pans were formed, one of brass and the other of iron, and there were a magnet concealed under the table on which the operator placed his balance, the masses would not be equal when there was equilibrium. But that the law is true, and that, accordingly, weight is a true measure of mass, follows with the highest probability from the third of Kepler's laws, and was proved experimentally by Newton, by experiments with pendulums. Newton's experiment has since been repeated by Bessel, with all the refinements of modern appliances, with the result that, so far as the most exact experiments enable us to decide, the law is strictly true. This is perhaps the only instance, as Sir William Thomson remarked to me in conversation, in which there is an exact agreement between two quantities, and yet we are unable to give any reason why they should agree. That such is the case, holds out some prospect of scientific men being able some day to explain gravitation itself; that is, to explain it as the result of some still higher law.

Such is the nature of our progress in scientific investigation. We collect facts; we endeavour to co-ordinate them and ascertain the laws which bind them together; we endeavour to refer these laws to their proximate causes, and to proceed step by step upwards in the chain of causation. Presently we arrive at a stage at which, even after long trial, we do not see our way to going further. Yet we are not able to demonstrate that further progress in the same direction,—that is, along the chain of secondary causation,—is impossible. Science conducts us to a void which she cannot fill.

It is on other grounds that we are led to believe in a Being who is the Author of Nature. A conclusion so important to mankind in general is not left to be established as the result of investigations which few have the leisure and ability to carry out. Doubtless, where it is accepted, the study of

science enlarges our ideas respecting the greatness of that Being, and tends to keep in check notions of too anthropomorphic a character which we might form concerning Him. Still, the subject-matter of scientific study is not, at least directly, theistic; and there have not been wanting a few instances of eminent scientists who not merely rejected Christianity, but apparently did not even believe in the being of a God.

The religious man, on the other hand, who knows little or nothing of science, is in the habit of contemplating the order of Nature not merely as the work of God, but in very great measure as his *direct* work. Of course, the concerns of everyday life present innumerable instances of the sequence of cause and effect; and few are now so ignorant of the very elements of science as not to allow that the sequence of day and night, of summer and winter, is proximately due to the rotation of the earth about its axis, and the oblique position of that axis with reference to the plane of the earth's orbit. But when we get beyond the region of what is familiarly known, still more, when we get outside the limits of well-ascertained scientific conclusions, and enter a region which is still debatable ground, where men of science are attempting to push forwards, and are framing hypotheses with a view to the ultimate establishment of a theory in case those hypotheses should stand the test of thorough examination; when, I say, we get into this region, a man such as I have supposed may feel as if the scientists who were attempting to explore it were treading on holy ground; he may mentally charge them with irreverence; perhaps he may openly speak of them in a manner which implies that he attributes to them an intention to oppose revealed religion.

To take a particular example. I can imagine that a man such as I have supposed may have always been in the habit of regarding each one of the thousands and tens of thousands of species into which naturalists have divided the animal and vegetable kingdoms as having originated in an independent creative act; that the supposition may have become entwined among his religious beliefs. Such a man would be apprehensive of any attempt to introduce second causes in explanation of the observed fact of the great multiplicity of species.

Akin to the feeling which I have attempted to describe is another, against which we must be on our guard. The religious man is strongly impressed with the truth of certain things which lie outside the discoveries of reason or the investigations of science, and which bear on the whole conduct of his life here, and on his hopes regarding a life hereafter. He

believes these truths to be divine, and, accordingly, that no legitimate deduction of human reason is liable to come in conflict with them. But the precise mode in which a conviction of the truth of these things was arrived at depends, to a considerable extent, on each man's idiosyncrasy. His natural bent of mind, his early training, his later associations, have all a good deal to do with it. Divine truth is one thing; our own apprehension of it, and the steps by which in our own minds it has been arrived at, are another. These are liable to human imperfection, and we may not attribute to them the infallibility which belongs to that which is divine. We are not to confound the scaffolding with the building; nor, if we are anxious for the safety of the edifice, need we therefore fear that, if the scaffolding were tampered with, the whole might come tumbling down, nor should we regard as a dynamiter a fellow-workman who would remove a pole or two.

That truth must be self-consistent, come from whence it may, is an axiom which nobody would dispute; the only question can be, What is truth? Now, there are truths which we know by intuition, such as the axioms of mathematics; and there are others, again, which, though we do not perceive them by intuition, yet demonstrably follow from what we do so perceive; such, for example, are the propositions of mathematics. Then there are other conclusions which we accept as the result of the application of our reason to a study of Nature. Here the evidence is not demonstrative, and the conclusion may have all degrees of support, from such overwhelming evidence as that on which we accept universal gravitation, to what hardly raises the conclusion above the rank of a conjecture. On the other hand, there are conclusions which we accept on totally different grounds, namely, because we think that they have been revealed. Why we accept a revelation at all, is a very wide question which I cannot here enter into. That we do accept it is implied in the membership of this Institute. But, granting the acceptance of revelation, the question remains, What and how much is involved in revelation? That is a question respecting which there are differences of opinion among those who frankly accept a revelation, and with it the supernatural.

Now, the primary object of the establishment of the Victoria Institute was to examine questions as to which there was a *primâ facie* appearance of conflict between the conclusions of science and the teachings of revelation. In order that such examination may be usefully carried out, it must be undertaken in a thoroughly impartial spirit, with a readiness honestly to follow truth

wherever it may lead. It will not do to assume that the immunity from error which belongs to the divine belongs also to our apprehension of what constitutes the divine, and that therefore, if a conflict there be, the error must be on the side of science. It is true that many statements which are really little more than scientific conjectures are represented, at least by those who take their science at second or third hand, as if they were the well-established conclusions of science. But it is true also that the progress of science has corrected the assertions of a crude theology. We are disposed nowadays to smile at the idea of any opposition between the Copernican system and the teaching of revelation; but we need not go back to the days of the persecution of Galileo to find an example of a well-supported scientific conclusion having met with a similar opposition, issuing in a similar result.

To gauge thoroughly the amount of evidence on which an asserted scientific conclusion rests, one ought to be well acquainted with the branch of science to which it relates. Still one can get a fair general notion of the evidence by an amount of reading which is by no means prohibitive, or by conversing with those who have made that branch a special study. It may be that the impression thus left on the mind will be that the votaries of science, carried away by an excess of zeal in the attempt to discover the causes of natural phenomena, have really, though honestly; over-estimated the evidence. It may be, on the other hand, that the inquirer will perceive the evidence to be weighty and substantial, in which case it behoves him to reconsider the supposition with which he started, that the conclusion was opposed to the teaching of revelation.

One should always bear in mind the great responsibility one incurs, and the mischief one may do, by representing as bound up with revelation that which really forms no part of it. Being by hypothesis no part of it, but only erroneously tacked on to it, it may be false; and being false, it may be in opposition to a conclusion supported by the weightiest evidence, it matters not of what kind, but say scientific. What then, will be the effect of the error committed by the upholder of revelation? The educated man of science may see through the fallacy; but will it not put a weapon into the hands of the infidel lecturer wherewith to attack revealed religion?

But whether we can agree or cannot agree with the conclusions at which the scientific investigator may have arrived, let us, above all things, beware of imputing evil motives to him; of charging him with adopting his conclusions for the purpose of opposing what is revealed. Scientific investigation is

eminently truthful. The investigator may be wrong, but it does not follow that he is other than truth-loving. If on some subjects which we deem of the highest importance he does not agree with us,—and yet it may be he agrees with us more than we suppose,—let us, remembering our own imperfections, both of understanding and of practice, bear in mind that caution of the Apostle: “Who art thou that judgest another man’s servant? To his own master he standeth or falleth.”

Mr. SAMUEL SMITH, M.P.—I have now to discharge the very pleasant duty of moving a vote of thanks to our very able President for the interesting address he has delivered to us this evening, and also for the services he has rendered to this Institute during the past year. I perform this task with the greater pleasure, because I am sure Professor Stokes, by filling the post he occupies, confers an honour on this Society, and he very fitly represents in his own person that union between Religion and Science which was exemplified in his great predecessor at Cambridge, Sir Isaac Newton. It is, of course, known to most of you that Professor Stokes occupies the chair which was once filled by Sir Isaac Newton, and consequently there is something peculiarly appropriate in his being here to certify to us that there is nothing unreasonable in the combination of faith in science and faith in religion. I have not been able of late to follow the proceedings of the Institute with the same attention I have given to them in former years. A great variety of occupations has not allowed me time to watch what has been going on here with the same care as in an earlier period. For several years, however, I have found great pleasure in reading the able papers presented to this Institute, and I was glad to perceive that it was doing a very valuable work. We had, as you will remember, some years ago, a very violent and aggressive type of speculative scientific infidelity brought before the British public. Those who remember some fifteen or twenty years ago, will bear me out in saying that at that time the attitude of scientific speculation was more violently opposed to revelation. There has been a very marked change passing over scientific speculation of late years. Whether that is owing in part to the work of this Society I will not say; but, as to the fact, every one present can bear witness to its truth. We have of late years had not a few of the most eminent of our men of science who have boldly avowed their faith in revelation. This was not the case fifteen or twenty years ago. At that time the cause of religion seemed to go by default in scientific assemblies. That is not so now. We now find men who are ready in our scientific assemblies to defend their faith in revealed religion without weakening their hold on science. This is a thing for which we ought to be thankful, as it marks some progress in an age which presents many features calculated to produce anxiety and sadness. We must acknowledge the truth of the closing remarks in the paper just read, that the defenders of Christianity have now abandoned some of their untenable positions. The somewhat

cramped and limited views of Divine Truth held by our forefathers have received a certain degree of widening and broadening, but that is only another way of saying that the Bible is a book so written, that it was intended to suit all ages ; for the infancy of mankind as well as its maturity ; that it was meant to be read in non-scientific epochs and to suit non-scientific minds. The cosmogony of the Old Testament was addressed to the infancy of the world. If it had been written only for scientific minds it would have been unintelligible to the rest of the human race for thousands of years ; and therefore, we need not be surprised at the varieties of interpretations that have prevailed during such long periods of the world's history. As the human mind advanced it was able to perceive more and more where the language of figure and parable was employed, and many things that were interpreted in a literal sense in the infancy of the human race—and very properly so interpreted—are now with equal propriety understood in a different way ; while, on the other hand, science has abandoned many of her untenable positions, and we have arrived at a point at which it is possible that men of scientific attainments and of devout Christian belief may have full conviction of the truth both of science and religion. We may congratulate ourselves on one advance that has been made of late years, and that is the wonderful testimony that has been brought out, by means of modern research, to the truth of the Old Testament history. We can most of us remember the time when the greatest doubt was cast on the truth of the history set forth in the Old Testament. It was largely believed in certain scientific circles that the historical accounts contained in that Book were little superior in point of accuracy and truth to the legendary myths of Greece and Rome. The discoveries, however, that have been made amid the ruins of Babylon, Nineveh, and other cities which prominently figure in Biblical history, together with the further discovery of the true method of interpreting the cuneiform characters of Assyria and hieroglyphics of ancient Egypt, have thrown a flood of light on the truthfulness of the Bible record, and I am inclined to think that, even when regarded from a merely historical point of view, the leading facts of the Old Testament are amply established. What we are now called upon to do is, not so much to refute scientific objections addressed to the more educated classes, because that has been done so largely during the last twenty years that there is not much more remaining to be accomplished in that direction. This Institute has dealt very copiously with those objections, and there is very little more requiring to be said ; but the work we have to do is this : Those objections and difficulties which were started in scientific circles during the first half of the century have since been popularised and have sunk down to the lower strata of society, so that many of us are scarcely aware how largely the working classes of the metropolis, and, generally speaking, the less educated classes of the British and Anglo-Saxon peoples, are being plied with all sorts of scientific difficulties of a very crude character, which have been dealt with and refuted in the higher circles of scientific thought many years ago, but which at the

present moment are being widely employed with deadly effect among the more ignorant portions of the population. Well, this being so, what I think is required now is to popularise the great body of scientific research which this Society especially has been the means of prosecuting for the last twenty years; to break it down into crumbs, so to speak, so as to make it intelligible to any one who can read the English language, and issue it in papers available to the working classes. I am glad I have been able to be present to-night, and can only express my regret that I am very seldom permitted, owing to a multitude of engagements, to attend your meetings. I have great pleasure in moving "that our best thanks be presented to the President for the annual address now delivered, and to those who have read papers during the session."

Mr. HORMUZD RASSAM.—I have great pleasure in seconding the well-deserved vote of thanks which has just been moved to our respected President for his very able and valuable Address. I am not sufficiently versed in science to enable me to say anything worth the attention of this assembly; but, I thank God, as one of the believers in Revelation, I am not afraid of any supposed difference between the two. On the contrary, as they both belong to the same Author, we ought to do all we can to support the men of science, because we know they cannot do us any harm. As our President has said, both ought to agree, otherwise the study of science and religion would be nonsense. We are aware that there are many things which have yet to be examined into, and there are many mysteries that will yet be explained, if not in this generation, at any rate in the future. We know from the discoveries that have been made in Assyria and Babylonia how much has been elicited therefrom to throw light upon many obscure passages in the Bible, especially as to the kings who have reigned in those parts of the world. When we resume our researches, which we hope to be able to do before very long, we shall probably come upon many other discoveries which will explain certain other seemingly unintelligible passages in the inspired writings. We cannot but join in returning hearty thanks to Professor Stokes for his learned and interesting Address, and in expressing a hope that he may long continue to be our President.

Admiral Sir F. LEOPOLD M'CLINTOCK, R.N., F.R.S.—It is my very pleasant duty as a stranger to express my warmest approval and highest appreciation of the objects of this Institute, and also of the admirable way in which you have hitherto endeavoured to carry them into effect. I have always deemed it to be one of the highest privileges of those who have sufficient talent and knowledge for the task, to compare the book of Nature as it lies spread open before us, with the Book of Revelation as we have had it handed down to us, and show the complete accordance which subsists between the two. I will not, however, take up the time of the meeting by enlarging upon this topic, because I did not come here prepared to speak upon it. This is, indeed, my first appearance here, but I am delighted to range myself on the side the Institute has taken up.

The resolution was then carried with acclamation.

The PRESIDENT.—As I am one of those mentioned in this resolution, although only one, because it also includes the authors of the various papers read during the session, I take it upon myself to return thanks for the way in which my services, imperfect though they have been, seem to be appreciated by the Institute, and also to thank you on behalf of those who have read papers during the year just terminated. I must confess that when I thought of addressing you this evening my heart rather failed me, for I had not much time in which to prepare anything worth your hearing; and I may truly say I feel the imperfection of what I have brought before you. But among the papers read before this Institute during the session have been many elaborate contributions to the Transactions of this Society—papers which I have no doubt have cost the authors a great deal of careful thought, and I am sure that your thanks to the authors of those papers are well deserved.

The members and their friends then adjourned to the Museum where refreshments were served.

NOTE.

THE following remarks by Professor G. G. Stokes, P.R.S., were delivered by him on another occasion, and their insertion here seems not inappropriate :—

“We all admit that the book of Nature and the book of Revelation come alike from God, and that consequently there can be no real discrepancy between the two if rightly interpreted. The provinces of Science and of Revelation are, for the most part, so distinct that there is little chance of collision. But if an apparent discrepancy should arise, we have no right, on principle, to exclude either in favour of the other. For however firmly convinced we may be of the truth of revelation, we must admit our liability to err as to the extent or interpretation of what is revealed ; and however strong the scientific evidence in favour of a theory may be, we must remember that we are dealing with evidence which, in its nature, is probable only, and it is conceivable that wider scientific knowledge might lead us to alter our opinion. We should be ready to hear the whole of the evidence, and judge honestly from the whole. We should admit the principle of hearing both sides ; not that we should each make the examination, for comparatively few would be competent to do so.

“It is impossible for the bulk of our population, whose lives are spent in earning their daily bread, to weigh the evidence of what are stated to be the conclusions of science. They take them on trust, if they attend to them at all ; and if scientific conjectures are represented to them as the conclusions of science, they are predisposed to accept them as such from the general knowledge they possess of the great things that science has done. It is quite possible that a stumbling-block may thus be placed in the way of religious belief ; for though our fundamental idea of the unity of truth involves, as an axiom, the absence of antagonism between real science and revelation, we have no such guarantee respecting scientific conjecture.

“As the dangers referred to arise from a separation of Science from Revelation, and a determination to ignore one of these two modes of arriving at truth which are open to man, it follows that they are best guarded against by a hearty recognition of both, as coming, in different ways, from the Author of our being.”