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OF
The Victoria Institute
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VOL. LXXII

1940



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War conditions having rendered it impracticable to hold an Ordinary Meeting on January 8th, 1940, the Paper to be read on that date was circulated to subscribers and is here published, together with the written discussion elicited.

*THE INFLUENCE ON HUMAN CONDUCT AND BELIEF
OF CERTAIN SCIENTIFIC HYPOTHESES.*

By SIR AMBROSE FLEMING, F.R.S., President.

1. DEFINITIONS OF TERMS.

OUR English word *science*, derived from the Latin *scientia*, is used to denote exact systematic or formulated knowledge of any subject, and more particularly the expression in terms of definite units of observed measurable phenomena. This quantitative determination is especially an object of scientific investigation, and the scientific character of any branch of knowledge is largely determined by the degree to which such measurements are possible. Thus we have a science of musical sounds, because we can measure the number of vibrations and nature of them, which give rise to such sounds. But we have no corresponding science of tastes or scents because no exact measurements of them are possible. We can, for instance, assert that one thing is more sweet than another, or scent more agreeable, but we cannot define these differences in terms of any units or make our knowledge quantitative. Hence Lord Kelvin once said: "Science is measurement," and those branches of knowledge in which exact measurement is possible stand in the front rank of all we call scientific knowledge. Although there are

large departments of knowledge in which such quantitative determinations are difficult, or not possible, such as the study of the human mind, or operations of living beings generally, the term science is commonly applied to all ordered knowledge of external Nature and material things, including man himself, which affect our senses or intermediate appliances which create sense impressions. To all this knowledge the term "Natural Science" is usually applied.

2. METHODS OF OBTAINING SCIENTIFIC KNOWLEDGE.

Although much knowledge of natural things and events has been gathered in ancient and mediæval times, yet the effort to obtain it was marred by the approach to the subject with pre-conceived ideas or unproved assumptions. It was not until about 300 years ago that Galileo (1564–1642) in Italy, and William Gilbert (1544–1603) in England, began to employ the true method of seeking scientific knowledge by systematic experiment and observation, with minds free from any suppositions as to the nature of the events considered. The events in Nature take place for the most part with such variation and complexity that prolonged observations and persevering experiment are necessary, and above all things an attitude of mind absolutely free from any hasty guesses as to the results, before we can conclude we have reached truth on the matters under investigation. Hence such unbiased observation and experiment, with logical or mathematical deduction therefrom, is now recognised as the only method of gaining true scientific knowledge concerning natural phenomena. In many cases the starting point for a train of scientific investigation has been an observation made accidentally or in the course of some other line of investigation. But such accidents can only be fruitful if they are made by men equipped with the necessary faculties for following them up. Thus in 1856, W. H. Perkin, a chemist, endeavouring to produce synthetic quinine, obtained a purple substance which proved to be a useful dye called mauve, and thus initiated discoveries of the so-called coal-tar dyes which developed into a vast and useful industry, although British slackness allowed it to fall at first entirely into German hands. Some 1,200 dyes and colours are now, however, made here in England from coal-tar. Then the discovery of the so-called X-rays, due to Röntgen in 1896, originated in a casual observation with a Crookes high-vacuum tube; and the starting

point for the extremely important discovery of the radio-active substances was an observation by H. Becquerel, in 1896, of the blackening of photographic plates kept in the same drawer as samples of uranium ore.

In all these cases, however, persevering observation and experiment were necessary to follow up the initial observation.

3. THE MAIN OBJECT OF SCIENTIFIC RESEARCH.

The collection of isolated facts or statements of events is not the primal aim of scientific research. We have an underlying conviction that the physical Universe is an ordered entity and that there must be general principles or controlling conditions which govern phenomena. One great purpose, therefore, of scientific research is to discover, if possible, these general principles. This can only be done by very extensive experiments or observation, made without presuppositions of any kind. One of these, called the Law of Conservation of Mass, was recognised as soon as the exact determination of weight by means of the balance or scales was introduced in chemistry. It was then found that in all chemical transformations, however much change in nature of the materials might take place, there was no loss in total weight or annihilation or creation of matter. Thus when a combustible body such as a piece of charcoal or carbon is heated in air, the oxygen gas in the air chemically combines with the carbon, producing a gas called carbon-dioxide. But exact weighing showed that the total weight of carbon and oxygen used are exactly equal to the weight of the carbon-dioxide and any ash or unconsumed matter which remains over. This is called the law of conservation of mass.

Then about the beginning of the last century it was recognised that there is another physical quantity, besides mass, which is also conserved, namely, that called *energy*. Certain physical changes take place of themselves in Nature. Thus heavy bodies at a height above the earth's surface when left unsupported fall to the earth. Charged electric conductors become discharged when connected to the earth by a conducting wire. Also hot bodies left to themselves cool by radiation. To reverse these states, thus to lift up a mass to a height above the earth's surface, or to heat it, or to charge it with electricity, or to set it in motion, requires an exertion or expenditure of *energy*. These different forms of energy can be converted into one another. The elevated

mass has potential energy measured by the product of its weight and the height to which it is lifted. If allowed to fall its potential energy disappears, but it gains kinetic energy, measured by the product of its mass and half the square of its velocity. On striking the ground its kinetic energy vanishes and heat is produced. Careful experiment shows that in these changes *energy* is not created or destroyed, but there is a conservation of the total quantity of energy. An important discovery of recent times is that *energy* and *mass* or matter are related and interconvertible so that mass can be taken as equivalent to a certain amount of energy. Energy is measured in units called ergs and mass is measured in grammes. Einstein has shown that one millionth of a gramme of mass is equivalent of 900 million million ergs. The only sufficient account of the source of the radiant energy emitted from our sun as heat and light is that 250 tons of the sun's mass disappears every minute by conversion into the solar radiation. Two other great generalisations which are the result of prolonged experiment and observation are contained in the statements we call the first and second laws of thermodynamics. The first of these tells us that all forms of energy can be entirely converted into heat at a certain rate of exchange. Thus a moving body such as a train or motor car has kinetic energy. But when brought to rest by the brakes all this energy is converted into heat at the rate of one calorie for 42 million ergs. The calorie is the amount of heat which will raise one gramme of water 1 degree Centigrade at a temperature of about 4 degrees Centigrade.

The second law is equally important. It asserts that heat cannot be entirely converted into mechanical energy, but in all transformation of energy some of it is converted into heat of low temperature which becomes equally diffused. It leads, therefore, to the conclusion that there is continually a dissipation of energy, as Kelvin called it, in which energy is passing from forms in which it is useful to us to a non-useful form. This heat-death, as it has been named, implies progress of the Universe to a state in which physical phenomena will cease, and equally that at some past time, not infinitely remote, some external Power must have intervened to create energy in various forms or distribute them.

Finally, another very important generalisation has been reached called the Principle of Least Action. The word action in physics is defined as follows. If we consider a planet moving in an orbit without constraint, and having its total energy potential *plus*

kinetic constant, then it can be shown that if we divide up its path into little elements of length in each of which it has a certain velocity, the product of mass, velocity, and element of length, when summed up over the whole actual path, is less in value for the actual path followed than for any slightly different neighbouring path. This summed-up product is called the Action. The Law of Least Action enables us then to determine what that path must be.

4. THE USE AND NECESSITY FOR WORKING HYPOTHESES IN RESEARCH.

In conducting experimental research, we can avoid useless or random work by the adoption of certain assumptions as to the underlying phenomena which suggest possible useful experiments and are called working hypotheses. Thus in making experiments in optics with the object of reaching consistent possible explanations, we may assume that light consists in the vibrations of a space-filling æther which also pervades and exists in all material substances. The important fact to bear in mind is that such working hypothesis is not to be taken as definite scientific knowledge. It is no more scientific knowledge than the scaffolding used in the erection of a house is part of the house. It is only a convenient temporary structure which facilitates operations. Such scientific hypotheses may have use for a time but invariably have to be abandoned when found inconsistent with further ascertained facts. The history of science is, in short, the story of discarded hypotheses. It is instructive, therefore, to look back at some of these in order to guard against the assumption that theories or hypotheses now held will escape from a similar fate of destruction by discovery of incompatible facts. In the middle part of the seventeenth century the curious hypothesis of *phlogiston* was firmly held as an explanation of combustion. It was assumed that inflammable substances such as wood, charcoal, dry vegetable matter, oils, or fats contained a great store of an imponderable fluid called *phlogiston* which escaped in the form of flame and heat when the substance was set on fire. Also it was assumed that some metals lost *phlogiston* when heated and formed powders then called *calxes*. The *calx* could be brought back to the metallic state by heating with some substance such as charcoal which contained a large store of *phlogiston*. The pure metal was assumed to be a compound of *phlogiston* and the *calx*.

This theory had vogue for some time, but was invalidated when the French chemist Lavoisier showed that the process of combustion was a combination of the gas oxygen in the air with the carbon of the combustible and that the calx was an oxide of the metal.

Then the hypothesis that heat was an imponderable substance called *caloric* was another scientific hypothesis held for many years. A hot body was one full of caloric which escaped from it as it cooled.

This hypothesis was discarded when Count Rumford showed that an unlimited quantity of heat could be produced by the friction of metallic substances, as in boring out cannon. Also Sir Humphrey Davy proved that two pieces of ice could be melted to water by rubbing them together. Little by little it became clear that heat was not a substance but the kinetic energy of atoms in rapid vibration.

A large number of optical theories have been proposed. Newton held that the emission of light from luminous bodies consisted in throwing out small corpuscles. But the phenomenon of interference in which two rays of light destroy each other showed that light must be a kind of motion and not a kind of substance. If, however, it is an undulation, then there must be something that undulates. Hence the hypothesis of an æther. The phenomena of polarised light proved that a ray of light has differences on its sides which imply that the vibrations are perpendicular to the direction of propagation, and not along it, as in the case of sound. This involved the assumption that the æther must be like a solid body and possess both inertia and resistance to distortion. Although the eminent mathematicians of the nineteenth century were able to make such conceptions the basis of an explanation of many optical effects, yet the theory of an elastic solid æther had to be discarded when Maxwell proved that light probably consisted in an electromagnetic vibration, and also when the experiments of Michelson and Morley and others showed that no experiment could detect motion of the earth through the æther, or resistance of the æther to motion of matter through it. All such mechanical æther theories have therefore been discarded. We have now for the most part abandoned the attempt to make visualisations of unseen processes or mechanical theories of phenomena. We are satisfied if we can arrive at mathematical expressions which enable us to predict results of observation or experiment, and we have found that the laws of

motion which are true for large masses of matter do not hold good for very small masses, such as atoms.

5. SOME SCIENTIFIC HYPOTHESES OF THE PRESENT DAY.

The scientific outlook of to-day is largely dominated by two very widely accepted hypotheses, namely, that of the absolute uniformity of events in Nature, and the doctrine of Evolution. The theory of Uniformity was originally suggested by the geologists James Hutton (1725-97) and Sir Charles Lyell (1797-1875), and asserts that the agencies which produce changes in earth strata such as earthquakes, rain, floods, waves and storms, have always acted in the same way and with the same force as at present and no cataclysmic or abnormal events have occurred.

This hypothesis has been extended to apply to all branches of science, and it proclaims, in short, that all events such as those called miracles which are out of line with present experience are impossible and have never happened. But this is an unwarrantable assumption. Those uniformities we call the Laws of Nature have only been studied carefully for the last few hundred years, and we have no right to assume for the far past conditions derived from a very limited present experience. Moreover, the gradual transformation of radio-active elements, such as uranium and thorium, into non-radio active elements such as lead, proves that in past time there must have been much more radio-active matter in the earth than at present.*

Also since the temperature at the earth's surface was at one time above that at which living tissue could exist, there must have been a beginning to living organisms and therefore of events not now taking place.

It will not be necessary here to discuss the hypothesis of the

* Lord Kelvin, then Sir William Thomson, wrote two important papers in 1862 dealing with the age of the earth, that is the distance in time from the present to the date when the earth solidified from the condition of a rotating liquid spheroid. From its shape and rate of slowing in rotation, viz., 22 seconds per century, Thomson concluded that the earth was not solid 5,000 million years ago and perhaps not 1,000 million years ago. The estimates of the time have been affected by the discovery that the earth's crust contains radio-active matter which generates heat. At present the earth temperature increases as we descend into it about 1° Fah. per 50 feet, but in past time it must have been far more rapid, and Thomson pointed out that this renders it probable that volcanic energy, earthquakes, and Plutonic action generally must have been far more violent than in the present age, which contradicts the assumption of the doctrine of uniformity.

evolution of animal species nor the arguments against it, because this has been very fully done in previous papers read to this Institute. There is one point, however, which needs consideration.

Many religious teachers and others who are wrongly under the impression that the case for organic evolution is clearly proved, and yet do not wish to commit themselves entirely to a denial of Divine Creation, take refuge in the assertion that evolution is a method of creation. But this position is an illogical one. The truth of Darwinian natural selection, or other process of evolution for the production of new species, is either proved or it is not proved. If it is proved it renders the employment of the word creation unnecessary, and if it is not proved, then it cannot be a method of creation. In any case the starting point for the beginning of the evolution of species must have been in an act of creation, as Darwin himself admits in the last paragraph of his *Origin of Species*, unless we admit the possibility of spontaneous generation of life, an assumption against which there is much evidence. The advocates of organic evolution never attempt to meet objections fairly by effective counter argument. They take refuge in the excuse that the case is so fully proved as not to require further discussion or else that the critics are ignorant or prejudiced.*

Accordingly, there are a large number of science teachers in elementary and higher schools who have never had the opportunity of hearing the case against spontaneous organic evolution properly stated. They themselves do not wish to take an antagonistic attitude to the hypothesis as this might injure their prospects of advancement. Hence as a matter of prudence they fall in line with those who accept it entirely without demanding proof.

* The advocates of the origin of species by Darwinian natural selection do not give sufficient weight to the objection that this theory implies an enormous number of intermediate forms of life between those of past and existing species. There is no evidence of this in the remains in fossiliferous strata of the earth. Neither do they attach adequate importance to the fact of the sterility of hybrids. That means that while the members of any species can interbreed and produce offspring which are fertile, the results of interbreeding between members of different species are sterile. This tends to preserve constancy in form in species and not to produce variation. A third objection is that, whatever theory of evolution is adopted, it is requisite to assume the spontaneous appearance of forms of life to start it, and this is negatived by the fact that all experiments and researches have shown that spontaneous generation of living matter or living organisms is impossible.

6. THE ETHICAL AND RELIGIOUS INFLUENCES OF SCIENTIFIC HYPOTHESIS.

The human mind is gifted with many faculties and powers such as the intellectual or ratiocinative, the æsthetic, the ethical, and religious. But these cannot be separated entirely as it were in water-tight compartments. The conclusions reached or accepted by anyone in one department may or must influence those in another.

If a man has convinced himself that this marvellous Universe has arisen as a matter of chance and struggle to exist, and that the so-called argument from design for a creator has been invalidated or destroyed by the principle of natural selection or automatic organic evolution, he may by this become agnostic in attitude, even if not unbelieving, in the existence of a creating God. It will then be impossible for him to accept the Bible as a divine revelation from a Deity who he thinks does not exist or is unknowable, and therefore the Deity or supernatural powers of the Christ, who is its chief subject, must also be rejected. Accordingly, acceptance of the doctrine of organic evolution as scientific truth is inconsistent with belief in the literal truth of the statements which form the Christian creed. But if belief in a God who is the Creator of all things visible and invisible has been weakened or destroyed by the diffusion of unproved hypotheses in the name of science, then also belief in a God who is the righteous judge of all men and will give to every man according to his work will be obliterated, and with that will disappear the strong control of human actions by religion. We may be back then in the state in which brute force or the politics of the jungle are the only Law, and as regards material benefits "those will take who have the power and those will keep who can." Have we not nearly reached this state already? We see great nations armed to the teeth with weapons for the wholesale slaughter of mankind. International treaties by them are considered as scraps of paper to be torn up when not convenient to observe, notable inventions such as the conquest of the air are consecrated to the murder of helpless men, women and children, and the wealth of the world cast away in the form of munitions of war.

There can be no doubt that a wide popular acceptance of the unproved hypothesis of organic evolution held to be scientific truth concerning the origin of animal species, when allowed to influence national ideals, is spiritually deteriorating. The basic conception of this evolutionary philosophy is that individual

improvement and species advancement is the result of the survival of the fittest in a struggle for existence. This means in the case of animal races the success of the strongest, swiftest, or most cunning in the struggle for food or escape from enemies; in short, the race is to the swift and victory to the strong. When these conclusions are accepted as also applying to the human race, war is elevated into an ennobling pursuit and as a result the individual becomes of no account but the State is to be supreme. All forces and agencies are therefore to be organised for successful war, so that the valuable possessions of weaker or less skilful nations may be transferred to the strongest and most ruthless peoples. The ideals of human life for the individual or nation set before us in Christianity are therefore deemed to be mere contemptible weakness to be derided and avoided, whilst relentless self-advancement or world dominion is the aim to be pursued at all costs and by any possible means. We see that to-day in several nations of the world.

One worthy aim of scientific research should be to discover means by which the great energies of nature can be utilised and applied for the benefit of all mankind and not its destruction. It is realised in those beneficial researches which have given us anaesthetics and antiseptic surgery, or the electrical discoveries which have enabled us to harness the water power of the world in the service of mankind, or in those which have annihilated distance and brought the nations of the world into closer contact by telegraphy, telephony and television.

Another equally worthy purpose is the discovery of great general principles of action which reveal to us the physical universe as "a mighty maze but not without a plan." Even if the argument for the existence of God derived from specific instances of apparent purposive design in nature has been to some extent weakened by the recognition of the great influence of environment, we may still rest firmly on the fact that the increasing intelligibility of the universe to our human minds, and the abundance of numerical relations in it, give us an unquestionable proof that it had its origin, not in chance, but in a Supreme Intelligence. The same argument applies in regard to our appreciation of its beauty in seen or hidden things. As regards processes, we must always remember that even if we can conceive a mechanism which can produce some effect we see in nature, it does not in the least follow it is done in that way. In any case, we have a right to demand that in the efforts of science

to discover how certain things are done in the visible world, popular science teaching shall not represent unconfirmed speculations as ascertained scientific knowledge to the injury of religious faith.

The practical inventions and discoveries of science have been of enormous utility and advantage to mankind. But in the endeavour to penetrate into the past history of the universe, or discover the means by which it has been brought to its present condition, scientific hypothesis has greatly erred and misled many. It has considered the universe rather as a thing than a thought, as a mechanism largely determined in its operations by chance, which may be explored by the human mind selecting some things as important and others which may be neglected.

We cannot ignore nor deny the existence in animals and mankind of intelligence and purposive actions; in other words, of Mind. Exact research has shown us that living matter can only proceed from previously existing living matter. We can then make another equally valid statement, viz., that mind can only be derived from mind.

Any hypothesis which assumes that animal or human intelligence can arise spontaneously by automatic bodily development, or causes which have no mentality, must then be erroneous. In the same way when we note the potential or actual religious or spiritual qualities in man, of which there is no trace in the animal races, we must account for them by an agency which is itself spiritual in nature. All scientific theories of origins which are materialistic in essence, and take no account of the psychic facts or "invisible things of creation" are destined to pass away, because they omit to take heed of the thought evidently present in the universe, and this necessarily implies that there must be a source of this thought or creative intelligence as its final cause.

DISCUSSION.

Rev. H. T. WILLS, M.A., B.Sc., wrote: I have read this paper with great interest, but I feel that there is one point against the doctrine of Evolution that has not been stressed as it might be. The point to which I refer is that of the unity of the human race. Granting, for the sake of argument, that Evolution was the method which the Creator used in the making of Adam, it was as real a

miracle of Divine power as the resurrection of Jesus Christ. It has never been repeated, for if Evolution were what its exponents imagine, there is no reason why it should have stopped its work. Instead of mankind being one, as it certainly is, it must be obvious to any thinker that millions of men are even now being evolved from diverse sources, and the race would be a mass of unrelated units. This is so utterly contrary to fact as to be absolute nonsense, unbelievable by any save those who are enemies of truth.

Dr. R. E. D. CLARK wrote: Without wishing to be destructive, it is perhaps worth pointing out that Sir Ambrose's argument about evolution appears, *on the surface*, to be self-destructive. First of all he appeals to the obvious falsity of the law of uniformity of nature in order to urge that the possibility of miracles cannot be lightly discarded. He then points out that life must have arisen either by creation or by spontaneous generation, but remarks that there is much evidence against the latter possibility. True: but might not a critic reply that all the evidence against spontaneous generation amounts to this—that no one has seen it happen to-day and, therefore, by the law of uniformity, it probably did not happen in the past? It might add somewhat to the value of Sir Ambrose's paper if he would care to make some comments on this matter.

The comparison made in the paper between present and past hypotheses in science is very instructive. It might, perhaps, be urged that *phlogiston* is an unfortunate case to cite, for, as Crum Brown pointed out long ago (*Proc. Roy. Soc. Edin.*, 1864, 5, 328), *phlogiston* is a perfectly sensible theory, and soon after its overthrow it was again revived under such names as "potential energy", "chemical affinity" and "free energy". The theory under the name of *phlogiston* was only overthrown when enthusiasts tried to make it explain chemical facts which depended not upon energy but upon the atomic nature of matter. In addition, Professor J. R. Partington has recently pointed out how remarkably closely the modern theory of "Redox" potentials corresponds to *phlogiston* (*Scientia*, Sept., 1938).

However this may be, the history of *caloric* is certainly very instructive, especially as the scientists of the seventeenth century had had perfectly correct views on the subject (*see, for e.g., J. Tyndall,*

Heat a Mode of Motion, 6th ed., 1880, p. 34 ff.), which were later abandoned. Dampier-Whetham (*History of Science*, 2nd ed., p. 245) argues that, historically, the true view of heat did little to stimulate research, while the caloric view "played a useful part in suggesting and interpreting experiments on the measurement of quantities of heat". For this reason *caloric* was still generally accepted for half a century after Rumford and Davy had performed the experiments which eventually resulted in its overthrow. During this period, upholders of the true and then "old-fashioned" view had often to contend with ridicule and prejudice.

As an example of the way in which believers in *caloric* tried to explain away facts, we may take the case of William Higgins, a man of great scientific insight who had anticipated Dalton's views on the atomic theory. Writing in 1814, Higgins says:—

"Heat evolved by friction, however unaccountable and mysterious it may appear, is not sufficient to invalidate the doctrine of the materiality of *caloric*, being only a solitary fact opposed to thousands that tend to establish its existence as an elementary substance" (*Experiments and Observations on the Atomic Theory*, Dublin, 1814, p. 37).

In the same way, the evolutionist of to-day finds spontaneous generation to be "unaccountable and mysterious", but the difficulty is turned on one side because it is "only a solitary fact opposed to thousands" which are supposed to indicate that living organisms have become more and more complex through the ages. Likewise, when we inquire *why* scientists hold evolutionary views, they will often confess that the real reasons are precisely analogous to those by which *caloric* was maintained—namely, that evolution has stimulated research, whereas the alternative view of special creation has not proved heuristically useful.

Mr. DOUGLAS DEWAR wrote: I am glad that Sir Ambrose Fleming has commented on the disgraceful manner in which biology is being taught in our schools. Many years ago, T. H. Huxley said "Science commits suicide when it adopts a creed". This is what has happened to biology; it has adopted evolution as a creed—a religion. That this assertion is not an exaggeration is easily demonstrated.

Professor J. Lefèvre, Director of the Laboratoire Bioénergétique of Paris, writes (*Manuel Critique de Biologie* (1938), p. 37): "Whether on account of routine, or of materialistic fanaticism, or of defective education, reflection or method, the transformist faith reigns supreme". He then proceeds to show that this faith is against reason, and against the data of morphology, embryology and palæontology.

In this country the editors of *Nature* periodically exhort biologists not to rest on their oars, but to row hard in order to stem the current of anti-evolutionism. Here we have the exhortations of priests to their people to defend the faith! The B.B.C. persistently propagates the doctrine of evolution through the medium of clergy and professors of biology.

In the United States matters are even worse, if possible. In the *Journal of Heredity* for January 1939, a letter was published castigating Dr. E. Grace White for substituting in her *A Textbook of Biology* the word "development" for "evolution", and for the splitting of the inadequate treatment of evolution into parts that are deftly subordinated to positions of inconspicuousness. The writer bleats: "Zoology teachers know that while *they* see evolution in structural 'advances', the beginning student does not (unless very specific reference is made to evolution at every opportunity)." The irate writer concludes his effusion with the following gem: "To accept heredity and to deny evolution is surely to be counted the neatest biological trick of the week, or of the year, for that matter". The truth is that the strict laws of heredity constitute one of the main objections to the doctrine of evolution.

Let us be thankful that the Victoria Institute has all along held its ground against the great flood of the transformist theory, according to which, again to quote Lefèvre, "animals fight one another, elongate themselves, re-arrange themselves, twist themselves, turn themselves, fold themselves, re-dress their limbs, ornament themselves with appendages, create organs for themselves, manufacture for themselves tentacles and eyes, transform themselves into one another, and differentiate and perfect themselves at will: prodigies more marvellous and far more miraculous than the idea of creation itself".

I subscribe to everything Sir Ambrose has said about the effects

of the acceptance of the evolutionary faith. The Germans deem themselves the finest of the recently evolved super-apes, and mean to dominate, at all costs, the other breeds of super-ape.

The Rev. Principal H. S. CURR wrote : Sir Ambrose has rendered valuable service to the cause of conservative and evangelical theology by his reminders that certain scientific doctrines are, in the last analysis, incompatible with Christianity. They may seem to have little bearing on religious questions, since their interest and implications seem to be exclusively technical, but when they are followed to their logical conclusions, it becomes perfectly plain that they are as uncongenial to the Christian faith as oil to water. In the paper, the doctrine of organic evolution is cited, and reference is made to its subversive effects on the Christian conception of God, and on Christian ethics. To my thinking, an even stronger case could be made out on the score that organic evolution is nonplussed by the facts of sin and salvation, and, above and beyond all, by the fact of Christ. These basic factors in the story of the universe cannot be explained on any theory of continuous and spontaneous development.

It is striking that the Bible should touch so many phrases of human life and knowledge. Its primary subject is God, but it has much to say on a vast variety of subjects, including scientific references which have been acknowledged by authorities to be remarkable in their anticipations of modern discoveries. These facts serve to confirm the view just expressed that neither science nor theology can be fully understood in isolation. Their claims must be tested with reference to the conclusions of other branches of inquiry. In the long last, truth is one, and our Lord Jesus Christ declared that He is the truth, and that no man cometh to the Ultimate Unity but by Him. Any scientific theory, therefore, which cannot give Christ the pre-eminence is condemned already.

It may not be irrelevant to remark that modern science is the result of Christianity. Sir Ambrose has referred to ancient scientific speculations and to their value. While giving full weight to these, it cannot be denied that the Bible has provided the key whereby the mysteries of the natural world have been unlocked one by one. If, then, views be entertained which are incompatible with the system

to which they ultimately owe their origin, they must be substantiated by evidence of the most clear and convincing order. "Doth a fountain send forth at the same place sweet water and bitter? Can the fig-tree, my brethren, bear olive berries? either a vine, figs? so can no fountain both yield salt water and fresh" (James iii, 11-12). Christianity is Christ, and in the evolutionary scheme Christ can have no place, on which the best comment is Our Lord's words: "I am the vine, ye are the branches: he that abideth in me and I in him, the same bringeth forth much fruit: for without me ye can do nothing. If a man abide not in me, he is cast forth as a branch, and is withered; and men gather them and cast them into the fire, and they are burned" (John xv, 5-6). These sentences state the only foundation for all man's endeavours on which lasting results can be obtained.

W. POYNTER ADAMS, Esq., M.I.E.E., A.K.C., wrote: Sir Ambrose Fleming is doing a notable service by drawing attention to one of the most pressing needs of the day. There can be no question that the failure to understand the limitations of science is a stumbling block with many who are unacquainted with scientific investigation.

I have always deplored the tendency of the human mind to place in opposition Science and Religion. That which is true in Science cannot possibly be opposed to Religion—that is, belief in God, resulting in the service of God. The problem is, however, not new, for even in Apostolic times, St. Paul found it necessary to warn Timothy against "oppositions of Science, falsely so called".

It has been frequently remarked recently that the testimony of scientific men to belief in Holy Scripture is of immense importance in these days, and I verily believe it is so. It cannot but be difficult for those who have had nothing to do with scientific investigations to sift the false from the true, and the human mind is only too ready, in its unbelief, to find an excuse in the uncertainty of things to let itself go in matters of conduct. Here, again, one can quote Holy Scripture as evidence that Sir Ambrose Fleming is dealing with no new problem. "Let us eat, drink and be merry, for to-morrow we die." This is undoubtedly the principle, or perhaps want of principle, with multitudes in these days.

However, thanks largely, I believe, to broadcasting and to the wonder of wireless itself, a very great body of opinion has been brought into the line of right thinking as regards Science and God. Wireless is a tremendous help in understanding the fact of prayer.

That Science should present difficulties is, of course, not at all surprising, but the right attitude of mind is what we scientific and Christian men desire. In all these great questions there should be the open mind—a readiness to learn and to wait, and also to pray, for if we take our reasonable difficulties to God and ask for light, He gives light. This I can state most emphatically from personal experience. I well remember hearing a young curate state from the pulpit in my parish church of Barnes in Surrey, when I was a lad, that the revealed facts of astronomy were a difficulty to many, the thought being how can God, so great and marvellous, “the Creator of the rolling spheres ineffably sublime”, take cognisance of the children of men, little better than “worms of earth”. He pointed out very faithfully that man has the faculty of love, and, infinite though God is, the love of the human race (seeing that God is Love) must be of more value to Him than the rolling spheres marching in their stately array upon their stupendous orbits. It is thoughts such as these that can prove of untold value to the seeking souls of men.

J. BARCROFT ANDERSON wrote: Sir Ambrose has mentioned one supposition of the so-called scientists which is contrary to the teaching of Scripture—the supposition that the animals and vegetation which Our Lord made to reproduce, each after its kind (לְמִינֵהוּ LMINE): have not always done so. An unprovable supposition, which many believe to be a fact, chiefly because one known cross does not reproduce anything.

There is another such supposition to which he has not referred, the supposition that the matter of which this Earth is made up always existed. This supposition seems to be equally demoralising and equally unscientific. There is no known evidence to prove this Earth to have been existing for as far back as seven of our days before Adam was created. But those who seem to believe that matter had no origin, seem equally to believe that the spirit of every man coming into this world is a new creation, as stated in

Zechariah xii, 1. They seem rightly to believe that thousands of new creations take place daily.

Brigadier N. M. McLEOD, D.S.O., M.C., wrote : I have read with great satisfaction and benefit Sir Ambrose Fleming's comprehensive and illuminating paper, and, if I venture to offer comment on one point that presents a difficulty, I do so in the hope that it may lead to a pronouncement by a scientist of distinction that will go far towards ending a long-drawn controversy.

On page 4 appears the statement that ". . . the experiments of Michelson and Morley and others showed that no experiment could detect motion of the earth through the æther," a statement so often repeated by leading scientists as to have acquired almost axiomatic effect.

On the other hand, in apparently direct contradiction, stands the report by Professor Dayton C. Miller on the "Ether-Drift Experiment,"* carried out with the most refined apparatus at Ether Rock, Mount Wilson, in which not only was the ether drift detected in many thousands of observations, but measurements of the shift of the colour fringes disclosed data sufficient for the calculation of the velocity and direction of the movement of the solar system. So far as I am aware, these results have never been successfully challenged.

The matter is one of importance, since on the same belief (that the Michelson-Morley experiment had yielded a nul result), I understand, the entire Einstein theory of "relativity" had been built up; whereas, according to the evidence of the scientists who carried out the famous experiment, "the indicated effect was not Zero".

The elaborate and exhaustive experiments by Morley and Miller at Mount Wilson confirmed the earlier results, and gave seemingly irrefutable evidence of an ether drift.

From the vast amount of data obtained in these experiments it was possible to determine the cosmic component of the Earth's absolute velocity, *i.e.*, the velocity of the motion of the solar system.

* "The Ether-Drift Experiment and the Determination of the Absolute Motion of the Earth" in *Reviews of Modern Physics*, Vol. 5, No. 3, July 1933.

This was found by Professor Dayton Miller to be 208 km. per sec. in the direction of R.A. 4 h. 54 m., Dec., $70^{\circ} 33'$ South (7° from the South Ecliptic Pole).

After studying Professor Miller's detailed report one feels inclined to ask whether this theory, based as it was on the assumption that the ether drift effect was exactly nil, should not now be abandoned.

The whole question seems to have been left in confusion, and, if our distinguished author could clarify it, I am sure his statement would be received with relief and gratitude.

REPLY COMMUNICATED.

In attempting a reply to some of the contributions made to the discussion on my paper, one remark which may be made is that more than one of the contributors fail to keep in touch with the precise topic defined by the title of the paper, viz., the influence on human conduct of adherence to certain scientific hypotheses.

Taking the contributions in order, the first is that of the Rev. H. Temple Wills. His argument in a few words is as follows:— Assuming that the human race originated by evolution, how comes it to pass that it has apparently ceased to be operative at present in producing new and greater varieties of human beings?

The conclusion I presume he desires to be drawn is, because evolution never had any share at all in the origin of mankind.

This argument is sound as far as it goes, but is not so forcible as many other reasons which can be given against the evolution of Man from the animal species.

Then next Dr. R. E. D. Clark opens his discussion by an ingenious attempt to impale me on the horns of a dilemma.

In effect his argument is as follows:—He quotes my objection to the theory of uniformity, in which I maintain that we cannot from a limited present experience of Nature say that no events of a vastly different character may not have taken place in the far past. He then proceeds to argue from this that though the spontaneous generation of life is not taking place now, my statement does not exclude the possibility it has taken place in past distant ages.

In reply I may say that the term "spontaneous generation", Dr. Clark uses, is an unphilosophical term. It suggests the idea of an event or events taking place without adequate cause or

dependence on some sufficient prior event. The problem of causation has often been fully discussed, but I do not think that any competent scientific opinion would admit that however obscure an event may be it is entirely without cause or absolutely spontaneous, self-produced and without connection with some previous events. Thus, in the case of radium we know that at intervals some of its atoms break up and fling out so-called *Alpha* and *Beta* particles. But we do not know why one atom of radium should break up rather than another. All we do know that in about 1,500 years one-half of the atoms of any mass of radium break up, and in the next 1,500 years one-half of the remainder and so on. In spite of this apparent spontaneity, I think prevalent opinion is that some adequate selective cause is at work in this case.

Returning, then, to Dr. Clark's argument. We know that at the present time all the evidence of fact goes to show that life only proceeds from some previous life or biogenesis holds the field. We know also that life cannot have existed on this earth for an infinite past time and hence it is legitimate to conclude that at some past time events must have taken place calling into existence some initial forms of life.

We cannot, however, assume that "spontaneous generation" is an adequate explanation or that life originated in a fortuitous concurrence of atoms or that living matter in the form of protoplasm came into existence by chance.

Each supposed origination must be examined on its merits as regards sufficiency and probability. The evolutionist asserts that accidental variations under the influence of environment and a struggle to continue to exist constitute such sufficient cause. But others of us claim that the manifold and beautiful forms of life and their exquisite adaptations can only have had a sufficient cause in the Will and Power of a Supreme Intelligence.

I submit, then, that there is no inconsistency in my arguments. Dr. Clark then criticises certain instances I have given of the essentially transient nature of scientific hypotheses. The facts of observation or experiment remain permanent, but our explanations of them are subject to continual change.

As regards the phlogiston hypothesis, I have long been aware of the suggestion of Crum Brown that it may be regarded as a

name for potential energy. But I have always thought this to be a fanciful analogy not consistent with facts. The phlogistonists assumed it to be an imponderable fluid and that pure metals were compounds of phlogiston with metallic calxes or what we now call metallic oxides. If so, then the weight of metal obtained from a certain mass of calx should have been equal to that of the calx. But as a matter of fact it is less, as was found as soon as the quantitative study of chemical changes began in the use of the chemical balance.

In the same way the caloric theory of Heat was destroyed by the measurements of Hirn, Colding and Joule. Nothing therefore has been said which contradicts the statement of the necessarily finite duration of any scientific hypothesis. The inference I wished to draw from the instances given was that the hypotheses of continuity and evolution cannot be regarded as having more permanent durability than those of phlogiston caloric or an elastic solid ether. Each hypothesis has its day and then ceases to be of use. Its only claim to consideration is as a stimulus to further research, but it has no claim to be regarded as a final statement of truth or fact. Even if we can imagine a means able to explain some fact in Nature, it does not in the least follow that events happen in that way.

I entirely agree with the remarks of Mr. Douglas Dewar. I think it is deplorable that wireless broadcasting, the most powerful means of influencing public opinion since the invention of printing, should have been used so exclusively to support the theory of organic evolution without giving an opportunity for stating the reasons against it. The teaching of evolutionary ideas in school books is unquestionably a dangerous and blameworthy thing. I entirely agree with the opinions of the Rev. Principal Curr that there is an anti-religious influence in evolutionary teaching which could be proved by many instances.

When unscientific people are told in the Press or even from the Pulpit that all scientific men agree with the theory of organic evolution, the inference they at once make is that if the Bible is misleading in its statements as to the origin of animals and man, it may also be in error in regard to its other statements as to the state and destiny of mankind or in those regarding the Deity it

reveals, and hence the hypothesis is an influence tending to undermine religious faith in "things not seen."

With regard to the matter mentioned in the communication of Brigadier N. M. McLeod on the experiments of Dayton C. Miller, which are assumed to contradict those of Michelson and Morley on the invariable velocity of light, I think that further investigation will show that Miller's conclusions are not accepted by those best fitted to judge. His conclusions that the ether is partly carried along by the moving earth is quite inconsistent with the well-known fact of the aberration of light discovered more than 200 years ago by the Astronomer James Bradley (1693-1762). This effect enables us to determine the ratio between the velocity of light coming from any star and the velocity of the earth in its orbit at the place of reception, and the result is to show that the velocity of light is not affected either by the motion of its source or of the observer. Also the important experiments of Michelson and Gale, made since those of Miller, have proved to contradict the conclusions of Miller that the ether is dragged along by the moving earth. Brigadier McLeod will find a full discussion of this matter in the little book, *Space and Time*, by Émile Borel, an eminent French Physicist (English translation published by Blackie & Son, 7s. 6d.).

Miller's results are therefore not accepted as final and I think my statement is perfectly correct that the original experiments of Michelson and Morley are entirely trustworthy and valid as a basis for the foundation of Einstein's doctrine of Relativity.