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1933

## 761ST ORDINARY GENERAL MEETING,

HELD IN COMMITTEE ROOM B, THE CENTRAL HALL,  
WESTMINSTER, S.W.1, ON MONDAY, DECEMBER 5TH, 1932,  
AT 4.30 P.M.

DR. JAMES W. THIRTLE, M.R.A.S., IN THE CHAIR.

The Minutes of the previous Meeting were read, confirmed, and signed, and the HON. SECRETARY announced the following elections since the last Meeting:—As a Member: Thomas Priestman, Esq.; and as Associates: Lieut. J. P. Hunt, R.N.; Professor W. C. Clinton, B.Sc., M.I.E.E.; Rowland Hogben, Esq.; Mrs. Mary Holland Butson; Sidney J. Arkwright, Esq.; Alfred Young, Esq.; Miss Grace M. Kerr; and as a Student Associate: T. M. Cuthbert.

The CHAIRMAN then called on the President, Sir Ambrose Fleming, D.Sc., F.R.S., to read his paper "On Beauty in Nature as a Supplement to the Argument from Design." This was illustrated by lantern slides of great interest.

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### ON BEAUTY IN NATURE AS A SUPPLEMENT TO THE ARGUMENT FROM DESIGN.

By Sir AMBROSE FLEMING, F.R.S. (*President*).

(*With Lantern Illustrations.*)

#### 1. THE ARGUMENT FROM DESIGN.

TWO years ago I had the privilege of drawing your attention in this room to some Adaptations in Nature giving Evidence of Purposive Thought in the Universe and therefore of a Supreme Intelligence as their final source.

It has often been stated that the force of this Argument from Design was destroyed by the introduction of the ideas of Evolution and Darwinian natural selection. But there are many thinkers who do not admit that there is valid evidence of any true evolution in the inorganic world in the sense of an automatic

and unguided progress from a simple to a complex state or from a crude to a more perfect condition.

The fact that there are 92 kinds of chemical atoms, each progressing in structure by one unit or step in what is called the atomic number, and each one identical with others of equal atomic number in whatever part of the Universe it is found, is an evidence that these atoms are "manufactured articles," as Herschell and Maxwell long ago declared. Moreover, we have no evidence that the complex atoms of large atomic number, such as Thorium and Uranium, have been produced spontaneously from those of small atomic number, such as Hydrogen and Helium, whereas we have everyday experience that the complex atoms such as Radium and Thorium break down spontaneously into the simpler forms of matter.

So far from there being any evolution of atoms, there is a steady and ceaseless decay or devolution, as shown by this breaking down of radio-active elements into simpler structures like the Helium nucleus and electrons.

It is the same with the agency called Energy. Like Matter, it exists in many forms, Light, Heat, Electric charge and currents, Mechanical motion, and potential Energy of strain, configuration, or gravitation.

These forms are convertible one into the other at a certain rate of exchange. But at every transformation some portion passes into the form of heat, which becomes diffused and cannot be collected again in a useful form. This dissipation of useful energy is always going on, and if the physical Universe had been existing for an infinite past time and no fresh energy created or brought into it, all Energy would by now have passed into the form of uniformly diffused and non-useful heat. But it has not yet arrived at that condition, and the inference is that at some past time, not infinitely remote, some external Power must have interfered to originate and distribute the energy and leave it to dissipate. These facts are perfectly inconsistent with the conception of a self-developing Universe, but imply a controlling and creating Intelligence.

## 2. THE RECOGNITION OF ORDER.

There is, however, another quality in the sum total of external things we call Nature, and that is that in some parts it excites in us a sense or appreciation of Order. We possess in our minds

a faculty or power of recognizing certain integral qualities in an aggregate of things which is independent for the most part of the nature of the things themselves. Thus, for instance, a number of trees may be arranged irregularly as in a forest or a number of pebbles disorderly as on a sea beach. If, however, those articles were arranged at equal distances in a straight line as in an avenue of trees, or in a pattern as in a tessellated pavement, we should at once appreciate a resulting quality we call "Order" in this aggregate.

Whether the articles are trees or pebbles or men or anything else does not matter. It is the spatial arrangement of them which excites our attention and recognition.

We know from experience that we ourselves can manipulate objects so as to arrange them in such spatial orderly fashion, and we furthermore know that such order requires intelligence or thought on our part or mental effort to produce it. Hence, whenever we see such Order we always conclude it to be the result of thought and not of accident. Disorder may arise from accident or the spontaneous operation of the forces of Nature, but nothing would make us agree that any very exact order was the result of chance. This is one way of stating a fundamental principle called the Second Law of Thermodynamics. Order requires intelligence to recognize it, and it also demands intelligence to produce it.

### 3. THE RECOGNITION OF PURPOSE, UTILITY, OR ADAPTATION.

There is another quality of individual things or of things in the aggregate, and that is purpose or adaptation. We see it, for instance, in the commonest man-made tools or household utensils. A spade, a rake, a knife, or a brush have this quality. A thing may not possess such utility taken alone, but a number of them may possess a suitability for a purpose, such as a brick or a tile.

It is a characteristic sign of intelligence or reasoning power to be able to fashion some raw material in such a way that it serves a certain purpose. The anthropologist who finds some flint fragments chipped in such a manner as to act as knives or arrowheads pronounces them human work, and no animal has been known to manufacture anything of the kind.

The higher we rise in the scale of intelligence the more complex or elaborate such structures become. Man is essentially a

tool-making or weapon-making being. The evidence and outcome of his intelligence is the degree to which he can impart utility and purpose to material objects for his own convenience and enjoyment. We can not only make such adaptations ourselves, but we can recognize them when made by others, and we always declare that such power is evidence of intelligence great or small.

#### 4. ADAPTATIONS AND ORDER IN NATURE.

There is clear evidence of certain adaptations in Nature which cannot have arisen spontaneously, and a few of these may be noticed here. In order that our earth may be suitable as the abode of life, at least in the form in which we know it, certain conditions must hold good. Life manifests itself not amorously, but in certain definite living organisms called vegetable or animal. These are built up of small units or elements called cells. The cell has a very intricate structure, and the material in which the vital powers seem to reside is called "protoplasm," although that term may cover several different kinds of material. This material is a colloidal or jelly-like substance of very unstable complex chemical constitution.

The simplest form of living organism consists of a little drop or blob of protoplasm. It contains a small special structure called the nucleus. It possesses three remarkable powers:—

- (i) It can spontaneously move or change its form.
- (ii) It can absorb from the surrounding medium (generally water) particles of non-living matter and convert them into protoplasm.
- (iii) When it reaches a certain size it can divide in two and produce two cells out of one. The nucleus at the same time divides.

These powers of spontaneous motion, assimilation, and subdivision or growth are not possessed by non-living matter. They are the essential characteristics of life. In the higher living organisms the multiplication of cells does not take place in a haphazard way, but they are guided and built up into a special animal or vegetable form. During their lifetime non-living matter is being converted into living matter, and living matter is breaking down into non-living matter.

In the higher organisms periods of activity and repose alternate. In the first the destruction of living matter pre-

dominates and in the latter the reconstruction. Moreover, for these life processes it is necessary that the organisms, at least the higher, should be immersed in an atmosphere containing oxygen gas for the animals and carbon dioxide gas for the vegetables at a certain pressure and exposed also to radiation, luminous or non-luminous at intervals, and also maintained in a region the temperature of which does not vary beyond certain rather narrow limits.

Now these conditions for life are all met in the simplest possible manner by the size and rotation of the earth in its axis and its rotation round the sun at a fixed distance.

The earth is a spheroid with a single axis of symmetry round which it rotates. That rotation maintains the axis by a gyroscopic action in a constant direction in space apart from certain slow motions called precession and nutation. The size of the earth is such as to maintain on its surface an atmosphere at present containing 20 per cent. of oxygen and some carbon dioxide. If the earth were as small as the moon it would have no atmosphere at all, and if it were as large as Jupiter it would have a very dense atmosphere, probably so cloudy that no sunlight could penetrate. The earth's distance from the sun is such as to maintain an average temperature on its surface well within the required limits for life of protoplasm, and its orbital rotation at a nearly constant distance keeps the temperature nearly constant. The rotation of the earth on its axis produces the phenomena of day and night. The axis of rotation of the earth is, however, inclined to the plane of its orbital rotation at an angle of about 77 deg., and this, combined with the constant direction of the axis during the orbital rotation, produces the larger day or cycle of the seasons—spring, summer, autumn, winter—which gives to vegetation the necessary periods of activity and repose.

All the physical conditions necessary for the manifestation of life in our material space-time world are achieved by rotation. Can we not say that this is an example of adaptation of means to an end? The evolutionist would say in reply that the kind of life which has appeared on this earth is one that is suited to the astronomical conditions, and if those conditions had been different the life would have been a different kind. He would advise us to beware of falling into the logical mistake of the schoolgirl who said, "What a fortunate thing it is that a large river flows through every great city!" On the other hand,

it is not certain that any other kind of physical life than that we have here on this earth can exist in our space-time material Universe.

It is clear that this could not exist on any of the other solar planets, even on Mars, where the climate is similar to that on the top of Mount Everest. There is strong reason for believing that a planetary system like our own is very rare, if not unique, in the Universe, and the nature and conditions of our earth are unique amidst that uniqueness.

##### 5. THE RECOGNITION OF STABILITY AS A PRODUCT OF THOUGHT.

In all our human constructions we recognize that there should be stability and it is only attained by careful thought. A house, a tower or a bridge must not be blown down by any ordinary storm. Also a ship must not capsize in a rough sea. If these disasters do happen we attribute it to want of sufficient forethought in the design, and we recognize the great thought required to secure this stability.

There are many cases in Nature in which we can recognize the same necessity for stability. One of the most important is that of the dimensions and form of the earth's orbit. When Newton had propounded his law of gravitation and shown that the planets were retained in their orbits by the mutual attraction of the sun and each planet, the question arose whether these orbits would be disturbed by the mutual attraction between the various planets themselves.

The problem was attacked by the eminent French mathematician Lagrange. He proved that the attraction of the various planets on the earth, chiefly that of Jupiter and Venus, varies periodically, and owing to the fact that the planets all circulate round the sun in the same direction these perturbations can never exceed a certain amount or alter permanently the earth's distance from the sun. If some of the planets revolved round the sun in one direction and some in another, and if the directions in which Jupiter and Venus in particular revolve were opposite to that of the earth, these perturbations might increase to a degree at which the earth might be drawn in course of time nearer or flung out farther from the sun and become unfit for the present type of life. As it is, the solar system is stable, and although the orbits are subject to small periodic variations they



do not permanently change. Considered simply as a problem in probability, the chance of a planet revolving one way or the other is denoted by the fraction  $\frac{1}{2}$ , but the probability that all the nine or ten planets circulating round the sun should revolve in the same direction as a mere matter of chance is about 1,000 to 1 against the occurrence of this uniformity. Accordingly, since they do rotate in the same direction, there must be some fundamental reason for it. Laplace's Nebular hypothesis of the origin of the solar system would account for it, but that hypothesis is inadmissible for other reasons. Jean's supposition that the passage of a large star near the sun at an early stage in the sun's life drew out by tidal action two long streamers of matter which broke up into discrete masses which formed the planets, would also account for it. In any case, the origin of the solar system is exceptional and cannot have come about by a commonplace accident, and whatever its cause we have produced as a result a stability which ensures permanence in the form and dimensions of the orbit of the earth and other planets.

Nevertheless, it will be seen that the above argument, commonly called the Argument from Design for a Purposive Intelligence as the origin of certain adaptations in Nature, has points in it open to attack owing to its incompleteness, as indeed Immanuel Kant well saw.

There is, however, a line of thought which affords a supplement to that argument from the presence in Nature of a quality difficult to define, but which is clearly not self-produced and not necessarily a consequence of mere existence, but requiring special adjustment to produce it, and also a faculty of recognition of it in ourselves, viz., Beauty. We ourselves can also in some degree create it, and hence from its presence in things not made by us we infer that this quality must have had its origin in a Mind not our own, also sensitive to Beauty.

#### 6. BEAUTY AS A SPECIAL QUALITY OF NATURAL OBJECTS.

We all recognize the quality we call Beauty in Natural objects whether in a human face or form, a landscape, a flower or an animal. It is, however, very difficult to give any complete or exact definition of beauty. It depends partly on form and partly on colour, outline and surface, and depends not only on the mere actual physical state, but in what it suggests as well.

Thus in the human being beauty suggests and is associated with youth, health, strength, grace and even psychical qualities, such as joy, purity and goodness.

In a landscape it is generally associated with well-marked atmospheric effects of light and shade, sunshine and shadow, colour and form in trees, mountains, lakes, rivers and waterfalls. Here also what we call beauty depends partly for its attractiveness on what it suggests, and the manifold emotions it arouses in us as well as on form and colour. Mountains by their massive grandeur, inaccessibility, steepness, snow-capped summits, and cloud-wreathed outlines arouse a feeling of the insignificance of all human physical powers in comparison with the mighty energies of Nature, which is impressive.

In fact, one of the conditions which must be present in order that a sense of beauty may be produced by natural scenery is that there must be a certain remoteness and absence of all human constructions in it. A lake surrounded by middle-class houses may be convenient and useful, but it does not excite in us the same feeling of beauty as some lonely tarn hidden away in the recesses of a mountain range, solitary and reflecting on its mirror-like surface only the dark rocky walls or grass-covered slopes of the summits which shut it in.

Man has, however, unhappily the power of destroying this natural beauty. Much of the lovely scenery round Snowdon and in North Wales had been ruined by the damming up of lakes, insertion of iron penstocks to lead the water down to electric stations, and more than all by the motor traffic which has converted lovely roads like the Llanberis Pass into dangerous streets and death-traps for the unwary.

## 7. THE RECOGNITION AND PRODUCTION OF BEAUTY REQUIRES INTELLIGENCE AND THOUGHT.

If we confine our attention to those cases in which human beings create beauty in articles made in metal, porcelain, clay, glass, stone, wood or textiles, which are not simply copies of natural objects, but original articles, like jewellery, ceramic ware, metal or wood work, furniture, or buildings, we notice that the ability to produce such articles which have the quality we call beauty is very rare. Such objects of art are therefore greatly valued, and our indignation is excited if they are wantonly disfigured or destroyed. It requires a certain training of eye

and mind to perceive their beauty and also a special ability called artistic genius to produce it. It never comes spontaneously or by chance, but is conceived first as an idea in the mind of someone, who then translates that idea into material substance of required form.

Now, may not the same thing be true of the beauty we see in Nature? This must be the product of special thought and feeling and the manifestation of it. We may notice that Beauty may be added to, but is not essential to utility. We ourselves can make useful pottery, chinaware, textiles, or woven material, as well as houses that are useful and convenient, but still ugly. It requires a rare ability to give beauty whilst at the same time retaining utility. Clothes, houses, furniture, may all be useful, but depressing in their ugliness, and only great skill can add the charm of beauty in form and colour without the sacrifice of usefulness. But in Nature we see everywhere this combination effected and even in the very smallest things which require microscopic examination to see them at all.

Sir James Jeans, reviewing the numerical phenomena everywhere present in natural objects, says that God must be a great mathematician. If, however, we fasten attention on the beauty present as well, we are forced to the conclusion that He is also the Supreme Artist. He has planted in our minds the power to appreciate this beauty in its various aspects or forms, and has given also the material on which to exercise that faculty.

### 8. BEAUTY MANIFESTED IN VARIOUS FORMS.

Note in the first place what pleasure we derive from harmonious or contrasted colours in Nature, yet outside of our minds there is no such thing as colour. Various material objects reflect and scatter certain selected rays of light of particular wave-length in the incident white light which includes all wave-lengths within a range of one octave.

These selected rays entering our eyes stimulate the rods and cones of the retina. Then some influence passes along the optic nerve to the optic centre of our brain and there in some quite inscrutable manner it is translated into a sensation of colour in the mind.

It would be an immense loss if we were deprived of this sense of colour. There have been, in fact, colour-blind persons to whom all Nature presented itself merely as a sort of photograph

in various shades of grey. The celebrated John Dalton, the chemist, was said to have been completely colour-blind, and admitted that he could imitate any colour by mixing together various proportions of powdered charcoal and salt.

Who, however, would not grieve to be unable to distinguish the thousand exquisite tints of flowers, the charm of the verdure in the spring, or the russets of autumn, or the ever-changing cloud colours of sunrise and sunset. This colour sense is certainly one great source of pleasure to us. All Nature is in such exquisite good taste there is nothing glaring or inharmonious.

Then next we have a source of pleasure in musical sounds. Our ears are sensitive to difference in pitch or frequency, to loudness, and to quality or purity in sounds. It is not merely the individual notes which matter, but the integral effect or order and duration as well as pitch and loudness which convey the beauty. If the notes of Handel's Largo in G or Bach's Air on the G string, or other familiar melody were arranged in any other way its beauty as music would disappear.

An important characteristic of any sound is its quality or degree to which it is pure or a mixture of harmonics. The quality of a human voice in speaking greatly determines the emotional appeal it makes to us. A voice that is "rich," as we say, is more arresting than one which is thin, grating or harsh, even when the same words are uttered.

Our sense of the beauty of music is also dependent on association with other events and it has marvellous powers to revive memories, create emotions, and stir sometimes the deepest feelings of our minds.

## 9. BEAUTY IN THE INFINITELY SMALL.

The quality of beauty is not merely seen in the large things of Nature, but it is also present in natural objects only to be detected when vision is assisted by a powerful microscope.

Amongst microscopic objects which exhibit in a remarkable way are those called Foramenifera, Radiolarians and Diatoms.

The first two are examples of low forms of life in the animal kingdom. The foramenifera construct for themselves wonderfully complex and beautiful shells of lime and form great tracts of Calcareous ooze on the ocean floor. Our chalk cliffs are for the most part the work of ancient foramenifera.

The radiolarians form a shell or skeleton of silica or flint in exquisitely beautiful spirals, lattices and stars.

The diatoms are minute plants with a box-like case or shell of flint or silica. They form the food of most small marine animals, which in turn are eaten by larger ones. The flinty cases after the death of their constructors, collected in large masses, form the so-called diatomaceous earth. It is this earth which, when impregnated with nitro-glycerine, forms the explosive called dynamite. These shells are of wonderful beauty, and yet so small that they form test objects for the microscope. It has been estimated that the diatomaceous earth of Bohemia contains 40 million such shells per cubic inch.

Not until the invention of the compound microscope was it possible to see and appreciate the beauty of many things in the range of the infinitely small.

#### 10. EVOLUTION ALONE NOT ABLE TO PRODUCE BEAUTY OR SENSE OF IT.

It is clear that natural selection or Evolution alone could not possibly produce in the human mind a sense or appreciation of beauty, because such sense serves no useful purpose in giving an advantage to the individual in the mere struggle for existence.

Neither, then, could it have produced that integral quality nor relation of parts in any object which can excite that appreciation of beauty in us. There is no reason to believe it exists in the animal races. An ape never stands entranced at the beauty of a sunset, nor does a cow rejoice in the carpet of flowers in the meadows of which she tramps.

No animal ever makes any attempt at artificial self-adornment.

Darwin and others have attempted to explain the brilliant plumage of birds or the colours of butterflies as due to sexual selection, and the colours of flowers as due to the attraction they exert on insects who then cross-fertilize them by conveying the pollen.

But it is clear that an attractiveness may exist without any corresponding sense of beauty. A staring advertisement compels us to draw near and look at it, but it very seldom excites a sense of beauty as well.

## II. CONCLUSION.

Our conclusion, then, is that Beauty is a special and widespread quality of things in Nature, recognized by a special quality or faculty in our own minds, not the outcome of mere chance, evolution, or the product of our own imagination, but one which bears witness to a great and particular attribute of the Creator, thus assisting and strengthening the argument for His Personality as against the hypothesis of an impersonal Evolution.

It draws from us His intelligent creation—feelings of wonder and worship of Him who has “so done His marvellous works that they ought to be had in remembrance.”

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*The paper was illustrated by the exhibition of about 50 lantern slides, showing various beautiful objects and places in Nature.*

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## DISCUSSION.

The CHAIRMAN (Dr. Thirtle) said: Once again the President has placed the Institute under an obligation, which should evoke ready response; and after what we have heard the expression of thanks may well be spontaneous and emphatic. During a succession of years as President of the Institute, Sir Ambrose Fleming has come before us with papers of great value and profound significance, and his utterances have ever commanded the close attention of Members and Associates. To-day is no exception to the rule, but with sustained delight it has been our privilege to follow him while demonstrating the thesis that Beauty in Nature serves as a Supplement to the Argument from Design.

Those of us whose memory sweeps a course of stirring decades now past, are able to recall days in which the Argument from Design occupied an important place in what was known as Natural Theology; and so far as we were careful to observe the progress of thought, we must have witnessed the virtual supersession of that vital argument, under the influence of ideas growing out of (and gathering round) the theory of Evolution. Those ideas, however, have failed of ready acceptance at the hands of men and women who have retained a regard for what is called Positive and Revealed

Theology ; in other words, who have valued what is known as Scripture Truth.

To satisfy the mind that has come under the influence of a full-orbed Christian instruction, Natural Theology must be supported by the body of doctrine derived from Holy Scripture—in other words, by Revealed Theology ; and, to be “furnished completely unto every good work,” we must know (and accept) the truth of Divine Revelation, as well as appreciate, in some measure, the round of things that grow out of the study of Nature.

A superficial view of Nature is not enough for the instructed Christian ; and, as we have found this afternoon, it is a superficial view that stands as an obstacle in the path of a full and satisfied Christian life. There is a demand for more ; and Sir Ambrose has covered ground which, among other things, goes to show that the Universe is greater than the materialist imagines, and that the properties of the Universe are richer than the scientific sciolist has seemed to discern. The result, as we shall doubtless agree, is one that tells for the things of faith, as we find them spread on the pages of Holy Scripture, and embodied in the Gospel of Christ. As we followed the massive periods comprised in the lecture, we could not but thank God for the strength of purpose that dominated the President’s mind, and the clearness of expression that characterized his paper from beginning to end.

We must all have been impressed with the conclusion of the lecture, wherein it was maintained that, as a special and widespread quality of things in Nature, Beauty bears witness to a great and particular attribute of the Creator, all-wise and all-powerful, and thus assists and strengthens the Argument for His Personality, as against the hypothesis of an impersonal Evolution.

It is with pleasure that I move that the thanks of the Meeting be formally accorded to the President, and declare the subject open for discussion.

Rev. Dr. H. C. MORTON said : I am glad that Sir Ambrose, in the brilliant paper he has given us, retains the Argument from Design as valid, and refuses to set it aside on account of Natural Selection ; moreover, that he fortifies it so well by consideration of the meaning of Beauty.

Even if Natural Selection were accepted—and if Evolution is to be accepted Natural Selection must be accepted, since there is no competing theory of the method of Evolution—Natural Selection clearly does *not* explain Design. Natural Selection acts solely by *eliminating* the unfit, not by bringing the fit into existence. It is no explanation whatever of the coming into existence of the fit, *i.e.* the existence of forms of life which are adapted to certain aims or to certain ways of life which Earth necessitates. Therefore there must be some other explanation of the existence of the fit and adapted forms. This is the Argument from Design, and Natural Selection does not make the slightest difference to it.

If Natural Selection is accepted as *a* method for eliminating the unfit, what we have to say is that when the Great Designer has found some of His designs spoiled by faulty material or by rebellious forces He eliminates some of them by Natural Selection. But we ought to be clear that Natural Selection does not affect in any way whatever the Argument from Design. It does not even enter the field.

Beauty—that elusive quality of which most, but not all, of us are aware—is always, I think, allied with a sense of fitness. Perhaps it would be truer to say that it consists of a sense of fitness. There is an indisputable beauty about any organism which is well adapted to its aim. A piece of machinery is beautiful *when well adapted*, that is, when well fitted to achieve its objects. It leaves the most pleasant impression upon the mind—only marred sometimes by hideous colour, badly chosen or ill-applied. Colour is always present in Nature, and colour is an undoubted element in all Beauty: but the colour must have the quality of fitness or harmony. In other words, I think it would appear to be true that Beauty is an element in Design itself, namely, adaptation to a purpose without any jarring features out of harmony with environment. Indeed Beauty is itself in its essence Design.

Plato in his *Philebus* discusses the nature of Beauty. He argues that “measure” is the *cause* of all right combinations, and that the *effect* of such right combinations is Beauty. Beauty is true proportion based on true measure. “The foundation of Beauty is a reasonable order, addressed to the imagination through the senses.” This is in full agreement with Sir Ambrose’s argument as presented before us this afternoon.



Words of warm appreciation of the paper followed by Mr. W. C. Edwards, Mr. Avary H. Forbes and Mr. R. Duncan ; and the vote of thanks to the President was passed with acclamation.

THE PRESIDENT'S REPLY.

Sir AMBROSE FLEMING expressed his warm thanks for the appreciation of the Members of the audience—especially to Dr. Thirtle and Dr. Morton—also to others for their undeservedly kind words concerning the paper he had had the pleasure of reading to them.