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714TH ORDINARY GENERAL MEETING,

HELD IN COMMITTEE ROOM B, THE CENTRAL HALL, WESTMINSTER, S.W.1, ON MONDAY, JUNE 4TH, 1928,

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 Election of the following as Associates:—Mrs. Marian Little, Arthur G. Harris, Esq., J.P., the Rev. A. J. Williams, M.A., Finch Perrott, Esq., and William H. Dempster, Esq.

The CHAIRMAN then called upon Dr. J. A. Fleming, F.R.S., the President, to give the Annual Address, entitled "Relativity and Reality."

ANNUAL ADDRESS.

RELATIVITY AND REALITY.

By DR. J. A. FLEMING, M.A., F.R.S. (*President*).

THE subject selected for this Address is too large and complicated to permit anything more than the mere fringe of it to be touched in the time at disposal, or for anything that could possibly be called adequate treatment by the present writer. Nevertheless, it is one which will afford us a number of points for consideration, no doubt revealing different views and opinions, and may, therefore, be acceptable as a

topic. It is the opinion, I believe, of more than one of our Members, that in the subjects selected for discussion at our meetings we do not sufficiently attempt to justify our secondary title as a Philosophical Society. Hence I have ventured this afternoon to point the way into regions where careful philosophic thought is required if we are not to lose ourselves in the mists of fruitless disputation.

1.—The Phenomenal and the Real.

Every one who has visited Switzerland and been to Zermatt remembers well the outline of the sharp peak of the Matterhorn mountain which there dominates the view.

If a picture or photograph without any subscript or title taken at this place were shown, such visitor would no doubt exclaim, "Why, that is the Matterhorn!" Not so many persons have seen the mountain from Breuil, on the Italian side, and fewer still from such western point as the Col du Lion, where the outline is again different. Suppose photographs were taken at these three places; anyone who did not know the district might think they were photographs of three different mountains. Such pictures are in two dimensions—that is, they have height and breadth but not thickness, the latter being only suggested by perspective and shadow. Hence, all distances in the direction of the observer are foreshortened, as an artist would say, or are distorted and made to appear as less than they are in reality. Points that are actually separated like two peaks of a mountain may, from one direction, appear as a single peak.

A closer contact with the mountain, as in climbing it, or by the inspection of a model of the mountain made in clay, convinces us, however, that these pictures are merely the appearance from different points of view of one and the same object having three dimensions—that is, length, breadth, and height.

This is merely a simple illustration of the familiar experience that all contact with the external world involves—first, a sensation or an impression made on a percipient mind at a particular place or from a certain point of view, and secondly, as is commonly believed, a permanent source of those impressions which is often called the thing-in-itself.

The fundamental problem of all philosophy is the nature of Reality, and the relation of the apparent or phenomenal world

of our perceptions to a possible real or external world independent of our percipient minds.

To the question, What is the ultimate reality or source of phenomena ? we may say that, broadly speaking, the philosophic answers may be grouped under three headings, respectively called Materialism, Idealism, and Realism.

The answer of Materialism is that the source of all phenomena is Matter or Substance in some form, and that the effects we attribute to Mind are solely the result of changes or operations of Matter in peculiar states, or else that Material Substance possesses not only physical but psychical powers which cannot be separated.

In its extreme form, as presented by Vogt, Moleschott, Büchner and Haeckel, this materialistic philosophy denied all possibility of Mind, Soul or Spirit, as distinct from Matter ; but it has in this aspect been discredited because it gives no valid explanation of the fact of human self-consciousness nor of the source of the order, beauty, and adaptation we find in the Universe, which are evidence of Mind. In a modified form it is, however, still with us in that theory of Evolution which regards the physical Universe as self-produced or produced by non-self-conscious agencies or principles. This theory is then driven to account for psychical phenomena as merely the operations of a highly organized unstable form of living substance called brain, or nervous tissue.

In Idealism we are supplied with an entirely different answer to our question. In the form in which it was presented by Berkeley, its teaching is that the ultimate reality in the Universe is Mind, and that the external or phenomenal world as perceived by us is simply the result of the direct operation on our minds of the ever-acting Divine Will and Intelligence. We have, therefore, no true knowledge of anything except our own perceptions and ideas. David Hume, however, pressed this philosophy to a point at which it resulted in almost complete scepticism.

Immanuel Kant sought to restore to philosophy a right appreciation of the relation of object to subject or thing perceived to the percipient mind.

Subjective Idealism in the form expounded by Berkeley fails as a philosophy to explain how there could be any Universe apart from conscious minds to perceive it. It is surely impossible for anyone to doubt that the Solar system, for instance, existed in some form long prior to the advent of any human intelligence to

perceive the sun, moon, and planets, and that it might continue to exist even if all humanity was annihilated. Modern Idealism does not deny the existence of an external world, and unites itself closely with the third form of philosophic thought, viz., Realism.

In this are postulated both the actuality of an external Universe of things, as well as truly existing percipient minds possessed of independent self-consciousness and freedom of choice as conjoined factors in all cognition. It has, therefore, sometimes been called Dualism, as it postulates two related but different entities, viz., Matter and Mind.

This Dualism seems, however, to be distasteful to much present-day scientific thought, and the latter inclines to a Monism in which Matter is regarded as a double-faced entity having inseparable psychic as well as physical properties. This Monism hopelessly fails to give any sufficient account of some unquestionable human experiences.

The most satisfactory reconciliation of our experience and intuitions is that which views the external world as a real existence, but operating as a means of communication between the Infinite Divine Mind and our finite minds.

In following along this path of Realism or Dualism we have to avoid falling into two errors of thought which border it on either side. We have to avoid carefully any confusion of the Divine Thought and Will which creates and the actual created Universe, which confusion leads to Pantheism, and, on the other hand, to refrain from adopting the view which has sometimes been called "the carpenter theory of creation," which regards the external world as something brought into existence and then left to itself. The true idea seems to be that the external world is continual concrete or embodied Thought, but in our present state of existence we cannot form any conception of the nature of the transition from Thoughts to Things.

The world of phenomena speaks to us, as it were, in a strange tongue, but we find ourselves not without power to interpret the thought expressed by it little by little. It is like some cryptic or cypher message which time, patience, and skill enable us to decipher. The very fact that the phenomena of Nature are to some degree intelligible to our minds is the highest proof that it is the product of a Supreme Intelligence not our own. Hence, the object of scientific investigation is the analysis and interpretation of these Divine ideas of which the physical or biological

phenomena we observe are, as it were, the letters or words expressing them, whether these are directly manifested to our senses or through special sense-exalting instruments such as telescopes, microscopes, spectroscopes, etc.

The physical Universe speaks to our minds through phenomena in symbolic language, and our object in scientific investigation is to penetrate behind these words to the underlying idea and thought.

We have learnt by our experimental and inductive methods to put questions to this speaker and obtain replies which we have to interpret as best we can.

Scientific investigation then finds its proper arena of operation in that region in which phenomena appear in an orderly and constant manner. Our scientific facts when truly ascertained are, so to speak, words which are constantly repeated to us. Our scientific theories are our interpretations of them in terms of our human range of thought.

But that interpretation proceeds by stages and may be quite erroneous and imperfect at any stage. Hence, from time to time we have to cast these theories aside and begin again, because we find them irreconcilable with augmented observation. Whilst, therefore, there are definite and final discoveries of fact, there is no necessary finality in our explanations or theories of them, although these may be stages in our approach to a right interpretation. Thus Newton observed certain effects in optics, and inferred that Light consists of particles he called Corpuscles shot out from light-producing sources. This interpretation explained some facts but not others. Huyghens, Young, and Fresnel made the supposition that Light consists of undulations in a universal medium called the Ether. The latter explained consistently vastly more than Newton's hypothesis, but it has been found of late that the undulatory hypothesis alone cannot explain certain effects such as those of photo-electricity. Recent experiments by Professor G. P. Thomson, described in a lecture by Sir J. J. Thomson, entitled "Beyond the Electron," have done much to reconcile these two theories.

2.—The Personal Factor in Observation.

The subject of our scientific investigation may not be merely some particular phenomenon in Nature, but also certain general

ideas produced in our minds by the sum total of phenomena such as the ideas of Space, Time, Energy or Mass.

These conceptions are quantitative—that is, subject to measurement in terms of certain units.

Up to a few years ago it was assumed that the measurements of them by different observers would always be in agreement. The searching analysis by Einstein and his followers has shown that this is not the case, but that the observer himself contributes some personal element to them.

The term " Theory or Principle of Relativity " which has been applied to this analysis is not, perhaps, the most illuminating which could be employed. It might better be called " The attempt to restate physical facts in such form as to be true independently of all observers." The word " Theory " connotes in most minds a mere speculation or hypothesis, and the term Relative is opposed generally to Absolute, and hence such phrases as " The Relativity of Knowledge " or " The Reign of Relativity " convey to some readers the idea that there is no possibility of attaining absolute truth on any subject.

The mathematical theory of Relativity which alone concerns us here is, however, not based on speculation, but rests upon a foundation of well-ascertained experimental fact and logical deduction therefrom. Its aim is to enable us to determine actuality or reality in a certain region of inquiry as opposed to mere appearances or phenomena. It may be well, then, to state in outline the nature of its basis.

Our knowledge of the external world is mostly obtained by vision, and the agency of vision is Light. A fact of fundamental importance is that Light takes Time to pass through Space, and the latest measurements have shown that its velocity is 299,850 kilometres per second, or 186,319 miles per second.

When anything takes time to pass through space we can only think of it as either the transmission of an actual object or else it may be a particular state which is propagated through a stationary medium such as a sound wave through air or a ripple on the surface of water. We have already referred to the two classical hypotheses which have been suggested to explain a ray of light. There are some reasons for thinking that both these theories have an element of truth in them, but that each is an imperfect view taken by itself. Astronomical observations seem to show, however, that the ether, if it exists, does not partake of the orbital or rotary motion of the earth, and therefore the ether must

pass freely through it. If this is so, then there must be a sort of ether wind blowing through or over the earth which in some direction may have a velocity of as much as 20 miles a second. Suppose a very long airship was flying through quiescent air. To those on board it would appear that a wind was blowing against them. If a man at the centre of the ship fired a pistol, a man at the stern of the ship would hear the bang a little before a man at the bows, because the former is moving to meet the expanding sound wave of the pistol and the man at the bow is moving away from the centre or source of the wave. Hence it follows that if a sound wave were to travel up a certain distance against a wind and be reflected back again, it would take longer to go and come than to travel there and back an equal distance across the wind.

As far back as 1887 an exactly similar experiment was tried with light, the moving earth being in this case the airship, but the experiments of Michelson and Morley, which have been carefully repeated since, showed that there was no observable difference between the velocity of the light in the two directions. It does not depend upon the motion of the source of light or the observer or the frame of reference, whether stationary or moving, with respect to which it is measured. It is a constant of Nature. In this respect light differs entirely from other types of wave motion. When this fact was expressed in mathematical language it was seen by H. A. Lorentz and by A. Einstein to involve consequences of a very astonishing kind. We cannot here give the proofs in detail, but they are furnished in many elementary books such as the lucid treatise by Mr. L. Bolton in his excellent *Introduction to the Theory of Relativity.*

The results, however, are as follows :—

Suppose two observers we will call A and B, both having identical clocks and similar measuring rods, and some standard of mass like a 1-lb. weight. Let these observers with their instruments move away from each other at a uniform rate and high speed, and let us suppose them to have telescopes or other appliances for seeing each other's clocks and rods.

If the observer A compares the rate at which the clock of B flying away from his is going, he would find it goes slow compared with his own clock—that is, its pendulum would appear to make less swings per minute when timed by his own clock than his own clock does. Also, he would find that if the measuring rod of B flying away from him has its length held in the direction of motion,

that it would appear shorter than his own rod which is stationary by him. Again, the moving mass would appear greater than when at rest close to him. Also as Einstein shows, two events such as two flashes of lightning might appear simultaneously to one observer, but would not necessarily be simultaneous to the other. The final result is that such quantities as lengths, times, velocities, masses, and coincidences are all relative in their measurement to a particular observer or frame of reference, and are different for various observers. Each, so to speak, sees a different universe. These differences are very small, because any speeds which we, as human beings, can command are excessively small compared with the velocity of light. Even the earth flying along in its orbit at 20 miles per second would appear to an observer outside the earth in a fixed position to be only $2\frac{1}{8}$ inches less in diameter in the direction of its orbital movement by reason of its motion.

Most persons might then say, Why make such a fuss about so small a change ? The answer is, that the size of the change is not the important matter, but the fact that there should be any change at all. If we deal with atoms and electrons the speed at which they can move does affect their sizes and masses to a notable degree.

When we endeavour to analyse more searchingly the reasons for these apparent changes in physical properties it becomes clear ; that is because we have become accustomed in thought to separate two conceptions of Time and Space, whereas they are, in fact, merely different aspects of the same entity. The founders of dynamics and kinetics or the laws of motion were Galileo and Newton. Newton started with the idea that Time flows, as he says, uniformly without respect to any events happening in it. He assumed Space to be mere unlimited emptiness and as affording only the possibility of motion for material things, and that motion may be in any direction or with any speed. He assumed that the geometrical properties of Space are everywhere the same. He also assumed that a material substance left to itself either stays in one place or moves uniformly in a straight line. If it changes its speed or direction of motion, that is ascribed by him to the action on it of an agency he called Force. He assumed that between all particles of matter a gravitational force exists which varies in amount inversely as the square of this distance and is proportional to the product of their masses.

All these are now known to be arbitrary assumptions and in some cases not quite correct. They are justified, however, to

a certain extent because they enable us to predict astronomical events such as eclipses, etc., within very narrow limits of time. They are not, however, the only basis upon which a consistent natural philosophy can be built up.

3.—The Starting Point of the Restricted Theory of Relativity.

Einstein starts his philosophy from one experimental fact, viz., the absolute constancy of the velocity of Light in all frames of reference, and next upon the almost axiomatic truth that the form of a mathematical equation or expression for any law of Nature must retain its form when the frame of reference is changed—in other words, must be an *invariant*. For the sake of those who are not mathematicians, this last term may receive a little further explanation. We determine the position of a point in Space by measuring its distance from three planes or three lines of reference or axes which are generally taken at right angles to each other. Thus the position of a point in a room is fixed when we know its shortest distance from the floor and adjacent two walls at right angles. These are called its coordinates. Time is also measured from some era such as midnight on January 1st or the beginning of the year A.D. 1. If, then, x, y, z denote the coordinates of one point and a, b, c that of another point, it is clear that the distance between these points is $\sqrt{(x-a)^2 + (y-b)^2 + (z-c)^2}$.

If the origin of the coordinates remains stationary, no matter where it may be taken, it is clear that the distance of these points will remain unaltered, and the expression for it is said to be invariant, because it retains its mathematical form. If, instead of considering two *points* in space, we have two *events*—say two electric sparks or anything else happening at two places—then we have to consider not merely their distance apart in space but their interval apart in time. Now we have seen that for observers in uniform motion with respect to the locality of these events, neither their space interval or time interval measurements are the same.

There is, nevertheless, a certain combination of Space *and* Time which remains constant for all observers.

If we multiply together a time interval and a velocity we have an equivalent space distance. Thus, if we can walk three miles an hour and walk for two hours we have covered a distance of

six miles. In the same way, if we multiply a Time interval in seconds by the velocity of light which is denoted by the letter c and is 186,319 miles, we have an equivalent Space interval. This product is called the *time coordinate.*

Now it is a remarkable fact that although neither the space distance of two events nor their time interval taken alone are invariant, the difference between the square of the space distance and the square of the time interval is invariable for all observers.

This means that time so converted to space, when a negative sign is prefixed, becomes a fourth dimension of space.

Space and Time considered separately are, therefore, as the mathematician Minkowski said, only shadows. They have no separate reality. The only measurable quantity which has real existence and remains constant for all observers is the above combination of space and time or four dimensional space, the fourth dimension being the product of time and light velocity.

We cannot visualize the nature of this four dimension space, because we can only visualize some combination of things actually seen, but mathematical rules allow us to determine its properties and powers.

There is one important difference between the time coordinate and the space coordinates, and that is that we are carried along the time coordinate without power to arrest or reverse our movement. We can come back to the same place in a certain framework of space reference, as, for instance, to the same place in this room as often as we please, but we cannot put ourselves back in time nor reverse or repeat the order of events which have taken place in between. The continuous series of events taking place in one object or person is delineated by a series of event-points forming a line called by Minkowski a *world line.* We cannot visualize the world line in the four dimensional space, but if we consider a material body such as a planet moving round the sun in one plane, then the space coordinates are reduced to two, and if the time coordinate is taken in a direction perpendicular to the plane of motion, then it is easy to see that the world line of the planet is a spiral line.

When events are thus translated into their equivalents in the four dimensional Space-Time they are stated in such manner as to be independent of the position and motion of the observer, and may, therefore, be said to have a reality which, compared with their appearance to us with our disunited space and time

mode of thought, is similar to that of the relation of the actual Matterhorn mountain to pictures of it taken from certain points of view.

At this stage it may be well to point out that apart from anything else the finite velocity of light is an obstacle to obtaining more than a phenomenal view by vision alone of the starry heavens. When we look at the star-spangled sky by night we see each star in the direction in which its rays of light reach our eyes, but on account of their immense distances and proper motion stars or nebulæ may have long since vanished from their visible position.

Thus, light takes $4\frac{1}{4}$ years to come to us from one of the nearest stars, viz., Alpha Centauri. It takes 8 years from Sirius, 10 from Procyon, 30 from Aldebaran, 44 from the Pole Star, 100 from Vega, 120 from Arcturus. But these distances, vast though they are, are small compared with those of many star clusters which are probably "island Universes" lying far outside of the Milky Way. Thus, Dr. Harlow Shapley, working at the Mount Wilson observatory, in the United States, has shown that the great globular cluster of stars in the constellation of Hercules is about 36,000 light-years distant, while some of the Magellanic clouds are upwards of 100,000 light-years away from us, and still fainter star clusters or spiral nebulæ on the boundary of our Universe as much probably as a million light-years or even hundreds of millions of light-years. When we remember that the light-year itself is a distance of nearly six million million miles, we see that long, long before the utmost limits of geological time these clusters have disappeared from the positions in which we now see, or think we see, them.

4.—The General Theory of Relativity.

So far we have only been concerned with what is called the Restricted Theory of Relativity, or that which concerns itself with uniform motion.

Most of the motions in the Universe are, however, accelerated —that is, the speed continually changes either in magnitude or direction or in both. Thus, if a stone is dropped from a height its speed continually increases during its fall. It falls 16 feet in the first second, 48 feet in the second, and 80 feet in the third.

The direction in which the earth moves in its annual motion round the sun is continually changing in direction and amount.

Newton laid it down in his *Laws of Motion* that this change of speed is due to an agency called *Force*, and in the case of gravitational force between masses such as the sun and earth he postulated that it is inversely as the square of the distance. It is clear, however, that this Newtonian expression for the law of gravitation cannot be the true one, because it is not invariant, since the measurement of distance depends or may depend on the motion of the observer.

Einstein set out, then, to discover a law of gravitation which should be invariant—that is, expressed in the same mathematical form in all frames of reference—and with remarkable mathematical skill he found it. An objection has always been raised against the Newtonian law, and that is that it assumes action at a distance. Newton himself felt the force of this objection and mentioned it in a celebrated letter to Bentley. Einstein has discovered a mode of explaining gravitation without the necessity for assuming any "force" acting at a distance.

We all know that the shortest line between two points on a plane surface is the straight line joining them. If the two points are situated on a sphere such as the earth then the shortest line is not a straight line or one drawn straight on a flat Mercator map, but is a line which is part of a great circle of the sphere passing through these points. Thus, ships voyaging across the Atlantic ocean travel as far as possible on great circle lines. These lines are also called geodesic lines.

In the four dimensional Space-Time there are also "world lines" which correspond to geodesic lines and may therefore be called by that name.

Newton said that a material body given an impulse and then left to itself moves in a straight line or shortest line. Einstein has substituted for this a more general statement which is true independently of all observers. A material body given an impulse and then left to itself follows a geodesic world line in four dimensional Space-Time. The geodesic world line is not the shortest line merely in space measurement. Moreover, Einstein made the remarkable discovery that the geometrical qualities or properties of Space-Time are altered in the neighbourhood of massive, or as we say, heavy bodies. Thus, in proximity to our sun the qualities of the space are not the same as at places very distant from it, and the form of the geodesic

lines are altered and become more curved. The difference, then, between the ideas of Newton and Einstein as regards the motions of the planets in the solar system are as follows :—

Newton said that a heavy or massive body such as the earth, when given a push in empty space and left to itself, would move away in a straight line due to its so-called inertia. If, however, it is in the neighbourhood of the sun, then in virtue of some agency called gravitational Force there is a pull drawing it to the sun and the combined action of the force of inertia and the gravitational force causes the earth to follow a slightly oval path round the sun called an ellipse.

On the other hand, Einstein says : There is no such pull or force. This so-called force of Newton is a mere philosophical fiction. The earth tends to follow along a geodesic line, and this line near a massive body such as the sun is a very curved line. The true orbit or path of the earth is not an ellipse which is traversed again and again, but a path equivalent to that of an ellipse the longer axis of which rotates in its own plane. This displacement or rotation of the " line of the apses," according to the Newtonian theory, is produced by the attraction of the other planets on the one considered. It has long been known that this rotation of the line of the apses is greater in the case of the planet Mercury than for any other, and moreover the Newtonian theory could not account for it entirely. But Einstein's theory explains it perfectly and predicts almost exactly the observed amount. Again, Einstein's theory predicts that light, being a form of radiant energy, has mass, and that therefore a ray of light passing near to a massive body like the sun should have its path slightly bent or deflected. This effect was found to exist in observations made at a total eclipse of the sun observed at Sobral in 1919, and again at another in 1922. In the third place, the Einstein theory predicts a change in the colour of a ray of light proceeding from a very massive body. Atoms are like clocks in a certain sense. They emit radiations of a definite frequency. Thus in the spectrum of the light emitted by a hydrogen or an iron atom we observe certain rays which present themselves as bright lines. Einstein predicted that when these rays proceed from an atom in a very massive star or sun, the frequency of vibration should be slightly decreased or the line slightly shifted towards the red end of the spectrum. Recent measurements made in the United States by Dr. C. E. St. John on 1,500 lines in the solar spectrum, have confirmed this prediction.

But although Einstein has thus been able to give a consistent explanation of gravity and the reason for the orbital motion of the planets round the sun, he has not been able to explain in a similar manner a far more potent force, viz., electrical attraction.

The force with which an atom of positive electricity called a proton is drawn towards an atom of negative electricity by electric attraction is so vastly greater than the mere gravitative or mass attraction between them that to express it numerically the number 22 would have to be placed in front of 38 cyphers, an inconceivably great number.

All that has been achieved, therefore, by the mathematical Theory of Relativity so far is a partial solution of a great problem.

All our theories of physical phenomena are, therefore, only imperfect interpretations of the underlying reality.

This does not mean that they are necessarily mere hallucinations and have no relation to truth. They may be partial interpretations of the Reality lying behind phenomena and have elements of truth in them.

They may, however, be perfectly erroneous if they start from the assumption that the final link in the chain of Causation is to be found in anything other than the Thought of a single Supreme Divine Intelligence and Will.

If this Universe is only a manifestation to us of the ever-acting Thought and Will of God, the ultimate realities must be spiritual and, therefore, not necessarily capable of being expressed or comprehended by the unaided intellect of man. No explanation, therefore, that our minds can devise or express of phenomena in the material universe is a final or ultimate one. It is relative to our present state of existence, and even in matters of pure physical science, all that we can say is, "Now we see through a glass darkly, but then face to face; now I know in part but then shall I know even as also I am known!" (1 Cor. xiii, 12).

5.—The Relativity of Human Values.

There is another field in which the difference between the relative and the real is strongly manifest, viz., in the arena of religious and ethical ideas and values.

This material Universe not only presents itself as a series of physical phenomena to percipient minds, but these last as self-conscious personalities or spirits having power of free choice,

desire, and action, have relations to each other and to their Creator.

The fundamental quality of spirit is sensibility, or the consciousness of personal states of feeling, or states of mind produced by various stimuli from without or within the personality. These produce in turn actions, or where these last are inhibited they engender desire. Some of these states are congenial or pleasant and some unpleasant. Hence, for each individual there is a certain value or degree of importance or desirability which attach to each of these sources of feeling. These are relative to the individual. We have all a set of values peculiar to ourselves with regard to these influencing states or stimuli.

One man, for instance, may consider that the highest importance and value attaches to the increase of personal possessions or wealth, but he may attach a small value to the risk of injury to others by questionable methods of obtaining it. Another may regard influence over his fellow-men or fame to have the greatest value, but a third may regard the pursuit of wealth and fame as of small importance or value compared with benefiting in some way his fellow-men or increasing the general welfare or happiness.

These different human values may be compared with the relative impressions as to form and size made by some object in the physical world on different observers; the absolute or real values with the dimensions measured in some system independent of all observers.

The question then arises, How shall we ascertain the absolute or true values or importance of these various objects of pursuit or desire in the mental and spiritual Universe?

Before attempting any answer to this question, we may glance at the various modes of classification of desires, actions, or values.

The first broad division is into right and wrong. Looked at purely from the human point of view, we call an action wrong which operates against the welfare of other persons or the community as a whole or ourselves. Thus, to steal is wrong because experience has shown that a stable human society cannot be built up on general dishonesty. There is another way of regarding the distinction, and from the latter point of view the terms right and wrong have reference not merely to human welfare, but to the accordance or discordance of the action with the Divine Will as expressed in a holy and all-perfect moral law.

Apart from this distinction as to right and wrong, there are other classifications of actions into wise and foolish, timely and untimely, or prudent and imprudent, safe or dangerous. An action which cannot be classed as wrong or foolish when done in moderation may be so when conducted in excess.

This leads us to notice briefly the very different relative values which nowadays attach to certain activities or things as compared with similar estimates in former times.

Consider, for instance, the altogether excessive importance which the conductors of daily newspapers, who reflect only average public opinion, attach now to success in competitive athletic sports and games. Those who excel in golf, lawn tennis, aviation, football, or cricket, whether men or women, are given a fame and notoriety compared with which the most eminent contributors to art, science, religion, or literature are mere nonentities.

These athletic pursuits or games are useful for bodily recreation or physical improvement, but the adulation and lavish attention given at present to those most successful in them is a mark of deterioration in the general power of assigning correct and true values to pursuits.

It is the same with certain other things, such as dress, theatrical performances, and other amusements. They have at the present time a much greater value or importance attributed to them than formerly, whilst many other serious and more beneficial occupations have a much-diminished value.

Just as the theory of Relativity shows that in physical matters each of us sees a different Universe as regards dimensions and duration depending on the position and motion of the observer, so each of us sees, so to speak, a different moral and ethical Universe in which various objects of human desire or activity have different values and importances. The objects which loom large in the mental and spiritual eye of some men are small in the eyes of others, depending upon the direction in which they are moving in a moral and spiritual sense, whether up or down.

It is the same with more important matters. The essential differences between them as regards real value are not perceived. Some are, as we say, " blind " to the true character of certain acts or activities, and these have a fictitious or distorted value given to them because viewed from only one point of view.

Thus, for instance, how few see the common vice of gambling in its true aspects? It is pursued simply for the chance of easily obtained wealth for the individual without any regard to its aspects from other points of view.

6.—Revealers of True Spiritual Values.

We return, then, to the consideration of the question how to reach an appreciation of the true values to be attached to various objects of human pursuit or desire.

In the physical world the agency which enables us to see material objects in right relation and proportion is Light. When we enter a new country in the dark or at night in feeble light, the nearer objects loom large. Hills which are near, but small, seem larger than distant mountains. But when the day dawns and sunlight comes these false values are corrected.

Hence to see ethical, moral or spiritual things in true relation and real importance we require an interior or spiritual light. This is something more than a mere phrase or figure of speech. There is a true inner illumination which can come to the soul of man, which reveals these human activities or desires, as well as moral and spiritual actions or states in their real magnitude or value, as compared with the false or relative values which imperfect human thought attaches to them.

This light originates in three sources. There is (i) the feeble light of Conscience; (ii) the clearer light of Revelation in the inspired Scriptures, or written Word of God; and (iii) the light which came to us from direct contact with the living Word of God, the final and true Light of the world, as revealed by the Divine Spirit to the believer.

Great efforts have been made to show that conscience is nothing but a so-called tribal instinct arising from the experience that the doing of certain things is inimical to the best interests of the tribe or race.

This, however, seems an insufficient account of it because it warns often against neglect to do good as well as doing that which is evil.

Shakespeare, who knew the human heart better than most men, does not regard conscience merely as a tribal instinct, but as an

internal witness to an external moral law. Turn to the plays of "Macbeth" or "Richard the Third," and many instances will be found.

These seem strongly to indicate that Shakespeare, at least, regarded conscience not simply as the result of human experience, but as a sturdy witness to a mighty moral law, independent entirely of human thought or experience.

Moreover, as Bishop Butler says in one of his Sermons on Human Nature, Conscience unless forcibly arrested magisterially exerts itself, and always goes on to anticipate a higher and more effectual sentence which shall hereafter second and confirm its own.

Nevertheless, neglect of its monitions causes its faint light to die away, and be replaced by a deeper darkness than before.

St. Paul shows this clearly in his first chapter of the Epistle to the Romans, in which the neglect by mankind to observe and follow out to their logical issue the evidences of Divine Wisdom in the material creation is followed by an interior darkness which prepares the way for the commission of deadly sin.

It is unquestionable that the light of conscience is at best a faint one and may easily become erroneous. It can become a Will-of-the-Wisp instead of a guiding light. Much evil has been done under the guidance of a supposed good conscience, and terrible cruelties inflicted by those who supposed themselves to be following the dictates of a conscience void of offence.

Then, next, we have the clearer light of revealed truth in the Holy Scriptures.

Here, again, rationalism has taken immense pains to try to prove the purely human origin of this literature; to abbreviate or delay the time of its production, multiply its authors and editors, and generally to undermine belief in its Divine origin and minimize its authority. But that superhuman origin and Divine authorship is supported by four great lines of argument which cannot be refuted. There is first the unity and uniqueness of this literature. There is no other literature of any ancient people, the production of which was spread over 1,000 to 1,500 years, and coming from the pens of more than threescore human authors, which has the peculiar character that when put together it seems to make one book and not many, and that all the parts elucidate and explain each other.

Then, in the next place, this literature has a singular tone of authority. It does not argue or demonstrate; it simply states or

asserts. In the earlier parts we have the phrase, "And God said;" in the middle portions, "Thus saith the Lord;" and in the Gospels, "Verily, verily, I say unto you." The third great evidence is in the predictive element of it. No efforts of the higher criticism have been able altogether to disguise the fact that there are predictions of events in it, and fulfilments of them at later dates. The history of the race, the Hebrews and Jews, with whom this literature originated is the standing proof of this fact. The Jews are the ever-enduring witness to the inspiration of the Scriptures.

Then, lastly, there is a peculiar and supernatural force or power about its words. A single verse of it seems to carry more appeal to, and food for, the human spirit than libraries full of merely human words.

What astonishing power it possesses to arrest attention, convict of sin, bring assurance of forgiveness, create hunger and thirst after righteousness, and rob death itself of its terrors.

There is no man-made literature which possesses the smallest fragment of this power.

The Bible compares itself as the Word of God to a light-giving source.

"Thy word is a lamp unto my feet and a light unto my path" (Ps. cxix, 105).

"The Commandment is a lamp and the law is light" (Prov. vi, 23).

"The entrance of Thy Word giveth light" (Ps. cxix, 130).

The prophetic element in it is compared by St. Peter to a "light that shineth in a dark place."

The Bible, then, is a source of light because it reveals to us the great realities of human life in their true magnitude and proportion.

On this point it is very likely some may offer the criticism that readers with equal sincerity and desire for the truth have yet drawn very different conclusions from the same passages of Scripture.

The Rationalist is accustomed to point out that whilst the Romanist seeks for certainty in the utterances of an assumed infallible church, the Protestant has looked for it in the statements of an assumed infallible book.

Perhaps the best answer to this difficulty is in the suggestion

that the Bible is not infallible when interpreted solely in the light of the unassisted human intellect, but is infallible in all matters pertaining to human salvation, when interpreted by the Holy Spirit to the spirit of man willing to make the great adventure of faith in carrying out its logical issue and in practice the truths so far revealed by the inner light already granted.

This our Lord explained in the statement, "My doctrine is not mine but His that sent me. If any man will do His will he shall know of the doctrine whether it be of God or whether I speak of Myself" (John vii, 16, 17).

This leads us to notice in the third place the true inner illumination that can come to the soul of man by direct contact with the Spirit of God.

7.—The Absolute or Final Reality.

God Himself is the great Reality, in the sense that He is the final, sole, and permanent Source of all things and effects. It is only when things and events are seen from His point of view, and close to Him, that they appear to us in their true values and proportions.

It is in this sense that Christ said, "I am the Light of the world; he that followeth Me shall not walk in darkness, but shall have the light of life" (John viii, 2). "I am come a light into the world, that whosoever believeth in Me should not abide in darkness" (John xii, 46).

The phrases "walking in darkness" or "abiding in darkness" used in Scripture, seem to mean not seeing facts or things in true relation or proportion or attaching false values to them.

That power of revealing absolute truth or true intrinsic values which appertains to God alone is signified in Scripture by the term Light, everywhere most appositely applied to the highest revelation of God in Christ. "That was the true Light, which lighteth every man that cometh into the world" (John i, 9). "God is Light, and in Him is no darkness at all" (1 John i, 5).

No one can look carefully and thoughtfully at much of the religious teaching and thought of to-day without noticing how widely different are the values given to certain things from the human and from the Scriptural or Divine point of view.

In one arena we see a large importance given to material symbols of spiritual things. We live at present in a material world, and are obliged, therefore, to use material things as symbols of spiritual realities. It is, however, essential that the symbols should be used as sparingly as possible and strictly in accordance with Scriptural instructions, so as to avoid the danger of resting on the material thing rather than the reality which lies behind it.

In the childhood of the race and under the Old Testament dispensation the things yet to come were denoted by material types, but now that the anti-types have appeared the attention should be fastened on them.

Hence, although certain material objects may be used to symbolize great spiritual realities, it is possible by an overwrought ceremonial religion to make the symbols themselves occupy the attention of the worshipper too much or else erroneously, and thereby check the growth of spiritual faculties.

The apostolic writers in the New Testament, following the example of their Lord everywhere, insist on the primary importance of spiritual things or events—the faith, the hope, the charity, the love to God and to man.

On the other hand, there may be and often is a movement in an opposite direction. Christianity is not infrequently preached at present as if it comprised only an all-embracing philanthropy, and what are called the social implications of the Gospel made the exclusive subject of attention.

Without doubt Christianity includes an unlimited philanthropy, but that is not the whole of it. There are explicit doctrinal teachings as to the individual relation of the soul to God, and especially as to the stupendous realities which underlie the words Sin, Atonement and Judgment.

It is a false value to regard sin as a mere imperfection, and to disregard the distinctly Scriptural teaching that it needs a remission which cannot be made by man to God, but only by God in Christ on behalf of man.

We cannot possibly adhere too closely to New Testament teaching if we are to apprehend and act upon the great realities there revealed.

The answer, then, to our question—How shall we ascertain the true realities or values of things and events in the moral and spiritual world ?—is that we must " walk in the Light."

If we ask the meaning of this phrase, the reply is perhaps best given in the words of Charles Wesley's fine hymn :—

"Christ, whose glory fills the skies,
Christ, the true, the only Light,
Sun of Righteousness, arise,
Triumph o'er the shades of night ;
Dayspring from on high, be near ;
Daystar, in my heart appear.

"Visit then this soul of mine,
Pierce the gloom of sin and grief ;
Fill me, Radiancy Divine,
Scatter all my unbelief ;
More and more Thyself display,
Shining to the perfect day."

After the reading of the paper, the CHAIRMAN proposed a cordial vote of thanks to Dr. J. A. Fleming, F.R.S., which was passed with acclamation.