LECTURE V. PSYCHOLOGICAL AND PHYSICAL CAUSAL LAWS

The traditional conception of cause and effect is one which modern science shows to be fundamentally erroneous, and requiring to be replaced by a quite different notion, that of LAWS OF CHANGE. In the traditional conception, a particular event A caused a particular event B, and by this it was implied that, given any event B, some earlier event A could be discovered which had a relation to it, such that--

(1) Whenever A occurred, it was followed by B;

(2) In this sequence, there was something "necessary," not a mere de facto occurrence of A first and then B.

The second point is illustrated by the old discussion as to whether it can be said that day causes night, on the ground that day is always followed by night. The orthodox answer was that day could not be called the cause of night, because it would not be followed by night if the earth's rotation were to cease, or rather to grow so slow that one complete rotation would take a year. A cause, it was held, must be such that under no conceivable circumstances could it fail to be followed by its effect.

As a matter of fact, such sequences as were sought by believers in the traditional form of causation have not so far been found in nature. Everything in nature is apparently in a state of continuous change,* so that what we call one "event" turns out to be really a process. If this event is to cause another event, the two will have to be contiguous in time; for if there is any interval between them, something may happen during that interval to prevent the expected effect. Cause and effect, therefore, will have to be temporally contiguous processes. It is difficult to believe, at any rate where physical laws are concerned, that the earlier part of the process which is the cause can make any difference to the effect, so long as the later part of the process which is the cause remains unchanged. Suppose, for example, that a man dies of arsenic poisoning, we say that his taking arsenic was the cause of death. But clearly the process by which he acquired the arsenic is irrelevant: everything that happened before he swallowed it may be ignored, since it cannot alter the effect except in so far as it alters his condition at the moment of taking the dose. But we may go further: swallowing arsenic is not really the proximate cause of death, since a man might be shot through the head immediately after taking the dose, and then it would not be of arsenic that he would die. The arsenic produces certain physiological changes, which take a finite time before they end in death. The earlier parts of these changes can be ruled out in the same way as we can rule out the process by which the arsenic was acquired. Proceeding in this way, we can shorten the process which we are calling the cause more and more. Similarly we shall have to shorten the effect. It may happen that immediately after the man's death his body is blown to pieces by a bomb. We cannot say what will happen after the man's death, through merely knowing that he has died as the result of arsenic poisoning. Thus, if we are to take the cause as one event and the effect as another, both must be shortened indefinitely. The result is that we merely have, as the embodiment of our causal law, a certain direction of change at each moment. Hence we are brought to differential equations as embodying causal laws. A physical law does not say "A will be followed by B," but tells us what acceleration a particle will have under given circumstances, i.e. it tells us how the particle's motion is changing at each moment, not where the particle will be at some future moment.

* The theory of quanta suggests that the continuity is only apparent. If so, we shall be able theoretically to reach events which are not processes. But in what is directly observable there is still apparent continuity, which justifies the above remarks for the prevent.

Laws embodied in differential equations may possibly be exact, but cannot be known to be so. All that we can know empirically is approximate and liable to exceptions; the exact laws that are assumed in physics are known to be somewhere near the truth, but are not known to be true just as they stand. The laws that we actually know empirically have the form of the traditional causal laws, except that they are not to be regarded as universal or necessary. "Taking arsenic is followed by death" is a good empirical generalization; it may have exceptions, but they will be rare. As against the professedly exact laws of physics, such empirical generalizations have the advantage that they deal with observable phenomena. We cannot observe infinitesimals, whether in time or space; we do not even know whether time and space are infinitely divisible. Therefore rough empirical generalizations have a definite place in science, in spite of not being exact of universal. They are the data for more exact laws, and the grounds for believing that they are USUALLY true are stronger than the grounds for believing that the more exact laws are ALWAYS true.

Science starts, therefore, from generalizations of the form, "A is usually followed by B." This is the nearest approach that can be made to a causal law of the traditional sort. It may happen in any particular instance that A is ALWAYS followed by B, but we cannot know this, since we cannot foresee all the perfectly possible circumstances that might make the sequence fail, or know that none of them will actually occur. If, however, we know of a very large number of cases in which A is followed by B, and few or none in which the sequence fails, we shall in PRACTICE be justified in saying "A causes B," provided we do not attach to the notion of cause any of the metaphysical superstitions that have gathered about the word.

There is another point, besides lack of universality and necessity, which it is important to realize as regards causes in the above sense, and that is the lack of uniqueness. It is generally assumed that, given any event, there is some one phenomenon which is THE cause of the event in question. This seems to be a mere mistake. Cause, in the only sense in which it can be practically applied, means "nearly invariable antecedent." We cannot in practice obtain an antecedent which is QUITE invariable, for this would require us to take account of the whole universe, since something not taken account of may prevent the expected effect. We cannot distinguish, among nearly invariable antecedents, one as THE cause, and the others as merely its concomitants: the attempt to do this depends upon a notion of cause which is derived from will, and will (as we shall see later) is not at all the sort of thing that it is generally supposed to be, nor is there any reason to think that in the physical world there is anything even remotely analogous to what will is supposed to be. If we could find one antecedent, and only one, that was QUITE invariable, we could call that one THE cause without introducing any notion derived from mistaken ideas about will. But in fact we cannot find any antecedent that we know to be quite invariable, and we can find many that are nearly so. For example, men leave a factory for dinner when the hooter sounds at twelve o'clock. You may say the hooter is THE cause of their leaving. But innumerable other hooters in other factories, which also always sound at twelve o'clock, have just as good a right to be called the cause. Thus every event has many nearly invariable antecedents, and therefore many antecedents which may be called its cause.

The laws of traditional physics, in the form in which they deal with movements of matter or electricity, have an apparent simplicity which somewhat conceals the empirical character of what they assert. A piece of matter, as it is known empirically, is not a single existing thing, but a system of existing things. When several people simultaneously see the same table, they all see something different; therefore "the" table, which they are supposed all to see, must be either a hypothesis or a construction. "The" table is to be neutral as between different observers: it does not favour the aspect seen by one man at the expense of that seen by another. It was natural, though to my mind mistaken, to regard the "real" table as the common cause of all the appearances which the table presents (as we say) to different observers. But why should we suppose that there is some one common cause of all these appearances? As we have just seen, the notion of "cause" is not so reliable as to allow us to infer the existence of something that, by its very nature, can never be observed.

Instead of looking for an impartial source, we can secure neutrality by the equal representation of all parties. Instead of supposing that there is some unknown cause, the "real" table, behind the different sensations of those who are said to be looking at the table, we may take the whole set of these sensations (together possibly with certain other particulars) as actually BEING the table. That is to say, the table which is neutral as between different observers (actual and possible) is the set of all those particulars which would naturally be called "aspects" of the table from different points of view. (This is a first approximation, modified later.)

It may be said: If there is no single existent which is the source of all these "aspects," how are they collected together? The answer is simple: Just as they would be if there were such a single existent. The supposed "real" table underlying its appearances is, in any case, not itself perceived, but inferred, and the question whether such-and-such a particular is an "aspect" of this table is only to be settled by the connection of the particular in question with the one or more particulars by which the table is defined. That is to say, even if we assume a "real" table, the particulars which are its aspects have to be collected together by their relations to each other, not to it, since it is merely inferred from them. We have only, therefore, to notice how they are collected together, and we can then keep the collection without assuming any "real" table as distinct from the collection. When different people see what they call the same table, they see things which are not exactly the same, owing to difference of point of view, but which are sufficiently alike to be described in the same words, so long as no great accuracy or minuteness is sought. These closely similar particulars are collected together by their similarity primarily and, more correctly, by the fact that they are related to each other approximately according to the laws of perspective and of reflection and diffraction of light. I suggest, as a first approximation, that these particulars, together with such correlated others as are unperceived, jointly ARE the table; and that a similar definition applies to all physical objects.*

*See "Our Knowledge of the External World" (Allen & Unwin), chaps. iii and iv.

In order to eliminate the reference to our perceptions, which introduces an irrelevant psychological suggestion, I will take a different illustration, namely, stellar photography. A photographic plate exposed on a clear night reproduces the appearance of the portion of the sky concerned, with more or fewer stars according to the power of the telescope that is being used. Each separate star which is photographed produces its separate effect on the plate, just as it would upon ourselves if we were looking at the sky. If we assume, as science normally does, the continuity of physical processes, we are forced to conclude that, at the place where the plate is, and at all places between it and a star which it photographs, SOMETHING is happening which is specially connected with that star. In the days when the aether was less in doubt, we should have said that what was happening was a certain kind of transverse vibration in the aether. But it is not necessary or desirable to be so explicit: all that we need say is that SOMETHING happens which is specially connected with the star in question. It must be something specially connected with that star, since that star produces its own special effect upon the plate. Whatever it is must be the end of a process which starts from the star and radiates outwards, partly on general grounds of continuity, partly to account for the fact that light is transmitted with a certain definite velocity. We thus arrive at the conclusion that, if a certain star is visible at a certain place, or could be photographed by a sufficiently sensitive plate at that place, something is happening there which is specially connected with that star. Therefore in every place at all times a vast multitude of things must be happening, namely, at least one for every physical object which can be seen or photographed from that place. We can classify such happenings on either of two principles:

(1) We can collect together all the happenings in one place, as is done by photography so far as light is concerned;

(2) We can collect together all the happenings, in different places, which are connected in the way that common sense regards as being due to their emanating from one object.

Thus, to return to the stars, we can collect together either--

(1) All the appearances of different stars in a given place, or,

(2) All the appearances of a given star in different places.

But when I speak of "appearances," I do so only for brevity: I do not mean anything that must "appear" to somebody, but only that happening, whatever it may be, which is connected, at the place in question, with a given physical object--according to the old orthodox theory, it would be a transverse vibration in the aether. Like the different appearances of the table to a number of simultaneous observers, the different particulars that belong to one physical object are to be collected together by continuity and inherent laws of correlation, not by their supposed causal connection with an unknown assumed existent called a piece of matter, which would be a mere unnecessary metaphysical thing in itself. A piece of matter, according to the definition that I propose, is, as a first approximation,* the collection of all those correlated particulars which would normally be regarded as its appearances or effects in different places. Some further elaborations are desirable, but we can ignore them for the present. I shall return to them at the end of this lecture.

*The exact definition of a piece of matter as a construction will be given later.

According to the view that I am suggesting, a physical object or piece of matter is the collection of all those correlated particulars which would be regarded by common sense as its effects or appearances in different places. On the other hand, all the happenings in a given place represent what common sense would regard as the appearances of a number of different objects as viewed from that place. All the happenings in one place may be regarded as the view of the world from that place. I shall call the view of the world from a given place a "perspective." A photograph represents a perspective. On the other hand, if photographs of the stars were taken in all points throughout space, and in all such photographs a certain star, say Sirius, were picked out whenever it appeared, all the different appearances of Sirius, taken together, would represent Sirius. For the understanding of the difference between psychology and physics it is vital to understand these two ways of classifying particulars, namely:

(1) According to the place where they occur;

(2) According to the system of correlated particulars in different places to which they belong, such system being defined as a physical object.

Given a system of particulars which is a physical object, I shall define that one of the system which is in a given place (if any) as the "appearance of that object in that place."

When the appearance of an object in a given place changes, it is found that one or other of two things occurs. The two possibilities may be illustrated by an example. You are in a room with a man, whom you see: you may cease to see him either by shutting your eyes or by his going out of the room. In the first case, his appearance to other people remains unchanged; in the second, his appearance changes from all places. In the first case, you say that it is not he who has changed, but your eyes; in the second, you say that he has changed. Generalizing, we distinguish--

(1) Cases in which only certain appearances of the object change, while others, and especially appearances from places very near to the object, do not change;

(2) Cases where all, or almost all, the appearances of the object undergo a connected change.

In the first case, the change is attributed to the medium between the object and the place; in the second, it is attributed to the object itself.*

* The application of this distinction to motion raises complications due to relativity, but we may ignore these for our present purposes.

It is the frequency of the latter kind of change, and the comparatively simple nature of the laws governing the simultaneous alterations of appearances in such cases, that have made it possible to treat a physical object as one thing, and to overlook the fact that it is a system of particulars. When a number of people at a theatre watch an actor, the changes in their several perspectives are so similar and so closely correlated that all are popularly regarded as identical with each other and with the changes of the actor himself. So long as all the changes in the appearances of a body are thus correlated there is no pressing prima facie need to break up the system of appearances, or to realize that the body in question is not really one thing but a set of correlated particulars. It is especially and primarily such changes that physics deals with, i.e. it deals primarily with processes in which the unity of a physical object need not be broken up because all its appearances change simultaneously according to the same law--or, if not all, at any rate all from places sufficiently near to the object, with in creasing accuracy as we approach the object.

The changes in appearances of an object which are due to changes in the intervening medium will not affect, or will affect only very slightly, the appearances from places close to the object. If the appearances from sufficiently neighbouring places are either wholly un changed, or changed to a diminishing extent which has zero for its limit, it is usually found that the changes can be accounted for by changes in objects which are between the object in question and the places from which its appearance has changed appreciably. Thus physics is able to reduce the laws of most changes with which it deals to changes in physical objects, and to state most of its fundamental laws in terms of matter. It is only in those cases in which the unity of the system of appearances constituting a piece of matter has to be broken up, that the statement of what is happening cannot be made exclusively in terms of matter. The whole of psychology, we shall find, is included among such cases; hence their importance for our purposes.

We can now begin to understand one of the fundamental differences between physics and psychology. Physics treats as a unit the whole system of appearances of a piece of matter, whereas psychology is interested in certain of these appearances themselves. Confining ourselves for the moment to the psychology of perceptions, we observe that perceptions are certain of the appearances of physical objects. From the point of view that we have been hitherto adopting, we might define them as the appearances of objects at places from which sense-organs and the suitable parts of the nervous system form part of the intervening medium. Just as a photographic plate receives a different impression of a cluster of stars when a telescope is part of the intervening medium, so a brain receives a different impression when an eye and an optic nerve are part of the intervening medium. An impression due to this sort of intervening medium is called a perception, and is interesting to psychology on its own account, not merely as one of the set of correlated particulars which is the physical object of which (as we say) we are having a perception.

We spoke earlier of two ways of classifying particulars. One way collects together the appearances commonly regarded as a given object from different places; this is, broadly speaking, the way of physics, leading to the construction of physical objects as sets of such appearances. The other way collects together the appearances of different objects from a given place, the result being what we call a perspective. In the particular case where the place concerned is a human brain, the perspective belonging to the place consists of all the perceptions of a certain man at a given time. Thus classification by perspectives is relevant to psychology, and is essential in defining what we mean by one mind.

I do not wish to suggest that the way in which I have been defining perceptions is the only possible way, or even the best way. It is the way that arose naturally out of our present topic. But when we approach psychology from a more introspective standpoint, we have to distinguish sensations and perceptions, if possible, from other mental occurrences, if any. We have also to consider the psychological effects of sensations, as opposed to their physical causes and correlates. These problems are quite distinct from those with which we have been concerned in the present lecture, and I shall not deal with them until a later stage.

It is clear that psychology is concerned essentially with actual particulars, not merely with systems of particulars. In this it differs from physics, which, broadly speaking, is concerned with the cases in which all the particulars which make up one physical object can be treated as a single causal unit, or rather the particulars which are sufficiently near to the object of which they are appearances can be so treated. The laws which physics seeks can, broadly speaking, be stated by treating such systems of particulars as causal units. The laws which psychology seeks cannot be so stated, since the particulars themselves are what interests the psychologist. This is one of the fundamental differences between physics and psychology; and to make it clear has been the main purpose of this lecture.

I will conclude with an attempt to give a more precise definition of a piece of matter. The appearances of a piece of matter from different places change partly according to intrinsic laws (the laws of perspective, in the case of visual shape), partly according to the nature of the intervening medium--fog, blue spectacles, telescopes, microscopes, sense-organs, etc. As we approach nearer to the object, the effect of the intervening medium grows less. In a generalized sense, all the intrinsic laws of change of appearance may be called "laws of perspective." Given any appearance of an object, we can construct hypothetically a certain system of appearances to which the appearance in question would belong if the laws of perspective alone were concerned. If we construct this hypothetical system for each appearance of the object in turn, the system corresponding to a given appearance x will be independent of any distortion due to the medium beyond x, and will only embody such distortion as is due to the medium between x and the object. Thus, as the appearance by which our hypothetical system is defined is moved nearer and nearer to the object, the hypothetical system of appearances defined by its means embodies less and less of the effect of the medium. The different sets of appearances resulting from moving x nearer and nearer to the object will approach to a limiting set, and this limiting set will be that system of appearances which the object would present if the laws of perspective alone were operative and the medium exercised no distorting effect. This limiting set of appearances may be defined, for purposes of physics, as the piece of matter concerned.