

II.—THE MEANING OF CAUSALITY.¹

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IN this lecture I propose to discuss what is meant, and what should be meant, by the word Causality. The question whether Causality, defined as we shall find reason to define it, does occur in the universe, will not be discussed. Personally I do believe that various existent realities in the universe are connected with one another by the relation of Causality, but the arguments which lead me to this conclusion would require more than a single lecture in which to explain them.

We must begin by considering what characteristics have, at different times and by different people, been considered as essential to causality. There are, I think, seven such characteristics, of which the first two are universally admitted to be essential to causality, while the other five are not:

In the first place, it would, I think, be universally admitted that causality is a relation of Determination. If A is the cause of B, then the existence of A determines the existence of B.² And it determines it in some way which does not hold between all things in the universe, so that it is possible for A to be the cause of B, and not the cause of C. We must, that is, give causality such a meaning that it is possible to say that the beheading of Charles I. was the cause of his death, but that it was not the cause of the death of Julius Cæsar.

What sort of determination is this? It is a determination of Implication. The cause implies the effect. What then do we mean by implication? I am using implication in what I believe to be the usual sense. I should say that implication is a relation between propositions, and that P implies Q when, if I know P to be true, I am justified by

¹ Henry Sidgwick Memorial Lecturer for 1914, delivered at Newnham College, Cambridge.

² It is not so universally admitted that the existence of the effect determines the existence of the cause. This will be discussed later.

that alone in asserting that Q is true; and, if I know Q to be false, I am justified by that alone in asserting P to be false. That is, the beheading of Charles I. implies his death, because, if I knew that he had been beheaded, I should be justified by that alone in asserting that he was dead, and, if I had known that he was not dead, I should have been justified by that alone in asserting that he had not been beheaded.

Strictly speaking, as we have seen, implication is a relation between propositions, or truths, and not between events. But it is convenient to extend our use of it, so as to say that, if one proposition implies another, then the event asserted in the first implies the event asserted in the second. It is in this sense that we say that the cause implies the effect.

It must not be supposed that implication is a subjective or psychological relation only. For we have not said that one event implies another because our knowledge of one causes us to assert the other, but because our knowledge of one *justifies* us in asserting the other. And this justification must be due to relation between the events themselves, and not merely to a relation between our thoughts of them.

In the second place, the relation of causality is always held to be a relation between realities which exist. We should not say that the definitions and axioms of Euclid were the cause that two of the sides of a triangle were longer than the third side, although this is implied in the definitions and axioms. For neither the definitions and axioms nor the proposition about the sides *exist*. But if an existent figure—some particular drawing or some particular piece of paper—was a triangle, we should, I think, naturally say that *its* triangularity caused two of its sides to be longer than the third. Again, we should not say that the law of the tides was partly caused by the law of gravitation, but we should say that the height of the sea at a particular time and place had the attraction of the moon as part of its cause.

Again, the beheading of an English king in the eighteenth century implies the death of that king. But we should not say that it caused it, because, in point of fact, no English king was beheaded in the eighteenth century, and so the relation of implication is not between terms which exist. All that we should say would be that, if a king of England had been beheaded in the eighteenth century, it would have caused his death—that is, to assert that, if the terms had been existent, the relation of causality would have held between them.

These two characteristics of causality are, I think, admitted by every one to be essential to that relation. But we now come to others, which are asserted by some thinkers to be essential to causality, while others deny this.

The first of these—the third in our general list—is that a certain activity is exerted by one term of the relation or the other, the name of cause being appropriated to the term which exerts the activity, and that of effect to the term on which it is exerted. Causation, it is said, is more than uniform conjunction. Even if the presence of A is invariably followed by the presence of B, this is not, it is maintained, sufficient to give causation, unless there is also present this activity. If it is asked exactly what is meant by such an activity, the usual answer is that each of us can observe it by introspection whenever an act of his own volition is the cause of the event which is willed in the volition.

The fourth point—which, as we shall see later, is very closely connected with the third—is that the cause determines the effect in some way in which the effect does not determine the cause. It is often held, for example, that our choice between resisting a temptation and yielding to it would be undetermined, if it were not caused, even if it were itself the inevitable cause of certain effects.

Fifthly, it is sometimes held that when the relation of causality holds between A and B, it involves that one of those terms is explained by its holding that relation to the other. When such an explanatory quality is attributed to causation, it is often held that the cause explains the effect, while the effect does not explain the cause. But sometimes the explanation is held to be reciprocal.

Those existent realities which are considered to be causes and effects are generally, though not always, events in time. This brings us to the sixth point. It is asserted that the cause cannot be subsequent to the effect. So much is very generally agreed, but there does not seem any general agreement that the cause must be prior to the effect. It is sometimes held that it can be simultaneous with it in time. Also it is held that a timeless existent reality can be the cause of events in time. For example, it is often held by theists that the creator who caused all temporal things is himself timeless. Nor would it be unusual, I think, to say that the Nicene Creed regarded the First and Second Persons of the Trinity as the causes of the Third, in spite of the fact that all three, and the Procession which relates them, are regarded as timeless.

In these cases, when the cause is not prior to the effect,

it would only be distinguishable from it by a discovery that one of the terms, and not the other, was the one which exerted an activity, or determined the other term, or explained the other term.

We pass to the seventh and last point. Here a word of preliminary explanation is wanted. When we look at what exists, we find that there are Qualities and Relations, and that there are things which have qualities, and which stand in relations. We may call qualities and relations by the general name of Characteristics. Characteristics have themselves other characteristics, but, besides this, we find that there are other things, which have characteristics, but which are not themselves characteristics. It will be convenient to call all of these Substances. It should be noted that if we define substance in this way—which I think, besides being the most convenient definition, is also the most usual—it will include more than is usually realised. For an event is something which has characteristics, and is not itself a characteristic. And thus not only can we so call by the name of substance such things as England, myself, and a pebble, but also such things as the battle of Waterloo or a flash of lightning.

Now a causal relation is always between substances. It is generally, though not always, between events, but it is always between substances. But—and here we come to the seventh characteristic—although it is itself between substances, it always rests on a relation between characteristics. The typical form of a causal proposition is that, whenever a substance occurs with the characteristic X, it causes a substance with the characteristic Y. We may say that the beheading of Charles I. caused his death, where we are speaking of particular substances. Or we might say that the most interesting event which has taken place in Whitehall caused the event from which the reign of Charles II. is measured. But we can only do this because “the beheading of Charles I.” and “the most interesting event which has taken place in Whitehall” are descriptions of an event which is the beheading of a human being, and “the death of Charles I.” and “the event from which the reign of Charles II. is measured” are descriptions of another event which is the death of the same human being, and because there is a causal law that the beheading of a human being always causes the death of that human being.

Of these seven characteristics, which have been asserted to be essential to causality, which shall we include in one definition? I think we should include the first two only,

and should say that causation is a relation of implication between existent realities—or, to put it more precisely, between existent substances.

My reason for leaving out the seventh characteristic from the definition is that, as I shall endeavour to show in a few minutes, it is implied in the two first. It is therefore true of all cases of causality, defined as I have defined it, but, since it follows from what is already in the definition, it is superfluous to add it.

With regard to the other four the case is different. I propose to leave them out for a different reason. I believe that by rejecting them we shall have a definition which is both more convenient, and, on the whole, more in accordance with ordinary usage. For, by the definition, I propose all that we assert, if we assert the validity of causality, is that the facts of the existent world are so connected with one another that it is possible, at any rate in certain cases, to infer one of them from another, and so form a basis for practical life and the validity of the empirical sciences. Now I believe that this is what people in general mean by causality, and that where these conditions are fulfilled, it would be in accordance with usage and convenience to say that there was causality. If that is the case, we ought not to put the other four characteristics under the definition of causality, even if they were true of all cases of causality.

There is also another reason why it is convenient to leave these other four characteristics out of the definition of causality. It is, I think, convenient, if possible, to reserve the term causality for some relation that actually does occur between all or most existent substances. Now, as I shall try to show, there is reason to judge that these four characteristics do *not* belong to any relation which holds among all or most existent substances.

If, on the other hand, we define causality, as I have proposed, as a relation of implication between existent substances; there is no reason whatever to believe that such a relation does not occur throughout the universe. That, of course, does not involve that there is any reason to believe that it *does* occur. I believe, as I said at the beginning of the lecture, that it can be proved to occur, but that is a point which we cannot consider to-day. But it remains the fact that it cannot be proved not to occur, and that almost every one does believe that it occurs—every one in fact who is not so thorough-going a sceptic as Hume. And, even if the relation does not occur, it is certain that the illusion that it does occur is one of which we cannot get rid.

No one realised more completely than Hume himself that, whether one event did imply another or not, we should always believe it, except when engaged in philosophic thought, and should act on our belief—that we should take food when we wished to appease our hunger, and not cut off our neighbours' heads unless we were prepared to cause their death. It seems therefore more convenient all round to define causality as a relation of implication between existent substances.

I must now proceed to justify the statements which I have made—that the seventh characteristic is implied in our proposed definition, and that the remaining four characteristics do not belong to any relation which holds between existent substance.

Let us first consider the seventh characteristic—that a causal relation, while itself a relation between substances, is based on a relation between characteristics of those substances. This, I submit, is involved in the fact that the relation of causality is a relation of implication. For all implication of one substance by another must rest on an implication of characteristics of the first by characteristics of the second.

This will be seen when we consider that implication must fall under one of two heads. Either it is evident *a priori* that the one term cannot occur without the other term in a certain relation to it—as when the triangularity of a particular figure determines the equality of its angles to two right angles. Or it is simply an ultimate fact that they are always found in a certain relation—as when a certain action in my brain causes the sensation of redness in my mind. Now it is clear that *a priori* implication of one substance by another can only happen as a consequence of *a priori* implication of characteristics, since it is only characteristics—qualities and relations—whose nature can be known *a priori*.

As for the second sort of implication, it depends on the terms always being found together, and has therefore no meaning unless they occur more than once. Now characteristics can occur more than once, for they are universal, and can occur in more than one particular case. But substances are themselves particular, and can only occur once. Therefore all implication must be based on the implication of characteristics. We can, indeed, say that one event implies another—for example, that the beheading of Charles I. implies the death of Charles I., where the two terms of the implication are both particular events. But this is only

because the first event has the characteristic of being the beheading of a human being, and the second event has the characteristic of being the death of the same being, and because the occurrence of an event having the characteristic of being such a beheading involves the occurrence of an event having the characteristic of being such a death.

It has not always been realised in the past that a causal relation must, in the last resort, rest on a relation of characteristics. And many of the difficulties in which writers on causation have involved themselves are, I think, due to their failure to see this, and, consequently, their failure to realise that any causal relation between particulars rests on a relation between universals—since all characteristics are universals. The reason of this failure has often, I think, been the belief that causality had the third characteristic which we enumerated—that there was an activity exerted by a cause or an effect. For, if this had been the case, it might have been maintained that the particular substance which was the cause did intrinsically determine the particular substance which was the effect, by means of this activity, and so implied it directly, and not by the intervention of characteristics. But, as we shall see, this conception of the activity exercised by the cause or the effect must be rejected.

We come now to the four characteristics which, as I have said, there seem to be good reasons for rejecting, as not being characteristics of any relation which does hold between existing realities.

The first of these is the third in our general list, which was spoken of just now—namely, that the cause exerts an activity or an effect. No reason, so far as I know, can be given why we should believe that such an activity exists. If we ask for a proof of its existence we are usually referred to the evidence of introspection. When I will to move my arm, and my arm is thereupon moved, I am directly aware, it is said, of an activity which I, the willing subject, am exerting.

Even if there were such an activity in such cases, it would give us no reason to believe that there was any such activity when the cause was not a volition, nor any indication of what the cause would, in that case, be like. And therefore some of the more consistent supporters of this view are driven to maintain that nothing but a volition is ever a cause—all events which are not the effects of human volitions being the direct effects of divine volitions, and having no other causes. As to this we may remark that it would be a very strained and inconvenient use of the word "cause," to say

that the *only* cause of the death of Charles I. was a divine volition, and that the beheading had no effect at all.

But I do not believe that there is any such activity to be perceived even when our volitions are causes. In my own case I can perceive no such activity. And I *can* perceive something else which could be mistaken for such an activity. I am conscious of willing. And then, after an interval of more or less duration, I am conscious that the result which I willed—the movement of my arm, for example, has taken place. In some cases, also, I am conscious of a feeling of tension or strain within myself. But this is all. Now this feeling of tension or strain is not an activity exercised by me on my arm. It is itself an effect of some cause or causes, and it is a psychical state, and falls wholly within the mind. But I venture to think that this feeling of tension is mistaken for an activity exercised by me on the arm. On these grounds I reject the view that we are directly aware of such an activity when our volitions are causes. And no other reasons have ever been given why we should believe such an activity to exist.

The fourth characteristic was that the cause determines the effect in some way in which the effect does not determine the cause. And it is for this reason that it is supposed that there must be a first cause in any chain of causation, while there need not be a last effect—that an unending series of causes of causes is impossible, while an unending series of effects of effects is quite possible. But, in truth, we do not find this characteristic in any relation of implication which holds between existing substances.

One reason why it has been thought that there is this non-reciprocal determination is, once more, the belief that the cause exerts an activity on the effect. If this were so, it is supposed, the term which determines the activity would determine the other term in a way which was not reciprocated. But this is of course invalid, if, as has been maintained above, there is no such exertion of activity.

Of course—and this may have contributed to the mistake—there really is a non-reciprocal determination between characteristics. Beheading determines death, but death does not determine beheading, since there are many other ways in which death can arise. But this will not justify us in saying that the cause has a non-reciprocal determination of the effect. Very often the determining characteristic belongs to the term which would be called effect, and not to the one which would be called cause. In the case given above, beheading and death, it belongs to the term which would be

called cause—the event of beheading. But, to take another case, we should certainly say that drinking alcohol was the cause of getting drunk, and not that getting drunk is the cause of drinking alcohol. And here the characteristic of what would be called the effect determines the characteristic of what would be called the cause, and not *vice versa*. For I cannot get drunk without drinking alcohol, but I can drink alcohol without getting drunk. It is therefore the characteristic of getting drunk which determines the characteristic of drinking alcohol, and not *vice versa*.

The fact is that it is impossible to say that either event determines the other non-reciprocally, because each event can be described by close and precise characteristics, or by vague and wide ones. And in proportion as it is described by vague and wide ones, they are likely to be such that they are determined without determining. We have seen that drinking alcohol is determined by getting drunk, and does not determine it. But any event which is a drinking of alcohol is also the drinking of a definite amount *M* under conditions *N*. And if we take *this* more definite characteristic we find that the drinking now determines the drunkenness and not *vice versa*. For it would be impossible to drink that amount under these circumstances without getting drunk, while it would be possible to get drunk without drinking that amount under these circumstances—a much less amount, for example, might be sufficient for a man with a different constitution.

Thus, of two events causally connected, we cannot say that the one which would generally be called the cause determines the other more than it is determined by the other. Nor can we say that whichever of the two does determine the other ought to be called the cause. Firstly, this would, as we have seen, involve that the one which was later in time should in many cases be called the cause, and the earlier the effect—which would be so contrary to usage as to be very inconvenient. Secondly, because the same event would often have to be called cause if you described it in one way, and effect if you described it in the other. An event, for example, which was described simply as drinking alcohol, would be called the effect of the subsequent drunkenness, but if it were more precisely described as the drinking of an amount *M* under conditions *N*, it would be called the cause of that drunkenness. This also would be extremely inconvenient. For all those reasons we must give up the fourth characteristic.

The fifth characteristic was that the discovery of a causal

relation between two events explained those events, or, at any rate, explained the event taken as the effect. Now if explanation here merely means that the events are taken as an instance of a general rule, then of course causality does give an explanation. If I ask why event B occurs, and am told that it was the death of a human body, that the beheading of the same body had immediately preceded it, and that there is a general law that the beheading of a human body is immediately followed by its death, then, in this sense, the event will be explained. But it will not be explained in any other sense, except that of being brought under the law. And, of course, in this sense, the law itself has not been explained. It, in its turn, may be explained by being shown to be a case of some more general law, but we must at last reach a causal law which is ultimate, and cannot be explained further.

But it is more than this which is meant when the characteristic we are considering is asserted. It is supposed that a causal law does not only say that every occurrence of X implies the occurrence of Z, but that in some way it shows us *why* every occurrence of X implies the occurrence of Z, and, that, as a consequence of this, a particular case of Z is explained by its causal relations in some deeper and more thorough manner than by being shown to be an example of a general rule.

Now it is very important to realise that every ultimate causal law—every causal law which is not a case of a more general law—asserts an ultimate connexion of two things—that is, a connexion of which we know that it does exist, but do not know why it exists.

This view is one which many people have been very unwilling to accept. They have been very anxious that causal laws should offer some explanation of that relation of characteristics which they assert, and their anxiety has led them in many cases to an entirely distorted view of the nature of causal laws.

In the first place, it has led to the belief that cause and effect are identical. If the cause is the same thing as the effect, it is thought that the relation between them—or rather the relation it has to itself—will be so obvious that it will be self-explanatory. But then any relation of a thing to itself cannot be a relation of causality. If, whenever we say that A is the cause of B, A is identical with B, what we mean is that B is its own cause, and the only cause it can have. And it is clear that this is not what is really meant by causation, and that it explains nothing, since it merely

connects a thing with itself and gets us no farther than we were before.

This seems so obvious that it seems strange that any one should deny it. And yet many great philosophers *have* denied it. The explanation is, I think, that what they are thinking of is that a cause and effect often have a common element. The egg is part of the cause of the chicken, and some of the content of the egg is some of the content of the chicken. Sugar and fruit are part of the cause of jam (not the whole cause, for there is also the person who makes it) and the same matter which was the sugar and fruit is the matter which is the jam. And we may perhaps say that the energy which was in the cause is also in the effect. But there are cases where there is no such common element. An east wind may be the cause of a bad temper. And the ambition of Napoleon may be the cause of bullet holes in the walls of Hougoumont. And in neither of these cases is there any common element that I can see, except those which are also common to things not causally connected.

But even when there is a common element this does not make the cause and the effect identical. Sugar and fruit may have a common element with jam, but they are not the same thing as jam, or we could not distinguish jam from them, which we can do. And when we say that sugar and fruit (*and* the jam maker) cause jam, what they cause are just the elements in the jam which are not identical with any elements in the sugar and fruit. The elements which are the same are not caused, but persist. We do not say that in making jam we cause its weight or its impenetrability.

Cause and effect, then, are not identical. And we must go farther. That any cause A has an effect B is never a self-evident proposition, in the way that it is self-evident that two straight lines cannot enclose a space. And, still further, it is never a proposition that can be proved by *a priori* considerations, in the way in which we can prove that the angles of a triangle are equal to two right angles. All ultimate causal laws are empirical truths. We know that they are so because, in point of fact, we find them to be so.

We have good reason to believe that, if a man's head is cut off, he dies. But our reason is purely empirical. We believe it either because it has been observed that, in none of the many cases in which a man has been beheaded, he fails to die, or else because it can be deduced from some wider law which itself rests on experience. Apart from experience we should have no reason to suppose that cut-

ting off a man's head would kill him than to believe that cutting his hair would kill him. Apart from experience, we have no more reason to suppose that cutting off my head would kill me than we have to suppose it would kill the executioner, or blow up the Taj Mahal, or destroy a mountain in the moon. We have good reason to believe that it will do the first, and not any of the other three. But our reasons are all empirical. All ultimate causal laws, in other words, are what is sometimes called "brute facts". But the name is misleading, since it rather suggests that there is some defect or imperfection about these facts, or about our knowledge of them, whereas the truth is that such facts not only have no reasons, but do not require any reasons.

There is one case in which it might seem particularly hard to admit that causal relations are here brute facts, and that is the case when a volition to do something—say to move one's arm—causes the movement. Surely, it might be said, even if it is not possible to be certain, apart from experience, that such volitions have such results, it could be seen, apart from experience, that it is likely to have such a result, and the probability, though not the certainty, is more than a brute fact? But this is mistaken. Except for empirical experience, it is just as probable that my volition to move my arm should move my leg, or Mount Everest, as that it should move my arm. This may be made more obvious if we reflect that the *immediate* effect of my volition to move my arm is to produce various changes in my brain, nerves and muscles, which I am not willing, and of which, perhaps, I know nothing whatever, and that, if for any reason this effect, which is not willed, fails, the effect which is willed fails with it.

The fifth characteristic, then, must be rejected. No relation of causality gives any explanation, except in the sense that it gives a general rule of which the particular case is an example. How about the sixth characteristic? This was that the cause could not be subsequent to the effect.

To answer this question, we must consider, in the first place, that we have not as yet found any criterion by which to distinguish the cause from the effect in a causal relation. The definition of causality which we have adopted was that it was a relation of implication between existent substances. The only difference between the two substances concerned which this relation involves is that one of them implies the other, while the second does not (except in cases of reciprocal causation) imply the first. But, as we saw when we were discussing the fourth characteristic, it would be im-

practicable to call the determinant substance the cause, and the other the effect. And thus our definition of causality gives us no criterion for distinguishing one term as cause and the other as effect. The third, fourth and fifth characteristics would have given us such a criterion, but we have found it necessary to reject them.

Accordingly, if we are to distinguish one term as cause and the other as effect it will have to be exclusively by means of a criterion based on the sixth characteristic. The earlier of the two terms connected by a causal relation will be called the cause, and the later the effect. But there will be considerable difficulties about such a use of words. If the distinction between cause and effect depends solely on temporal order, then there could be no causal relation between strictly simultaneous events. And, again, there could be no causal relation between two substances, one or both of which is out of time. A timeless God, for example, could not be the cause of the world, and between such a God and the world there could be no causal relation at all. Whether there is a God, and, if so, whether he is timeless, is another question, but there is, I think, no doubt that a use of the word "cause" would be very inconvenient if it prevented us from saying that such a God, if he existed, could be a cause.

Moreover, although it has been very generally held in the past that the earlier of the two terms should be called the cause, it has by no means been very general to hold that priority by itself is sufficient to make the earlier term the cause. It is generally, I think, believed that the earlier term is the cause because it is the earlier term which exerts an activity, or which determines the other, or which explains the other. And now that we have had to reject this view, it does not seem that we should be in very much harmony with ordinary usage, if we called the earlier term the cause, merely because it was earlier.

The course that I think most convenient therefore is to speak of causal relations as existing between two terms, but not to speak of one of those terms as cause, and of the other as effect. Of course, I am speaking here of philosophical usage. In ordinary life one should doubtless continue to say that a particular drinking of alcohol is the cause of a particular state of drunkenness. But philosophically we should say only that the drinking and the drunkenness stood in a causal relation to one another, since they were existent substances which stood in a relation of implication. What the implication, or rather the implications, may be, depends on the various characteristics of each. We saw above that,

if the drinking is described only as a drinking of alcohol, it is determined by the other, described as a state of drunkenness, and does not determine it, but that this is reversed if it is described as a drinking of an amount *M* under conditions *N*.

Of course it might be objected that, after all we have given up, we ought not to speak of causal relations at all. If we have given up all idea of activity, and of explanation, and of the non-reciprocal determination of the later term by the earlier, and if we have given up the designation of one of the terms as cause, and of the other as effect, ought we not to give up causality altogether? This view is taken by Mr. Russell, who, in his paper before the Aristotelian Society on the Notion of Cause, says that the idea of causality "is a relic of a bygone age, surviving . . . only because it is erroneously supposed to do no harm".

There is, no doubt, something to be said for this view, but, as I said previously, I think the balance is the other way. It is admitted that, for example, the occurrence of an event which is the beheading of a human being implies the occurrence of an event which is the death of the same human being. And I think that in this we have the essence of causality, and that we ought therefore to say that there is a causal relation between the beheading of Charles I. and the death of Charles I. Still this is, after all, a matter of definition. The results which we have reached which are more than matters of definition are that we ought to reject the conceptions of a cause which exerts activity, of a cause which explains its effects, and of a cause which non-reciprocally determines its effect, together with the further result that these rejections do not involve the rejection of the implication of one event (or other substance) by another.

We have then defined causality. The further question arises of the universal validity of causality. The question of whether causation is universally valid, or, indeed, valid at all, is beyond the scope of this lecture. All that I shall try to do is to state precisely what its universal validity would mean.

For causality to hold universally it would be necessary that each characteristic of any substance, in each case in which it occurred, should be implied by some other characteristic which had occurred. It would be necessary, then, that the following statement should be true. Let *G* be any characteristic which occurs, that is to say, which is found in any existing substance. Then, in each case in which *G* occurs, a characteristic, *Ha*, can be found, which occurs in a

relation, La to that occurrence of G , and which is such that, in each case in which Ha occurs, it will stand in the relation La to some occurrence of G .

Thus G might be the death of a human body. The Ha that we might find in connexion with a particular case of G might be the beheading of a human body. The relation La would then be that they were characteristics of the same body, and that the death immediately followed the beheading. And it is the case that whenever the beheading of a human body occurs the death of a human body is found in that relation to it.

I do not say that this is the form which causal laws invariably take. They do take it in some cases, but in others (especially, though not exclusively, in the sciences of inorganic matter) the laws of most importance take a quantitative form. For example, a change in the temperature of water determines a change in the space it occupies, and the amount of the one change is connected with the amount of the other according to some definite formula. But, although such a law as this does not take the form of the proposition given above, yet many propositions of this form must be true, if the law is to be true. If the changes of temperature and sign are connected in this way, then, whenever the change takes place from some particular temperature to another, there must be a change from some particular size to another. And then these two changes will be the G and the Ha , of which one is always found in a certain relation to the other. Such a law as that which correlates temperature and size will imply many such propositions as these, and cannot be true unless these propositions are true. And thus our statement above will have to be true in any field—whether the universe or a part of the universe—in which causality is universal, even though many of the causal laws are not expressed in this form.

The universality of causality is what is meant when we speak of the Uniformity of Nature, and we may therefore give the name of the Law of the Uniformity of Nature to our proposition which asserts that a causal law can always be found by which any particular occurrence of G is determined.

It will be noticed that our statement of the Law of the Uniformity of Nature does not assert reciprocal determination. The Ha which can be found for any occurrence of G is to be such that every occurrence of Ha stands in the relation La to an occurrence of G , but it has not been said that every occurrence of G will have an occurrence of Ha stand-

ing in the relation of $L\alpha$ to it. It may well be that different occurrences of G may be related respectively to occurrences of $H\alpha$, $H\beta$, and $H\gamma$, by the relations $L\alpha$, $L\beta$, and $L\gamma$, and therefore, while every occurrence of $H\alpha$ stands in a relation $L\alpha$ to a G , not every G has an occurrence of $H\alpha$ standing in the relation $L\alpha$ to it. Thus, in our previous example, the beheading of a body is always followed by its death, but the death of a body is not always preceded by its beheading. The death may be determined by hanging or poisoning.

Of course, if G does not reciprocally determine $H\alpha$, it will be necessary, if the law of the uniformity of nature should be true, that $H\alpha$, whenever it occurs should be determined by some other characteristic. Since, for example, the death of a body does not imply the previous beheading of that body, there must, if the law of the uniformity of nature be true, be some other characteristic, the occurrence of which on any occasion implies the beheading of a body. This need not be a characteristic of the body itself. The law may be that whenever a certain characteristic occurs in something in a relation to a body that body will be beheaded.

Why does the law of the uniformity of nature lead to this apparently one-sided result—that for every occurrence of G we can find an $H\alpha$ which determines G , while there is no guarantee that any $H\alpha$ can be found which G will always determine? The answer is that G stands in the law for any characteristic which occurs in the universe, whether that characteristic is a description so minute that it applies only to one case in the universe, or is so closely defined and so narrow in its application as “the death of a King of England,” or is as broadly defined and as narrow in its application as “event,” “substance,” “thing”. $H\alpha$, $H\beta$, etc., on the contrary are not *any* characteristics, but only such as fulfil the required conditions with reference to G . They can therefore be chosen so as to be as closely defined and as narrow in their application as is necessary to ensure that there shall be no occurrence of $H\alpha$, or of $H\beta$, which does not determine an occurrence of G .

The law of the uniformity of nature, then, does not imply the reciprocal determination of characteristics. How must a law be stated which would assert that reciprocal determination?

It is clear, in the first place, that any law which asserted that, whenever there was determination, there was reciprocal determination, would be false. We know that drunkenness determines the drinking of alcohol, and we know that the drinking of alcohol does not determine drunkenness, since

there have been cases in which men have drunk alcohol without getting drunk. Here, then, is at least one case of causal determination which is not reciprocal. Again, if an existent thing is red, that fact determines that the same thing shall be coloured. But the fact that an existent thing is coloured does not determine that it should be red.

If then universal reciprocal determination is taken to mean that every determination of one characteristic by another is reciprocal, it is clear that reciprocal determination does not hold universally. And when it has been said that all causal determination is reciprocal, something else, less far-reaching than this, has, I think, been meant. It has been meant, not that every determination of a characteristic is reciprocal, but that every characteristic has at least one determination which is reciprocal. The determination of death by beheading, it would be admitted, is not reciprocal, but, it would be asserted that all deaths by beheading have some particular characteristic which is found in no other sort of death, and that this particular sort of death and beheading are in reciprocal determination. Again, it would be asserted that there was some characteristic which occurred whenever the characteristic of death occurred, and only then, so that it stands in reciprocal determination with death.

If such reciprocal determination were universal, the law asserting it might be expressed as follows: Let *G* be any characteristic which occurs. Then, in each case in which *G* occurs, a characteristic *H* can be found, which occurs in a relation *L* to that occurrence of *G*, and which is such that in each case in which *H* occurs it will stand in the relation *L* to an occurrence of *G*, and that in each case in which *G* occurs, an occurrence of *H* will stand in the relation *L* to it.

It is impossible to prove empirically that this law does not hold universally. There may be many cases in which we do not see it to hold. There may be many characteristics, even among them for which we can find determinants, for which we cannot find any case of reciprocal determination with another characteristic. Yet for each of them there *may* be a determinant, unknown to us, where the determination is reciprocal. But, on the other hand, it would seem that it must be impossible to prove the law of reciprocal causal determination from the law of the uniformity of nature, even if the latter were itself established. For it is obvious that there is no contradiction in a determination which is not reciprocal, since, as we have seen, many determinations—such as the determination of death by beheading—are not reciprocal.

There is one more question about laws of causation which we may profitably consider. It has sometimes been asserted that complete knowledge of any substance would imply complete knowledge of any other substance, so that, if it were possible for us to know all that was true about any other substance, it would be ideally possible, with a sufficiently powerful intellect, to infer from this all that is true about every other substance in the universe, and the universe itself. This is apparently what Tennyson means when he says that if he could know completely what the flower was that he plucked from the crannied wall, he would know what God and man were. It is often said that this implication of the nature of each substance with that of every other must happen if the law of the uniformity of nature were universally valid, and could not happen unless it were universally valid.

This seems to me to be mistaken. In one sense this implication of the nature of each substance with that of every other is true, and it is true quite independently of the law of the uniformity of nature. In another sense it could be false even if the law of the uniformity of nature—and the law of universal reciprocal determination—were true.

The sense in which it is true, independent of the uniformity of nature, is as follows. Every substance in the universe is related to every other substance in the universe. Complete knowledge of all that was true about any substance A would include knowledge of all its relations to all other substances. This will include complete knowledge of all those other substances. For, if A has the relation L to B, then every fresh fact, C, about B is also a fresh fact about A, since it tells us that A has the relation L to something of which C is true. My relation to Julius Cæsar is not a very close one, but there *is* a relation, and therefore complete knowledge of me will include complete knowledge of Cæsar, since without complete knowledge of Cæsar it will not be known exactly what it is to which I stand in this relation. So a complete description of A—including all facts true of A—would include complete descriptions of all other substances. It would scarcely be correct to say that complete knowledge of B could be *deduced* from complete knowledge of A, but it would be true that, if we had complete knowledge of A we should have complete knowledge of B, and of every other substance.

But this inclusion of knowledge of all other substances in knowledge of A is not what is meant by the theory we are discussing. That theory asserts that from a knowledge of A which does not include knowledge of B, complete knowledge of B might be inferred by any one who had sufficient

knowledge of the laws by which one substance causally determines another, and sufficient power of reasoning to carry out the arguments required. And there seems no reason to suppose that this would necessarily be true, even if universal reciprocal causal determination were true.

That causal determination should be universal means that every occurrence of a characteristic in the universe is implied by the occurrence of some other characteristic in the universe. Now there is nothing in this to prevent it from being the case that there should be two substances, A and B, such that there is no characteristic of B the occurrence of which is implied, directly or indirectly, by the occurrence of any characteristic in A. (It is, of course, as we have just said, impossible that there should be any two substances in the universe which are not related in some way, but it does not follow from this that any two substances must be related by a relation of implication, since there are many other sorts of relation.)

And, even if it should be the case that every substance in the universe were connected with every other substance by relations of implication, the theory we are considering would not be proved. For it might still be the case that, though some characteristics of B were implied by characteristics of A, there were other characteristics of B which were not implied either directly or indirectly, by any characteristic of A. And, in this case, no knowledge of A will enable us to infer all the characteristics of B.

We have thus attempted to decide what should be meant by the word causality, and what would be meant by the universal validity of causal determination. The question whether causal determination is valid is beyond the scope of this lecture. Yet it may be pointed out that, if it is to be shown to be valid, it can only be in one way. To attempt to prove it empirically is hopeless, for all empirical proof must rest on induction, and induction itself rests on the uniformity of nature, so that any such argument would move in a vicious circle. And it is clear that the universal validity of causal determination is not *self-evident a priori*. In the mere assertion that it is not valid, taken by itself, there is nothing self-contradictory nor absurd. Only one alternative remains—that it should be capable of proof by a chain of reasoning resting on premises known *a priori*. It is further to be noticed that it does not follow that causal determination cannot be proved or be valid at all, unless it is proved to be valid universally. It might conceivably be proved to be true with respect to characteristics of certain classes, if it could not be proved about all.