

*Where Is
Science Going ?*

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WHERE IS SCIENCE
GOING?

— WITH A PREFACE BY —

ALBERT EINSTEIN

Translated and Edited

by

JAMES MURPHY

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CHAPTER IV

CAUSATION AND FREE WILL

STATEMENT OF THE PROBLEM

THIS is one of man's oldest riddles. How can the independence of human volition be harmonized with the fact that we are integral parts of a universe which is subject to the rigid order of nature's laws?

At first sight these two aspects of human existence seem to be logically irreconcilable. On the one hand we have the fact that natural phenomena invariably occur according to the rigid sequence of cause and effect. This is an indispensable postulate of all scientific research, not merely in the case of those sciences that deal with the physical aspects of nature, but also in the case of the mental sciences, such as psychology. Moreover, the assumption of an unfailing causal sequence in all happenings is the basis on which our conduct of everyday life is regulated. But, on the other hand, we have our most direct and intimate source of knowledge, which is the human consciousness, telling us that in the last resort our thought and volition are not subject to this causal order. The inner voice of consciousness assures us that at any given moment we are capable of willing this or that alternative. And the corollary of this is that the human being is generally held responsible for his own actions. It is on this assumption that the ethical dignity of man is based.

How can we reconcile that dignity with the principle

of causation? Each one of us is an integral part of the world in which we live. If every other event in the universe be a link in the causal chain, which we call the order of nature, how can the act of human volition be looked upon as independent of that order? The principle of causation is either universally applicable or it is not. If not, where do we draw the line, and why should one part of creation be subject to a law that of its nature seems universal, and another part be exempted from that law?

Among all civilized races the profoundest thinkers have tackled this problem and have suggested innumerable solutions. I have no intention of adding to the sum-total here. My reason for taking up the question in connection with my own science is that the controversy has now entered the scientific field. From suggestions which have been made as to the inapplicability of the causal principle to certain types of research in physical science extensive conclusions have been drawn and the age-old controversy is now being waged more bitterly than ever.

After all the thought that has been expended on it, since man first began to reason over his place in the universe, one might justifiably assume that the problem of causation would be nearer to a solution now than formerly, even if we grant that a complete and final solution is impossible, from the very nature of the question itself. And we might reasonably expect that at this stage of the controversy the disputants would at least be in agreement as to the nature of the fundamental issues under discussion. But the opposite is the

case. Nowadays it is not merely the problem itself that is debated; but even the very basic ideas involved in it are called into question—ideas such as the meaning of the concept of causality in itself and epistemological questions regarding the objects which should be considered to be within the legitimate scope of human knowledge, the difference between objects that are sensuously perceptible and objects that are outside this range and other such questions. All this quarrelling over fundamentals has added to the confusion.

The protagonists are mainly divided into two schools. One school is interested in the question chiefly from the viewpoint of the advancement of knowledge, holding that the principle of strict causation is an indispensable postulate in scientific research, even including the sphere of mental activity. As a logical consequence of this attitude, they declare that we cannot except human activity in any shape or form from the universal law of causation. The other school is more concerned with the behaviour of human beings and with the sense of human dignity, which feels that it would be an unwarrantable degradation if human beings, including even the mentally and ethically highest specimens of the race, were to be considered as inanimate automata in the hands of an iron law of causation. For this school of thinkers the freedom of the will is the highest attribute of man. Therefore we must hold, they say, that the law of causation is excluded from the higher life of the soul, or at least that it does not apply to the conscious mental acts of the higher specimens of humanity.

Between these two schools there is a great number of thinkers who will not go the whole distance in either direction. They feel in a certain sense that both parties are right. They will not deny the logical validity of the one position nor the ethical validity of the other. They recognize that in the mental sciences the principle of causation, as a basis of scientific research, is nowadays being pushed far beyond the borders of inanimate nature and with advantageous results. Therefore they will not deny the play of causality in the mental sphere, though they would like to erect a barrier somewhere within that sphere and entrench the freedom of human volition behind that barrier.

Among those who do not belong to either of the extreme schools perhaps I ought also to mention those scientists who are against the universal application of the principle of causality in physical science. They hold that it is inapplicable to the natural phenomena that are studied in quantum physics. But most of the scientists who hold this do not question the universal validity of the principle in itself. Still the attitude must be mentioned here; because, though it does not form anything like a school of thought, it indicates a tendency. And inasmuch as that tendency has been exploited by popularizers, who speak of spontaneity in the inner workings of nature, it deserves to be dealt with, if for no other purpose than to keep the lines of communication clear between serious science and the seriously thinking public.

As to the general controversy itself, if it did not

affect our approach to physical science physicists as such would not have to concern themselves with the matter. But the controversy now affects the very basic method on which scientific research is carried on. If the basis of causation be not valid, then how can the decisions arrived at on this basis be considered as reliable? Therefore the controversy affects the general claim to reliability which natural science puts forward. That is the reason why I am discussing it here as a physicist, in the hope that what I have to say may help to keep clear the grounds on which my own branch of science rests its claim to reliability.

Let us first consider the problem under its general aspect. What is the significance of the concept underlying the expression *Law of Causation*? In everyday life we are familiar with the idea of a *cause* and, like so many everyday things, we imagine that this idea is the simplest thing in the world to explain. Common sense and daily experience show us that all things and events are the products of other things and events. We say of what happens before our eyes that it is the effect of something else and we call that something else the cause, realizing at the same time that several causes may have contributed to bring about one and the same effect. On the other hand, we realize that effects themselves may be the cause of subsequent events.

When we find ourselves face to face with an event which we cannot possibly refer to any cause or series of causes, and which lies outside the range of all the causes that we are familiar with, then what happens?

Is it perfectly certain and necessary for human thought that for every event in every instance there must be a corresponding cause? Would the thought involve a logical contradiction that in this or that case the event has absolutely happened of itself and has no causal relation whatsoever to any other event? Of course the answer is in the negative; for it is very easy to *think* of an event as having no explanatory cause whatsoever. In such cases we speak of miracles and wonders and magic. And the simple fact that there exists a whole range of literature whose scenes are laid in wonderland is proof in itself that the concept of strict causality is not an inherent necessity of human thought. Indeed the human mind finds little difficulty in thinking of everything in the world as turning topsy-turvy. We can say to ourselves that to-morrow the sun may rise in the west, for a change. We can say to ourselves that a miracle of nature may occur, contrary to all the known laws of nature. We can think of the Niagara Falls for instance as shooting upwards, though this would be impossible in the world of reality. I can think of the door of my room in which I am now writing as opening of its own accord. And I can think of historical personages as entering the room and standing beside my table. In the world of reality to talk of such events may be meaningless and we may call them impossible, at least in our everyday way of reasoning. But we must distinguish this kind of impossibility from a logical impossibility, such as the idea of a square circle or that the part of something is greater than the whole, for no matter

what efforts we make to think such things we cannot think them, inasmuch as they entail an inner contradiction. We can think of a part and we can think of the whole to which it belongs but we cannot think of the part as greater than the whole. This kind of impossibility is inherent in the nature of human thought itself, whereas the idea of something happening outside the range of causation is quite logically coherent.

Thus from the outset we can be quite clear about one very important fact, namely, that the validity of the law of causation for the world of reality is a question that cannot be decided on grounds of abstract reasoning. But reality, no matter what may be said to the contrary, is only a particular and small section of that immense sphere over which human thought can range. This is true even though our powers of imagination have always to take their cue from some real experience. Indeed experience is for us the starting-point of all thought; but we possess the gift of going beyond reality in thought. And were it not for this faculty of the imaginative intellect we should have no poetry and no music and no art. Indeed it is one of the highest and most precious gifts that man possesses, this power of lifting himself in thought into the realms of light whenever the weight of everyday life presses upon him and makes itself intolerable.

The creations of art are similar to those of science at least to the extent that scientific research, in the strictest sense of the term, could never advance without the creative force of the imaginative intellect. The

man who cannot occasionally imagine events and conditions of existence that are contrary to the causal principle as he knows it will never enrich his science by the addition of a new idea. And this power of thinking beyond the range of causation is a prerequisite not only for the construction of hypotheses but also for the satisfactory co-ordination of results that have been arrived at through scientific research. It is the imaginative vision that puts forward a hypothesis. Then comes experimental research to put the hypothesis to its test. The results immediately arrived at through experiment have to be co-ordinated so as to form the basis of a theory, in the hope of discovering the laws of nature underlying the phenomena that have been studied. This work again calls the imaginative powers into play and further experiment puts the laws thus constructed to their final critical test.

To show how the scientific mind must necessarily imagine alternative happenings that lie outside the actual range of causation, when it is seeking to establish its conclusions, let us take a simple example from natural science as an illustration. Let us think of a ray of light coming to us from some distant star. Or indeed we can think of it as coming from some nearer source, such as an electric lamp. But let us think of it as passing through many transparent media of different nature and different densities, such as air, glass, water, etc., before it finally reaches the eye. What route will the light choose in coming from its point of origin to the eye of the observer? Generally speaking, this will not be a straight line; because

when light passes through one medium after another its direction is bent from the direction of the line of entry. We are all familiar with this phenomenon in the case of a stick put into water. The line of light coming from the stick to the eye is bent at the point of emergence. And so the line of transmission for a beam of light coming from a distant source to the eye will be bent in each of the different transparent media through which it passes; so that its course will be zig-zag, according to the number and varying densities of the media. Even in the atmosphere itself the line which a ray of light follows is quite irregular, because the atmosphere possesses different powers of deflection at different heights.

Now, can we get any formula which states the actual route which our imaginary ray of light follows? We can. The answer is very definite. It is contained in that remarkable law of nature according to which a ray of light leaving a distant source will always choose, from the many alternative routes at its disposal, that route which will bring it to the eye of the observer within the shortest time, allowing for the fact that the light has to pass through the different media at different rates of speed. This is called the Principle of Quickest Arrival. And it has been a very useful principle in scientific research. But it would have no meaning whatsoever were we not in a position to imagine other alternative ways through which the light might travel, though in reality it does not travel along these ways and therefore they are causally impossible, in the sense that light cannot actually

come by any other route. All the alternative routes that we may imagine are possible only in the abstract realm of the brain. They are impossible in the reality of nature. It is as if the light possessed a certain amount of intelligence and acted by the necessity of its own nature on the laudable principle of accomplishing its task in the quickest possible time. Therefore it has not the opportunity to dally and try out alternative ways, for it has to decide at once on the quickest way.

We have other similar cases in natural science such, for instance, as virtual motions which do not obey dynamical laws and therefore in the causal sense are impossible. But all these fanciful constructions play a very important rôle in theoretical science. They are employed as very useful instruments of thought in the carrying out of researches and the construction of theories. Therefore they certainly do not involve any contradiction of the laws of thought itself.

Once we have decided that the law of causality is by no means a necessary element in the process of human thought, we have made a mental clearance for the approach to the question of its validity in the world of reality. Now in the first place let us ask what is meant by the term, Causation? We might mean by it a regular interrelation between effects that follow one another in time. But we can at once ask whether this relation be founded in the nature of things themselves, or is it totally, or partly, a product of the imaginative faculty? Might it not be that mankind

originally developed this concept of causation to meet the necessities of a practical life, but afterwards found that if men were to confine themselves to an outlook exclusively based on this principle life would then turn out to be unbearable? We need not delay here to discuss the various philosophical aspects of these questions. For our present purpose it is much more important to ask whether the causal connection between events must be considered as absolutely complete and always unbroken or are there events in the world which do not enter the chain as connecting-links?

Let us first see whether this question can be settled by a systematic application of deductive reasoning. As a matter of fact some of the most famous philosophers in the history of human thought have produced solutions of the causal problem which were based on purely abstract grounds. They took their first stand on the axiom *ex nihilo nihil fit*, that nothing comes from nothing, in other words that no event in the world holds in itself an adequate explanation of its own existence. Reasoning back from this standpoint the philosophers of what is generally called the rationalist school established as a logical necessity the existence of a Supreme Cause. This Supreme Cause is the God of Aristotle and the scholastic philosophers. As a logical consequence of the line of reasoning thus adopted it was necessary to attribute to this Godhead the possession in their plenitude of all the perfections that are present in the world. If there be an actually existent Supreme Cause outside of the world, who is

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the Creator of the world and the Creator of all things in the world, then man can deduce the nature of this Supreme Cause only through a study of His handiwork. From this one can easily see that the nature to be attributed to that Supreme Cause must necessarily depend upon man's outlook on created things. In other words the concept of the Divinity in this case must take its colour from the world outlook either of the individual philosopher in question or of the particular cultural background to which he belongs. In the attempt which the scholastics made to harmonize the Jehovah of the Jewish culture with the rational God of Aristotle, emphasis was laid on the fact that there is no logical contradiction whatsoever in the idea of the Creator interposing his hand suddenly within the order of His own creation, and thus we have belief in miracles and wonders established on a philosophical basis. Therefore in the philosophy of the historic rationalist school, though the order of nature is admitted as inevitably predetermined by the Supreme Cause, yet the causal chain in the world itself may at any time be interrupted by the intervention of a supernatural power.

We pass now from the Greco-scholastic to the modern philosophical concept of the world. René Descartes is generally considered to be the father of modern philosophy. According to Descartes, God made all the laws of nature and all the laws that govern the human spirit by an act of His own free will and for purposes which are so recondite that human thought is unable to penetrate to their full meaning.

Therefore in Cartesian philosophy the possibility of miracles is by no means excluded. Moreover, the logical consequence of the inscrutability of God's design in the world is that we must admit the possibility of events the understanding of which lies entirely outside of the range of the human intellect. These may be called mysteries rather than miracles in the scholastic sense of the latter term. In other words, as our minds are not capable of encompassing the laws which guide the universe we must be content to treat certain happenings as beyond all our power of explanation and referable only to the mysterious ways of Divine Providence. For the purpose of science this means that practically we must admit the existence of breaks in the causal chain.

In contradistinction to the Cartesian Divinity, the God of Baruch Spinoza is a God of harmony and order, whose nature so interpenetrates all creation that the universal causal relation is itself divine and therefore absolutely perfect and permitting of no exceptions. In Spinoza's view of the world there is no room for accident or miracle. That is to say, the causal interrelation is absolutely unbroken.

The next great name that comes into view, when looking over the various world philosophies which were founded on a rationalistic basis, is that of Gottfried Wilhelm Leibniz. According to Leibniz the world was made in fulfilment of a plan corresponding to the supreme wisdom of the Creator. In every created thing God implanted the law of its own individual being, so that each being in the world is independent

Leibniz =>
independence of
individual beings

of and develops independently of all other things, following only the law of its own individual destiny. Therefore, according to Leibniz, the causal interrelation between one thing and another is only apparent. This means that we must exclude the principle of causation.

We may conclude, I think, from these few examples that the philosophical theories rationally deduced from abstract principles, as regards the place of the causal principle in the world, are almost as numerous as the philosophers themselves. It is obvious that along this road we can make no progress towards a solution of the general problem.

Now we come to a break in the philosophical tradition. Whatever may be said against the English empiricist school and its solipsist¹ consequences, at least it made a break with the naïve conceits of the traditional rationalist school and opened up the way to the development of a philosophical outlook which is more in harmony with the scientific view of the world. The outstanding characteristic in the teaching of the English empirical school is that there is no such thing as certain knowledge or innate ideas, such as were presumed by some of the earlier rationalist philosophers. The human mind as it comes into the world is an absolute blank, on which sense-given impressions are automatically recorded without any action on the part of the mind itself.

John Locke was the founder of this school. He represents the first systematic attempt to estimate in

¹ Solipsism is the theory that the only conscious being is myself.

a critical way the certainty and adequacy of human knowledge when confronted with the universe around it. According to Locke all ideas ultimately depend on experience and by experience Locke means the sensory perceptions of the five senses. Beyond these five senses there is only the reflective consciousness, which is not a sense, as having nothing to do with objects, but as Locke says "it may properly enough be called an internal sense." What we feel to be warm or cold or hard or soft and what we see to be red or blue, that we know; and no other special definition of it is necessary or indeed possible. One often hears of a delusion of the senses, as may happen in the case of a mirage, for instance. This however does not imply that the sensation itself is mistaken, but rather that the conclusions which we draw from the sensory perception are incorrect. What deceives us is not the perceive sense but the rationalizing intellect.

Sensory perception is something entirely subjective and therefore from this we cannot deduce the existence of the object. Green is not a property of the leaf but a sensation which we experience on looking at the leaf. And so it is with the other senses. Remove the sense-impressions and nothing of the object will remain. John Locke seems to have thought that the sense of touch plays a more important rôle than the other senses, because it is through this sense that we perceive the mechanical qualities of bodies such as thickness, extension, form and movement, and Locke seems to attribute these qualities to something in the bodies themselves. But the later empiricists, especially

David Hume, held that all mechanical qualities of bodies existed only in the senses of the perceiving subject.

In the light of this theory the so-called outer world resolves itself into a complex of sense-impressions and the principle of causation signifies nothing more than a certain order experienced in the sequence of one sensation after another. The idea of order is itself a sense-impression which must be taken as something immediately given and which does not permit of further analysis, for that order may come to an end at any moment. Therefore there is no causation. One thing is observed to follow another but observation cannot assert that it is "caused" by that other thing.

If a rapidly moving billiard-ball strikes against another and sets the latter in motion we experience two independent sense-impressions, one after the other: namely the sensory perception of the moving billiard-ball and the sensory perception of the one set in motion by it. If we stand beside the billiard-table as the play goes on these observations are repeated and we can register a certain regularity between the impressions. For instance, we can perceive that the velocity of the second billiard-ball depends upon the velocity and mass of the billiard-ball that strikes it. We can discover also a further order between these two phenomena. We can, for instance, measure the noise of the impact by its force and we can detect the momentary flattening on each ball at the point of contact with the other ball if we smear one of the balls with some coloured material. All these however are

only so many sense-perceptions which accompany one another regularly or displace one another regularly. But they are such that there is no logical connecting-link between the one and the other. If we speak of the *force* which the moving billiard-ball exercises on the one that is at rest, this is only an analogy concept which arises through the muscular sensation which we feel if we ourselves move the ball that is at rest with the naked hand rather than through the medium of the moving billiard-ball. The concept of force has been very useful for the formulation of the laws of motion, but from the viewpoint of knowledge it helps nothing whatsoever. And this is because we have no way of joining up, through a causal bond or a logical bridge, the different phenomena of motion that we have experienced. The individual sense-impressions are different and will remain different, no matter what relations between them may be perceived.

Here the meaning of the principle of causation, taken fundamentally, lies simply in the statement that from the same or similar sensory complexes as cause the same or similar sensory complexes will follow as an effect; but herein the question as to what may be looked upon as similar will on each occasion demand special proof. Formulated in this way, the principle of causation is deprived of all deeper meaning. But this of course does not mean that the law of causation has no practical significance for the human reason. All it means is that the postulate of causation does not furnish us with the grounds of any certain knowledge.

How then can the fact be explained that in common everyday life we take the causal relation of things as something objective and independent? How can this be if in reality we experience nothing more than orderly succession of individual sense-perceptions? The teaching of empirical scepticism answers that this happens through the enormous utility of the causal concept and through the force of habit. Habit certainly plays an important part in life. From childhood onwards it influences our temperament, our wills and our thought. We think we understand a thing merely because we have become accustomed to looking at it. The first time that something new strikes us we feel surprised; but if the same thing happens for the tenth time we find it quite a natural happening. If it should happen a hundred times we say that it is obvious and we even go the length of looking upon it as a matter of necessity. Over one hundred years ago or so mankind in general was acquainted with no other locomotive force except the muscular force of man and beast. As a consequence, no other form of force was considered possible. The pressure of the air and falling water was recognized and applied to mechanical purposes. But here the force itself was stationary and not locomotive in the arbitrary sense. Only men and animals by their muscular effort could move at will from one place to another. A story is told that when the first railways were seen running through the countryside the peasants betted with one another as to how many horses were concealed in the engine. With steam and electric motors everywhere our youth

Habit:
the unconscious
mind.

of to-day cannot easily understand the mentality of the peasant of one hundred years ago who felt the necessity of attributing locomotive transport exclusively to a natural horse power.

So far the sceptics are right in saying that it is by force of habit and custom that we attribute certain happenings to certain causes. But at the same time this force of habit cannot explain why we should make the attribution at all. In Fritz Reuter's story *Rei's Nah Bellingen*, the peasants undoubtedly made a ludicrous mistake in supposing that there were horses concealed in the steam engine, just as the ancient Greek peasant made a mistake in attributing the thunder to the personal anger of Zeus. But this is not the point here. The point rather is to answer the question why these events should be attributed to a cause at all and how it is that the concept of causation itself arises when we see one event following another. The mere regular succession of impressions does not explain this.

If we go a little deeper into the consideration of the empiricist theory and ask where it would finally lead us were we to pursue it to its logical consequences we shall thus be putting it to a practical test. In the first place we must bear in mind the fact that when there is question of sensory perception as the sole and exclusive source of knowledge, then there can be question only of each one's personal sensory perception in each one's own consciousness. That other men have similar perceptions we can assume only by analogy; but, on the empiricist theory, we cannot know this nor can we logically prove it. Therefore if

we are to abide by the logical consequences of the empirical doctrine and exclude all arbitrary assumption, we must confine ourselves, each one of us, to the grounds of his or her own personal sense-perceptions. Then the principle of causation is only a framework for our experiences, connecting them with one another as they enter through the senses and, being entirely unable to tell us anything of what is to come next, it cannot tell us whether the sequence of our experiences may not be broken in a moment. This condition of affairs would seem to obliterate every line of distinction between the sensory perceptions arising from the world of ordinary happenings and those that have no foundation whatsoever in that world. Take the case of sleep for instance. I may dream all sorts of things during the night; but the moment I wake up the reality of my surroundings gives the lie to the dream. The empiricist however cannot logically admit that. For him there is no waking reality; because the subjective sensation is the sole source of awareness in consciousness and is the sole basis and criterion of knowledge. Now the dreamer during the dream believes automatically in its reality and, according to the empiricists, the wideawake person believes automatically in the reality of his sense-perceptions; but has no more reason than the dreamer has for saying that one set of perceptions is false and the other true.

On the grounds of pure logic of course this system of thought, which is commonly called solipsism, is impregnable. The solipsist establishes his ego at the centre of creation, and he does not consider any

On the
Grounds
of pure
logic
impregnable

knowledge as real or sound except that which he for the moment is receiving through his sensory perception. Everything else is derivative and secondary. When the solipsist goes to sleep at night the world ceases to exist for him the moment his eyes and ears and sense of smell and touch become inactive. On rising in the morning everything is new to him again. Here of course I am only imagining what a human being would be if he were a logical consequence of the empirical teaching.

All this of course amounts to a repudiation of common sense; so much so that even the most advanced sceptics of this school find themselves constantly compromising between the claims of common sense and the purely logical conclusions of their own philosophic system. In this connection it is interesting to call attention for a moment to the figure of one of the most outstanding personalities in the subjectivist school, namely Bishop Berkeley. As a student Berkeley studied Locke. But he was of a very deep religious nature and launched a strong criticism against Locke's philosophy because of its scepticism. For Berkeley all things exist only in the mind and the external world can be accounted for only by saying that it exists in the mind of God. He arrives at the existence of God in this way: There are in our own consciousness impressions which are independent of our own wills and sometimes exist even contrary to our wishes. For these impressions we must seek a cause elsewhere than in ourselves and so Berkeley is led to establish the existence of God by practically the same line of

reasoning as the rationalist school. For him, however, mind and mind alone exists—the Divine Mind and the human mind. The world of reality as we perceive it exists only in our own mind. Therefore with Berkeley we have no right to talk about a causal interrelation between things in the outer world of reality.

To sum up, empiricism is unassailable on the fundamental ground of a pure logic; and its conclusions are equally impregnable. But if we look at it purely from the viewpoint of knowledge it leads into a blind alley, which is called solipsism. In order to escape from this *impasse* there is no other way open but to jump the wall at some part of it, and preferably at the beginning. This can be done only by introducing, once and for all, a metaphysical hypothesis which has nothing to do with the immediate experience of sense-perceptions or the conclusions logically drawn from them.

Immanuel Kant, the founder of the critical school, was the first to recognize this truth clearly and to point out the way in which the metaphysical step must be taken. According to Kant, the sense-impressions in our consciousness are not the only source of knowledge. The mind has certain concepts that are independent of all experience. These are the so-called categories; and in the philosophy of Kant they are a necessary condition of all knowledge. Kant concluded that causality is such a category. It is one of the ultimate *a priori* forms in which the understanding spontaneously orders its experience—something that is not a derivative from experience but on the contrary

is necessary to make orderly experience itself possible. Kant formulated the principle of causality in this way: "Everything that happens presupposes something from which it follows according to a law." Kant held that this postulate is independent of all experience. But Kant's proposition cannot be stated by saying that everything which regularly follows something else has a causal relation to that thing. For instance, there scarcely can be a more regular succession than that of night following day; but nobody would assert that the day is the cause of the night. Succession therefore is not of itself, as with the empiricists, the same as a causal relation. In the example given, namely that of day and night, we have two effects which follow from the same cause. This cause is two-fold. It consists on the one hand of the earth's rotation on its axis and, on the other hand, of the fact that the earth is opaque to the sun's rays.

In the Kantian system therefore the universal validity of the principle of causation is asserted. At the same time, however, it cannot be denied that Kant's teaching, though useful and conclusive in most of its results, is to a certain extent arbitrary on account of its strong dogmatic attitude. This is the reason why it became the subject of so much direct attack and has been altered somewhat with the course of time.

We need not trouble ourselves here with a detailed description of the development of the philosophical side of the causal problem since the time of Kant. It will be sufficient to point out the main features of this development. The strongest opposition to the Kantian

doctrine came from the side of those philosophers who maintained that it went too far into the metaphysical field. Now it is perfectly true of course that we cannot avoid metaphysics if we are to save ourselves from falling into the deadlock of solipsism; but, on the other hand, in so far as any system attempts to avoid the metaphysical extreme on the one side and the solipsist extreme on the other, it must be somewhat in the nature of a compromise with logic and therefore will present certain weak features. It is quite possible, however, to construct a system on this basis of compromise wherein the weaker features can be sufficiently strengthened for all practical purposes.

Kant's teaching, and with it the whole of transcendental philosophy from idealism to extreme materialism, is from the outset based on admittedly metaphysical grounds. In contradistinction to this, the positivist system, founded by Auguste Comte, has maintained itself as free as possible in its various shapes and forms from metaphysical influences. It achieves this end by making the experience of our own consciousness the only legitimate source of knowledge. According to the positivist teaching, causality is not founded in the nature of things themselves but is, to put it briefly, an experience of the human mind. It plays an important rôle principally because it has proved itself fruitful and useful. Thus the law of causality is the application of this experience. Because we can always exactly know what we ourselves have discovered by our own experience, the meaning of the causal concept is quite clear to us. But at the same time the possibility remains

that there may be cases to which our discovery is not applicable and which therefore contradict the law of causation. Whereas Kant teaches that knowledge without causality is impossible from the very outset, because the category of the causal concept was already in the human mind previous to any experience, the positivist standpoint is that the creative mind of man has fashioned the causal concept for its own convenience. Therefore it is not a primal, inborn quality in the mind. "Man is the measure of all things," said Protagoras long ago. We can twist and turn as we will but we can never get out of our own skins. And whatever tangent we may fly off at into the realm of the absolute we are always really moving around within our own orbit, which has been prescribed for us by the range of experience perceived in our own consciousness. To a certain extent it is not possible to gainsay this positivist attitude, though from the standpoint of transcendental philosophy there are many objections to it. And so argument and counter-argument follow one another in an endless interchange. For us the *dénouement* of the story is the confirmation of our previous conviction, namely, that the nature and universal validity of the Law of Causation cannot be definitely decided upon any grounds of purely abstract reasoning. The transcendental and positivist viewpoints are irreconcilable and they will remain so as long as the race of philosophers lasts.

If pure reasoning had the last word in dealing with such cases then the outlook would be hopeless for any satisfactory settlement of the causative problem. But

philosophy, after all, is only one branch of human activity in the study of problems effecting nature and mankind. Science is another branch. And where philosophy has failed in a given instance we are perfectly justified in turning to science and asking whether it may not have a satisfactory answer to suggest.

Now, let us first ask whether the various branches of science are divided against one another on this question of causation, just as philosophy is divided? At the very threshold of this inquiry it may be objected that a problem which falls within the scope of philosophy and which philosophy fails to solve cannot possibly be solved within the limits of a single science. This objection is urged on the grounds that philosophy furnishes the mental foundations on which scientific investigation rests. Philosophy must precede every special science and we should be going against the grain of our whole mental discipline if one of the special sciences were to take up the treatment of general philosophic questions.

That argument is very often urged. But in my opinion the weakness of it is that it leaves out of consideration the collaboration which actually exists between philosophy and the various special sciences. We must remember that the starting-point of all investigation and the mental equipment used in the pursuit of it are fundamentally the same in the case of philosophy as in the case of science. The philosopher does not operate with a kind of human understanding that is special to himself. The structure of thought

which he builds up is not based on any other foundation except that of his daily experience and the opinions which he has formed during the course of his professional studies. These latter must largely correspond to his individual talents and the background of his personal philosophical development. In a certain sense the philosopher is in a much higher position than the scientific specialist, because the latter confines observation and research to a much narrower range of facts that are systematically assembled and call for a deep and concentrated kind of probing. Therefore the philosopher has a better outlook on general relations which do not immediately interest the scientific specialist and which may easily pass unobserved by the latter.

The difference between the outlook and work of these two types of investigation may be compared to the case of two travellers who visit the same district together. The first traveller, let us say, is interested in the general features of the landscape, the undulations of hill and valley, and the varying patterns of forest and meadowland. The second traveller is interested only in the flora and fauna or possibly only in the mineral products of the region. His eyes are watching for particular specimens of the former, or he may select various patches of ground for scientific examination in the hope of discovering the presence of mineral wealth beneath. Now the first traveller certainly acquires a better knowledge of the landscape as a whole and can contrast it with other landscapes. From a general view he may conclude in a general

way as to the mineral qualities of the soil and the kind of vegetation or animal life that characterize it; but his deductions would be quite general and will depend for verification and clarity of statement on the opinion supplied to him by his companion. Therefore the work of the one is complementary to the work of the other; and there may be innumerable instances wherein the work of the second traveller will be absolutely necessary to the solution of problems which have baffled the man with the more general outlook.

This comparison, like every other comparison, is not fully adequate to the situation. But at least it brings out this point, namely, that in the case of a definite problem which philosophy recognizes as fundamental and the final solution of which is the business of philosophy alone, where philosophy cannot come to a decisive formulation by the use of its own methods it must seek information from the special branches of science in regard to particular features of the problem at issue. Now if the answer here turned out to be definite and final then it must be treated as such. It is a characteristic mark of every true science that the general and objective knowledge which it arrives at has a universal validity. Therefore the definite results which it obtains demand an unqualified acknowledgment and must always hold good. The progressive discoveries of science are definite and cannot permanently be ignored.

This is shown very clearly in the development of natural science. By means of wireless telegraphy we can now send whatever news we wish to the most

distant parts of the earth within the infinitesimal fraction of a second. Modern man can lift himself into the air in an aeroplane and transport himself from one part of the globe to the other, over valley and mountain and lake and ocean. By means of X-rays he can pry into the secret activities and inner functions of living organisms and can discover the location of individual atoms in the crystal. This objective achievement which science has accomplished, in collaboration with the technique that it has fertilized, has thrown into the shade some of the greatest discoveries of the philosophers of past times and made a laughing-stock of the crude arts of the magician.

Were anybody to close his eyes to such tangible results and talk about the collapse of science people in general would not think of taking the trouble to refute him. There is no need whatsoever to bring forward any elaborate proof of the contribution to the advancement of knowledge which science has to its credit. It is sufficient merely to point to the events that are before everybody's eyes. One has only to look up when sitting in one's garden and call attention to the drone of the aeroplane or to turn on a switch in one's study and bid the sceptic listen to voices that are coming from a distance of thousands of miles. The worth of any human endeavour is and always must be the results which it has obtained.

Now let us return to the particular problem that we are dealing with and let us admit for the moment the competence and reliability of the scientific method in the treatment of it. Let us ask how does science, in

each of its different branches, actually regard the problem of causation. Here it must be remembered that I am talking of specialized science as such and not of the philosophical or epistemological foundations on which it works. Does science as a matter of fact occupy itself exclusively with data immediately given by sensory impressions and their systematic organization according to laws of reason? Or does it at the very outset of its activities reach out beyond the knowledge given us by this immediate source and make, as it were, a jump into the metaphysical sphere?

I do not think that there can be any doubt whatsoever as to the answer. The first alternative is ruled out and the second affirmed in the case of each special science. Indeed it may be said that every individual science sets about its task by the explicit renunciation of the egocentric and anthropocentric standpoint. In the earlier stages of human thought mankind turned its attention exclusively to the impressions received through the senses, and primitive man made himself and his own interests the centre of his system of reasoning. Confronted with the powers of nature around him, he thought that they were animated beings like himself and he divided them into two classes, the one friendly and the other inimical. He divided the plant world into the categories of poisonous and non-poisonous. He divided the animal world into the categories of dangerous and harmless. As long as he remained bound within the limits of this method of treating his environment it was impossible for him to make any approach towards real scientific knowledge. His first

advance in this knowledge was accomplished only after he had taken leave of his own immediate interests and banished them from his thought. At a later stage he succeeded in abandoning the idea that the planet whereon he lives is the central point of the universe. Then he took up the more modest position of keeping as far as possible in the background, so as not to intrude his own idiosyncrasies and personal ideas between himself and his observations of natural phenomena. It was only at this stage that the outer world of nature began to unveil its mystery to him, and at the same time to furnish him with means which he was able to press into his own service and which he could never have discovered if he had continued looking for them with the candlelight of his own egocentric interests. The progress of science is an excellent illustration of the truth of the paradox that man must lose his soul before he can find it. The forces of nature, such as electricity for instance, were not discovered by men who started out with the set purpose of adapting them for utilitarian purposes. Scientific discovery and scientific knowledge have been achieved only by those who have gone in pursuit of it without any practical purpose whatsoever in view. The few examples that I have mentioned make this abundantly clear. Heinrich Hertz, for instance, never dreamt that his discoveries would have been developed by Marconi and finally evolved into a system of wireless telegraphy. And Roentgen could never have called up a vision of the immense range of beneficial purposes to which the X-rays are applied to-day.

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the metaphysical hypothesis — that there exists
an outer world which is entirely independent of
ourselves.

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WHERE IS SCIENCE GOING?

I have said that the first step which every specialized branch of science takes consists of a jump into the region of metaphysics. In taking this jump the scientist has confidence in the supporting quality of the ground whereon he lands, though no system of abstract reasoning could have previously assured him of that. In other words, the fundamental principles and indispensable postulates of every genuinely productive science are not based on pure logic but rather on the metaphysical hypothesis — which no rules of logic can refute — that there exists an outer world which is entirely independent of ourselves. It is only through the immediate dictate of our consciousness that we know that this world exists. And that consciousness may to a certain degree be called a special sense. And one may go even so far as to say that the existence of the exterior world strikes the consciousness of each individual in some particular way. It is as if we looked at some distant object through a pair of glasses and as if each one were wearing glasses of a slightly different shade of colour. And we must take this into account when we deal scientifically with natural phenomena. The first and most important quality of all scientific ways of thinking must be the clear distinction between the outer object of observation and the subjective nature of the observer.

Once the scientist has begun by taking his leap into the transcendental he never discusses the leap itself nor worries about it. If he did science could not advance so rapidly. And anyhow — which is fundamentally a consideration of no less importance — this

line of conduct cannot be refuted as inconsistent on any logical grounds.

Of course there is the positivist theory that man is the measure of all things. And that theory is irrefutable in so far as nobody can object on logical grounds to the action of a person who measures all things with a human rule, and resolves the whole of creation ultimately into a complex of sensory perceptions. But there is another measure also, which is more important for certain problems and which is independent of the particular method and nature of the measuring intellect. This measure is identical with the *thing* itself. Of course it is not an immediate datum of perception. But science sets out confidently on the endeavour finally to know the *thing* in itself, and even though we realize that this ideal goal can never be completely reached, still we struggle on towards it untiringly. And we know that at every step of the way each effort will be richly rewarded. The history of science is at hand to confirm our faith in this truth.

Having once assumed the existence of an independent external world, science concomitantly assumes the principle of causality as a concept entirely independent of sense-perception. In applying this principle to the study of natural phenomena science first investigates if and how far the law of causal relation is applicable to the various happenings in the world of nature and in the realm of the human spirit. Science finds itself here exactly on the same footing which Kant took as the starting-point of his theory of knowledge. As in the case of Kantian philosophy, so also

science assumes the principle of causality as a concept entirely independent of sense perception

in the case of each special branch of science the causal concept is accepted at the outset as belonging to those categories without which no progress in knowledge can be made. But we must make a certain differentiation here. Kant took not merely the concept of causality but also to a certain degree the meaning of the causal law itself as an immediate datum of knowledge and therefore universally valid. Specialized science cannot go thus far. It must rather confine itself to the question as to what significance the law of causality can be proved to have in each individual case, and thus through research give practical meaning and value to the empty framework of the causal concept.

CHAPTER V

CAUSATION AND FREE WILL

THE ANSWER OF SCIENCE

WE now come to ask whether and how far science can help us out of the obscure wood wherein philosophy has lost its way. What is the practical attitude adopted by the special sciences in regard to the universal and invariable validity of the law of causation? Does science in its everyday investigations accept the principle of causation as an indispensable postulate? Does it act upon the assumption that there are no loopholes in the causally governed order of nature? Or, while using the principle as a working hypothesis, does scientific practice intimate that there are certain happenings in nature where the law of causation does not function, and that there are regions in the mental sphere where the causal writ does not run? In our endeavour to find a definite answer to those questions we shall have to put them singly to each of the several branches of specialized science. In doing this of course we shall have to be content with quite a summary cross-examination. What has physical science to say to our problem? What has the science of biology to answer? And what have the humanist sciences, such as psychology and history, to say?

Let us begin with the most exact of the natural sciences, namely, physics. In classical dynamics,

among which we must include not only mechanics and the theory of gravitation but also the Maxwell-Lorentz view of electrodynamics, the law of causality has been given a formulation which for exactitude and strictness may be considered almost as ideal, even though it may be somewhat one-sided. It is expressed in a system of mathematical equations through which all happenings in any given physical picture can be absolutely predicted if the time and space conditions are known—that is to say, if the initial state be known and the influences which are brought to bear upon the picture from outside. To put the matter in a more concrete way: according to the law of causation as expressed in the equations of classical dynamics, we can tell where a moving particle or system of particles may be located at any given future moment if we know their location and velocity now and the conditions under which the motion takes place. In this way it was made possible for classical dynamics to reckon beforehand all natural processes in their individual behaviour and thus to predict the effect from the cause. The last significant advance which classical dynamics achieved in our day came about through the general relativity theory of Einstein. This theory welded together Newtonian gravitation and Galileo's law of inertia. Several attempts have been made recently to show that the relativity theory corroborates the positivist attitude and in a certain sense is incompatible with transcendental philosophy. These attempts are entirely mistaken. For the foundation of the relativity theory is not based on the rule that all

the foundation of relativity theory is that in the four-dimensional space-time manifold, there is a measure

THE ANSWER OF SCIENCE which

for all reference systems + for all measuring observers has the self-same value.

time and space dimensions have only a relative meaning, which is determined by the reference system of the observer. The foundation of the relativity theory lies in the fact that in the four-dimensional space-time manifold there is a measure, namely the distance between two points approximating with infinite closeness. This is the so-called Tensor or *Massbestimmung*, which for all measuring observers and for all reference systems has the self-same value, and it therefore is of a transcendental character entirely independent of any arbitrary action of the human will.

Into this harmonized system of classical-relativist physics, however, the quantum hypothesis has recently introduced a certain disturbance, and one cannot yet definitely say what influence the subsequent development of the hypothesis may have on the formulation of fundamental physical laws. Some essential modification seems to be inevitable; but I firmly believe, in company with most physicists, that the quantum hypothesis will eventually find its exact expression in certain equations which will be a more exact formulation of the law of causality.

It is of a transcendental character.

the quantum hypothesis

Besides dynamical laws applied to individual cases, physical science recognizes other laws also, which are called statistical. These latter express to a fairly accurate degree the probability of certain happenings occurring and therefore they allow for exceptions in particular cases. A classical example of this is the conduction of heat. If two bodies of different temperatures be brought into contact with one another then, according to the two laws of thermodynamics,

the heat energy will always pass from the warmer to the cooler body. We know to-day from experiment that this law is only a probability; because, especially when the difference of temperatures between two bodies is exceptionally small, it may well happen that at one or other particular point of contact and at one particular moment of time the conduction of heat will take place in the opposite direction—that is to say, from the cooler to the warmer body. The second law of thermodynamical, as in the case of all statistical laws, has an exact significance only for average values arising from a great number of similar happenings and not for each happening itself. If we are to consider the individual happening we can speak only of a definite measure of probability. The case here is quite similar to the case of a non-symmetrical cube used in playing with dice. Let us suppose that the centre of gravity of the cube is not at the centre of the body but lies definitely towards one of the sides, then it is likely though by no means certain that when the cube is thrown it will come to rest on that side. The smaller the distance of the centre of gravity from the symmetrical centre of the cube the more variable will the result be. Now if we cast the dice sufficiently often and observe what happens in each case, then we can arrive at a law which will tell us that the dice will fall on a certain side so many times out of a thousand for instance.

Let us return to the example of heat conduction and ask whether the strict validity of the causal law holds for individual cases. The answer is that it does

hold; because more thoroughgoing methods of investigation have proved that what we call transfer of heat from one body to another is a very intricate process, unfolding itself through innumerable series of particular processes which are independent of one another and which we call molecular movements. And investigation has further shown that if we presuppose the validity of dynamical laws for each of these particular happenings—that is to say, the law of strict causality—then we can arrive at the causal results through this type of observation. In point of fact, statistical laws are dependent upon the assumption of the strict law of causality functioning in each particular case. And the non-fulfillment of the statistical rule in particular cases is not therefore due to the fact that the law of causality is not fulfilled, but rather to the fact that our observations are not sufficiently delicate and accurate to put the law of causality to a direct test in each case. If it were possible for us to follow the movement of each individual molecule in this very intricate labyrinth of processes, then we should find in each case an exact fulfillment of the dynamical laws.

In speaking of physical science under this aspect we must always distinguish between two different methods of research. One is the macroscopic method, which deals with the object of research in a general and summary manner. The other is the microscopic method, which is more delicate and detailed in its procedure. It is only for the macroscopic observer—that is to say, the man who deals with big quantities in a wholesale way—that chance and probability

But are these molecular movements really independent of one another or subject to structure laws?

i.e. we are not aware of all of the structure laws & there is too much information happening too quickly for us to observe it all simultaneously

exist in regard to single elements in the object that he handles. The extent and importance of the chance elements are of course dependent on the measure of knowledge and skill which is brought to bear on the object. On the other hand, for the microscopic investigator only accuracy and strict causality exist. His livelihood depends, as it were, on the quality of each individual item that he deals with in retail. The macroscopic investigator reckons only with mass values and knows only statistical laws. The microscopic investigator reckons with individual values and applies to them dynamical law in its full significance.

Suppose we consider again the example of the dice which I have mentioned already. And suppose we treat it microscopically. This means that together with the nature of the dice itself—its non-symmetrical character and the exact location of its centre of gravity—we also take into account its initial position and its initial velocity and the influence of the table on its movement, the resistance of the air and every other peculiarity that may affect it—supposing we could examine all these minutely, then there could be no question of chance; because each time we can reckon the place where the dice would stop and know in what position it would rest.

Without going into any further details, let me say that physical science applies the macroscopic method of research to all happenings where molecules and atoms are concerned. But it naturally strives to refine its treatment towards the microscopic degree of delicacy and always seeks to reduce statistical laws

This is a paradoxical way to describe since we would say that classical mechanics deterministic cannot apply to microscopic objects while at the quantum or microscopic level we have only probabilities & statistics

anachronistic

to a dynamic and strictly causal system. Therefore it may be said here that physical science, together with astronomy and chemistry and mineralogy, are all based on the strict and universal validity of the principle of causality. In a word, this is the answer which physical science has to give to the question asked at the beginning of the present chapter.

Let us come now to the science of biology. Here the conditions are very much more intricate, because biology deals with living things and the problem of life has always presented very serious difficulties for scientific research. Of course I cannot speak with special authority in this branch of science. Yet I have no hesitation in saying that even in the most obscure problems, such as the problem of heredity, biology is approaching more and more to the explicit assumption of the universal validity of causal relations. Just as no physicist will in the last resort acknowledge the play of chance in inanimate nature, so no physiologist will admit the play of chance in the absolute sense, although of course the microscopic method of research is very much more difficult to carry out in physiology than in physics. For this latter reason the majority of physiological laws are of a statistical character and are called rules. When an exception occurs in the application of these empirically established rules, this is not attributed to any skip or failure in the causal relation but rather to a want of knowledge and skill in the way that the rule is applied. The science of biology sets its face against permitting exceptions as such to exist. What appear to be exceptions are carefully recorded

rule bound
 cause + effect = relationships,
 connection established
 at the foundation of
 the universe.

and collated and are further studied until they are cleared up in the light of causal relations. Very often it happens that this further study of exceptions shows interrelations which were hitherto unthought of, and throws a new light on the rules under which the exceptions were originally found to occur. It very often happens that the universal causal relation is thus corroborated from a new side, and that is the way in which many significant discoveries have been made.

How can we distinguish between what is veritably a causal relation and what is merely a coincidence or external succession of one event following another? The answer is that there is no hard and fast rule for making such a distinction. Science can only accept the universal validity of the law of causation, which enables us definitely to predict effects following a given cause, and in case the predicted effect should not follow then we know that some other facts have come into play which were left out of consideration in our reckoning. A little story will illustrate my meaning here. It refers to the efficiency of artificial manure in agriculture.

If I am not mistaken the story is told of Benjamin Franklin. He was not merely a first-class statesman but he was also a very able research worker and discoverer in natural science. At one time he took a great interest in the problem of artificial manuring and clearly showed the importance of its development in agrarian economics. He put his theories to the test and achieved practical successes which were quite satisfying for his own scientific bent of mind. But he

found it very difficult to convince his sceptical neighbours that the luxuriant crop of clover which they saw growing in Franklin's field was due to the use of artificial manure. For the peasant clover was clover and land was land and there were good land and bad land and good weather conditions and bad weather conditions, and these were the only factors that he recognized as causes of a good crop or a poor crop. Franklin determined to convince the peasant that the art of man could directly influence the quality of nature's growth. At the time of seed-sowing he dug in the soil a series of small furrows which formed alphabetical letters. These small furrows he filled with rich quantities of artificial manure, while the other parts of the field were left solely to nature's hand. As the crop grew the letters that corresponded to the manured furrows showed rows of clover much taller and more luxuriant than that in the other parts of the field; so that the passers-by were able to read the sentence: *This part has been manured with gypsum.* History does not relate whether the obstinate peasants were or were not convinced by the proof. But that is neither here nor there; for nobody can be forced on purely logical grounds to acknowledge the causal connection, because the causal connection is not logically demonstrable. The point of the illustration here is that if in a particular case we introduce a cause which of its very nature "flows into" the result, as the scholastics used to say, and if the result is in full accord with what was predicted, then we can be certain of the causal relation. In the instance of



Franklin's clover there could possibly be no other explanation except that of the manuring, and this explanation, as a cause, has a natural and exclusive connection with the result.

Q Of course it may be said that the law of causality is only after all an hypothesis. If it be an hypothesis it is not an hypothesis like most of the others, but it is a fundamental hypothesis because it is the postulate which is necessary to give sense and meaning to the application of all hypotheses in scientific research. This is because any hypothesis which indicates a definite rule presupposes the validity of the principle of causation.

We now come to those sciences which deal with human events. Here the method which the scientist follows can have nothing like the same exactitude as that which he follows in physics. The object of his study is the human mind and its influence on the course of events. The great difficulty here is the meagre supply of source materials. While the historian or the sociologist strives to apply purely objective methods to his lines of investigation, he finds himself confronted on all hands with the want of data whereby he might determine the causes that have led to general conditions in the past and lead to the general conditions in the world at the present moment. At the same time however he has at least one advantage here which the physicist has not. The historian or the sociologist is dealing with the same kind of activities as he finds in himself. Subjective observation of his own human nature fur-

nishes him with at least a rough means of estimation in dealing with outside personalities or groups of personalities. He can "feel into" them as it were and may thus gain a certain insight into the characteristics of their motives and their thoughts.

Let us ask then what is the attitude of the humanist scientist towards this problem of causation. In the activities of the human mind and in the play of human emotions, and in the outer conduct that results from these, is there everywhere a rigid causal interrelation? And is all conduct in the last resort to be attributed to the causal activity of circumstances, such as past events and present surroundings, leaving no place whatsoever for an absolutely spontaneous action of the human will? Or have we here, in contradistinction to nature, at least a certain degree of freedom or arbitrary volition or chance, whichever name one wishes to choose? From time immemorial this question has been a source of controversy. Those who hold that the human will is absolutely free in its act of volition generally assert that the higher we go in the scale of natural being the less noticeable is the play of necessity and the greater the play of creative freedom, until we finally come to the case of human beings, who enjoy the full autonomy of the will.

Such an opinion cannot be spoken of as correct or incorrect except by putting it to the test of historical and psychological research. And here we have the problem in exactly the same position as in the case of physical science. In other words we cannot know how far the principle of causality is valid except by putting

it
must be put to the
test of outer reality

it to the test of outer reality. Of course a different terminology is used when causal methods are applied in the humanist sciences. In natural science a definite physical picture with given characteristics is the subject of research. In psychology we have a definite individual personality to study. That individual personality has inherited qualities such as bodily conformation, intelligence, imaginative capacity, temperament, personal tastes and so on. Working on this personality we have the physical and psychic influences of the environment, such as climate, food, upbringing, companionship, family life, education, reading, etc. Now the question is whether all these data determine the conduct of this personality in all its particulars and according to definite laws. In other words if we suppose, what is impossible in practice, that we had a thorough and detailed knowledge of all these factors here and now, could we tell with certainty, on the causal basis, how the individual will act a moment hence?

In seeking for a sound and logical and adequate answer to this question we are here in quite a different position from that in which we were when dealing with natural science. Obviously it is extremely difficult to give anything like a definite answer to such a question as that asked above. One may have opinions and make suppositions and assumptions; but these do not furnish logical grounds for an answer. Still I think that it may be said definitely that the direction in which the humanist sciences, such as psychology and history, are developing nowadays furnishes certain

grounds for presuming that the question should be answered in the affirmative. The part which force plays in nature, as the cause of motion, has its counterpart in the mental sphere in motive as the cause of conduct. Just as at each and every moment the motion of a material body results necessarily from the combined action of many forces, so human conduct results with the same necessity from the interplay of mutually reinforced or contradicting motives, which partly in the conscious and partially also in the unconscious sphere work their way forward towards the result.

Of course it is perfectly true that many acts which are done by human beings appear to be inexplicable. At times it is an extraordinarily difficult riddle to find anything like reasonable grounds for certain acts, and other acts seem so utterly foolish as to suggest no grounds at all. But consider for a moment the way these acts appear to a trained psychologist and the way they appear to the ordinary man in the street. What is entirely puzzling to the latter is often quite clear to the former. Therefore if we could study the acts of the human being at very close and intimate quarters, we should find that they can be accounted for through causes which lie in the character or in the momentary emotional tension or in the specific external environment. And in those cases where it is extremely difficult and wellnigh impossible to discover these explanatory causes, then we have at least grounds for assuming that if we cannot find any motive as an explanation, we must

attribute this not actually to the absence of motive but rather to the unsatisfactory nature of our knowledge of the peculiarities of the situation. Here we have the same case as in the throwing of the unsymmetrical dice. We know that the way in which the dice finally comes to rest is the nett result of all the factors active in the throwing of the dice, but in the case of a single throw we cannot detect the function of strict causality. And so, even though the motive of a certain line of human conduct may often lie utterly hidden, conduct entirely without motive is scientifically just as incompatible with the principles on which mental science is carried on as the assumption of absolute chance in inorganic nature is incompatible with the working principle of physical science.

It is not merely however that conduct is conditioned by the motives which lead to it. Each act has also a causal influence on subsequent behaviour. And so in the interchange of motive and conduct we have an endless chain of events following one another in the spiritual life, in which every link is bound by a strict causal relation not only with the preceding link but also with the following one.

Attempts have been made to find a way to free these links from the causal chain. Hermann Lotze, in open contradiction to Kant, put forward the suggestion that such a causal chain can have no end, although it has a beginning. In other words, that circumstances occur in which motives appear entirely independently, not caused by any preceding influence, so

that the conduct to which these motives lead will be the first link in a new chain. Such an interpretation, Lotze held, must be given especially to the acts of those choice spirits that are called creative geniuses.

Even though we may not question the possibility of such cases happening in the world of reality yet we may reasonably answer that the thoroughgoing scientific research which has been carried on in the region of psychology would have pointed to such a possibility. But as far as psychological research has gone there are no indications which might furnish a starting-ground for this theory of the so-called free beginning. On the contrary, the deeper scientific research goes into the peculiarities that have characterized even the great spiritual movements of world history, more and more the causal relation emerges into the open. The dependence of each event upon preceding fact and preparatory factors gradually begins to appear under the strong light of scientific investigation, so much so as to warrant the statement that present-day scientific procedure in psychology is founded practically exclusively on the principle of causal interrelations and the assumption of an active law of causality which permits no exceptions. This means that the postulate of complete determinism is accepted as a necessary condition for the progress of psychological research.

Under these circumstances it is obvious that we cannot erect a definite boundary and say: Thus far but no farther. The principle of causality must be held to extend even to the highest achievements of

the human soul. We must admit that the mind of each one of our greatest geniuses—Aristotle, Kant or Leonardo, Goethe or Beethoven, Dante or Shakespeare—even at the moment of its highest flights of thought or in the most profound inner workings of the soul, was subject to the causal fiat and was an instrument in the hands of an almighty law which governs the world.

The average reader may be easily taken aback by such a statement. It may sound derogatory to speak thus of the creative achievements of the highest and noblest of the human race. But on the other hand it must be remembered that we ourselves are only common mortals, and that we could never hope to be in a position to follow out the delicate play of cause and circumstance in the soul of the genius. There is nothing derogatory in saying that they are subject to the law of cause and effect, though it would be derogatory of course if this were interpreted in the sense that the ordinary mortal is capable of following the workings of that law in the case of supremely gifted souls. Nobody would feel it disrespectful if one were to say that some superhuman intelligence could understand a Goethe or a Shakespeare. The whole point lies in the inadequacy of the observer. Just so the macroscopic physicist is entirely unable to pursue microscopic workings in natural phenomena, yet, as we have seen, this does not mean that the law of causality is not valid for these microscopic happenings.

Where is the sense then, it may here be asked, in talking of definite causal relations in regard to cases

wherein nobody in the world is capable of tracing their function?

The answer to that question is simple enough. As has been said again and again, the concept of causality is something transcendental, which is quite independent of the nature of the researcher, and it would be valid even if there were no perceiving subject at all. We shall see more clearly the inner meaning of the causal concept if we consider the following:—

At this present moment of time and space the human intellect as we know it may possibly not be the highest type of intellect in existence. Higher intelligences may exist in other places or may appear in other epochs. And the intellectual level of these beings may be as much above ours as ours is above the protozoa. Then it may well happen that before the penetrating eye of such intelligences even the most fleeting moment of mortal thought, as well as the most delicate vibration in the ganglia of the human brain, could be followed in each case, and that the creative work of our mortal geniuses could be proved by such an intelligence to be subject to unalterable laws, just as the telescope of the astronomer traces the links of the manifold movement of the spheres.

Here, as everywhere else, we must differentiate between the validity of the causal principle and the practicability of its application. Under all circumstances the law of causation is valid, because of its transcendental character. But as its application can be carried out in full detail only by the microscopic observer in natural science, so in the region of the

human mind the law can be applied only by an intelligence that is far superior to the object of research. The smaller the distance between the investigator and the object in this case, the more uncertain and fallible will be the causal and scientific treatment. The whole problem lies in the difficulty, indeed the impossibility, with which we are faced in trying to understand the behaviour of a genius from the standpoint of causation. Even a congenial spirit in such cases would have to be content with presumptions and analogies; but to the average blockhead the genius will ever remain a closed book signed with the seven seals.

The conclusion therefore is that the highest types of human intelligence are subject to the causal law in the processes that result in even their greatest achievements. That is the first part of our conclusion. And the second part is that in principle we must reckon with the possibility that a day will come when the more profound and increasingly more refined development of scientific research will be able to understand the mental workings not only of the ordinary mortal but also of the highest human genius in their causal relations; because scientific thought is identical with causal thought, so much so that the last goal of every science is the full and complete application of the causal principle to the object of research.

From all that I have said what conclusion are we to draw in regard to Free Will? In the midst of a world where the principle of causation prevails universally,

what room is there for the autonomy of human volition? This is an important question, especially to-day, because of a widespread tendency unwarrantably to extend the tenets of scientific determinism to human conduct and thus shelve responsibility from the shoulders of the individual. We have had an example of this in some modern interpreters of historical development who would hold that the destiny of a group of individuals, forming a nation or a civilization, is determined by blind fate. Therefore in the last analysis the responsibility for such a destiny does not rest with the individual. Is this attitude a legitimate deduction from all that I have said? In other words, amid the all-round causal sequence in natural phenomena is there still room for the free and responsible act of the will of the individual?

Before directly answering that question I may point to a notable characteristic of everyday life which may help us in forming a decision. Though chance and miracle in the absolute sense are fundamentally excluded from science, yet science is confronted to-day, more than ever before perhaps, with a widespread belief in miracle and magic. Such belief, which has been so universal in former ages, repeats itself with the passing of the centuries in innumerable forms. This means that science is repeatedly called upon to give the scientific causal explanation of facts that are popularly interpreted in the light of some belief. Belief in miracle is a very important element in the cultural history of the human race. It has brought untold blessings and has inspired noble men to the

greatest of heroic deeds. But where it has degenerated into fanaticism it has also been the cause of untold evil.

In view of the remarkable progress of physical science during our own time and the universal extension of its benefits amongst civilized nations, we might naturally assume that one of the achievements of science would have been to restrict belief in miracle. But it does not seem to do so. The tendency to believe in the power of mysterious agencies is an outstanding characteristic of our own day. This is shown in the popularity of occultism and spiritualism and their innumerable variants. Though the extraordinary results of science are so obvious that they cannot escape the notice of even the most unobservant man in the street, yet educated as well as uneducated people often turn to the dim region of mystery for light on the ordinary problems of life. One would imagine that they would turn to science, and it is probably true that those who do so are more intensely interested in science and are perhaps greater in number than any corresponding group of people in former times; but still the fact remains that the drawing power of systems which are based on the irrational is at least as strong and as widespread as ever before, if not more so. The Monist League which was formed some years ago with so much *éclat* and promise, for the purpose of establishing a world outlook based on purely scientific grounds, has certainly not achieved any success corresponding to the rival systems.

How is this peculiar fact to be explained? Is there,

in the last analysis, some basically sound foothold for this belief in miracle, no matter how bizarre and illogical may be the outer forms it takes? Is there something in the nature of man, some inner realm, that science cannot touch? Is it so that when we approach the inner springs of human action science cannot have the last word? Or, to speak more concretely, is there a point at which the causal line of thought ceases and beyond which science cannot go?

This brings us to the kernel of the problem in regard to free will. And I think that the answer will be found automatically suggested by the questions which I have just asked.

The fact is that there is a point, one single point in the immeasurable world of mind and matter, where science and therefore every causal method of research is inapplicable, not only on practical grounds but also on logical grounds, and will always remain inapplicable. This point is the individual ego. It is a small point in the universal realm of being; but in itself it is a whole world, embracing our emotional life, our will and our thought. This realm of the ego is at once the source of our deepest suffering and at the same time of our highest happiness. Over this realm no outer power of fate can ever have sway, and we lay aside our own control and responsibility over ourselves only with the laying aside of life itself.

And yet there is a way in which the causal method can be applied within the limits of this inner realm. In principle there is no reason whatsoever why the individual should not make himself the observer of

what has happened within himself. In other words, he can look back over the experiences through which he has passed and endeavour to link them up in their causal relations. There is no reason indeed, at least in principle, why he should not scrutinize each experience—by which I mean each decision and line of conduct which he has taken—and study it from the viewpoint of finding out the cause from which it resulted. Of course that is an extremely difficult task; but it is the only soundly scientific way of dealing with our own lives. In order to carry out this plan of action the facts of our own lives which we now place under observation would have to be distanced in the past, so that our present complex of living emotions and inclinations would not enter as factors into the observation. If we could possibly carry out the plan in this detached way, then each experience through which we have passed would make us immeasurably more intelligent than we were before, so intelligent indeed that in relation to our earlier condition we should rise to the level of the super-intelligence postulated by Laplace. You remember that Laplace held that if there were a super-intelligence standing entirely outside of the facts occurring in the universe, this intelligence would be able to see causal relations in all the happenings of the world of man and nature, even the most intricate and microscopic. It is only by aiming at this sort of distance that the individual could establish the required detachment of the perceiving subject from the object of his research, which we have already seen to be

an inevitable condition for the application of the causal method in research. The nearer we are to events in time the more difficult it is to trace their causal structure. And the nearer we are to the events of our own personal experience the more difficult it is for us to study ourselves in the light of these happenings; for the activities of the observer are here partly the object of research and, in so far as that is so, the causal connection is practically impossible to establish. I am not preaching a moral sermon here or suggesting what ought to be aimed at for the sake of the moral uplift of one's own being. I am only treating the case of individual freedom from the viewpoint of its logical coherence with the principle of causation, and I am saying that *in principle* there is no reason why we should not discover the causal connections in our own personal conduct, but that in practice we never can do so because this would mean that the observing subject would also be the object of research. And that is impossible; for no eye can see itself. But in so far as any man is not entirely to-day that which he was years ago there is a relative degree to which he might subject his own experiences to causal scrutiny; and I have mentioned this as illustrative of the general principle.

It will occur to many readers to ask if thus in relation to the chain of causality the freedom of the individual will, here and now, is only apparent and results solely from the defects of our own understanding. That way of putting the case is, I am convinced, entirely mistaken. We might illustrate the

mistake by saying that it is like the mistake of suggesting that the inability of a runner to outrun his own shadow is due to his lack of speed. The fact that the individual here and now, in regard to his own living present act, cannot be subject to the law of causation is a truth that is based on a perfectly sound logical foundation of an *a priori* kind, such as the axiom that the part is never greater than the whole. The impossibility of the individual contemplating his own activity here and now under the light of the causal principle would hold good even in the case of the super-intelligence postulated by Laplace. For, even though this super-intelligence might be able to trace the causal structure in the achievements of the most gifted geniuses of the human race, yet that same super-intelligence would have to renounce the idea of studying the activities of its own ego at the moment it contemplated the activities of our mortal ego. If there be a Supreme Wisdom whose celestial nature is infinitely elevated above ours, and who can see every convolution in our brains and hear every pulse beat of each human heart, as a matter of course such a Supreme Wisdom sees the succession of cause and effect in everything we do. But this does not in the least invalidate our own sense of responsibility for our own actions. From this standpoint we are on an equal footing with the saints and confessors of the most sublime religions. We cannot possibly study ourselves at the moment or within the environment of any given activity. Here is the place where the freedom of the will comes in

and establishes itself, without usurping the right of any rival. Being emancipated thus, we are at liberty to construct any miraculous background that we like in the mysterious realm of our own inner being, even though we may be at the same time the strictest scientists in the world, and the strictest upholders of the principle of causal determinism. It is from this autarchy of the ego that the belief in miracles arises, and it is to this source that we are to attribute the widespread belief in irrational explanations of life. The existence of that belief in the face of scientific advance is a proof of the inviolability of the ego by the law of causation in the sense which I have mentioned. I might put the matter in another way and say that the freedom of the ego here and now, and its independence of the causal chain, is a truth that comes from the immediate dictate of the human consciousness.

And what holds good for the present moment of our being holds good also for our own future conduct in which the influences of our present ego play a part. The road to the future always starts in the present. It is, here and now, part and parcel of the ego. And for that reason the individual can never consider his own future purely and exclusively from the causal standpoint. That is the reason why fancy plays such a part in the construction of the future. It is in actual recognition of this profound fact that people have recourse to the palmist and the clairvoyant to satisfy their individual curiosity about their own future. It is also on this fact that dreams and

ideals are based, and here the human being finds one of the richest sources of inspiration.

I might mention here in passing that this practical inapplicability of the law of causation extends beyond the individual. It extends to our relations with our fellow-men. We are too much a part of the life of our fellow beings to be in a position to study them from the viewpoint of motives, which means the causal viewpoint. No ordinary human being can put himself in the position of the super-intelligence imagined by Laplace and consider himself capable of tracing all the inner springs of action from which the conduct of his fellow-men originates. On the other hand, however, I would mention here again a phase of the causal application corresponding to that which I have already spoken of in relation to the individual's capacity for scientifically observing his own past experience. To a relative degree it is possible to study the motives on which other people act, just as they are studied by the psychologist or the alienist. In all such cases there is to a certain degree the requisite distance between the researcher and the object of his research. And therefore to this extent there is no logical incoherence in the idea of a person studying the activities of his fellow beings. Indeed all who wish to influence others do so in everyday life, which is largely the secret of political success. It is the secret of all the power for good which so many people exercise in relation to their fellow beings. Most of us remember from childhood personalities whom we shirked because of some sort of innate feeling of

insecurity in their presence, and on the other hand most of us, I imagine, have memories of acquaintances to whose influence we were willingly amenable because we felt a certain reverence towards them. And everybody is more or less familiar with the feeling of withdrawal which comes over one in the presence of a person who is suspected of seeing too clearly into the inner lives of others. All these immediate reactions bear witness to a sort of instinctive recognition that our own lives are in the last analysis subject to causation, though the ego as regards its immediate destiny cannot be subject to that law.

Science thus brings us to the threshold of the ego and there leaves us to ourselves. Here it resigns us to the care of other hands. In the conduct of our own lives the causal principle is of little help; for by the iron law of logical consistency we are excluded from laying the causal foundations of our own future or foreseeing that future as definitely resulting from the present.

But mankind has need of fundamental postulates for the conduct of everyday existence, and this need is far more pressing than the hunger for scientific knowledge. A single deed often has far more significance for a human being than all the wisdom of the world put together. And therefore there must be another source of guidance than mere intellectual equipment. The law of causation is the guiding rule of science; but the Categorical Imperative—that is to say, the dictate of duty—is the guiding rule of life. Here intelligence has to give place to character, and

scientific knowledge to religious belief. And when I say religious belief here I mean the word in its fundamental sense. And the mention of it brings us to that much discussed question of the relation between science and religion. It is not my place here nor within my competency to deal with that question. Religion belongs to that realm that is inviolable before the law of causation and therefore closed to science. The scientist as such must recognize the value of religion as such, no matter what may be its forms, so long as it does not make the mistake of opposing its own dogmas to the fundamental law upon which scientific research is based, namely the sequence of cause and effect in all external phenomena. In conjunction with the question of the relations between religion and science, I might also say that those forms of religion which have a nihilist attitude to life are out of harmony with the scientific outlook and contradictory to its principles. All denial of life's value for itself and for its own sake is a denial of the world of human thought, and therefore in the last analysis a denial of the true foundation not only of science but also of religion. I think that most scientists would agree to this, and would raise their hands against religious nihilism as destructive of science itself.

Q There can never be any real opposition between religion and science; for the one is the complement of the other. Every serious and reflective person realizes, I think, that the religious element in his nature must be recognized and cultivated if all the powers of the human soul are to act together in perfect

balance and harmony. And indeed it was not by any accident that the greatest thinkers of all ages were also deeply religious souls, even though they made no public show of their religious feeling. It is from the cooperation of the understanding with the will that the finest fruit of philosophy has arisen, namely the ethical fruit. Science enhances the moral values of life, because it furthers a love of truth and reverence—love of truth displaying itself in the constant endeavour to arrive at a more exact knowledge of the world of mind and matter around us, and reverence, because every advance in knowledge brings us face to face with the mystery of our own being.