CHAPTER VI

FORMAL GROUNDS OF INDUCTION

(THE LAW OF CAUSATION)

We have read that the Law of Causation and the Law of the Uniformity of Nature constitute the formal grounds of Induction. Induction has to rely upon these two Laws in order to arrive at generalizations. Hence they are the assumptions or presuppositions of Induction.

We shall discuss the Law of Causation in this chapter, and the Law of the Uniformity of Nature in the next.

Law of Causation

The Law of Causation states that every event or phenomenon has a cause. For everything that happens in the world, there must be an adequate cause. In other words, nothing can happen without a cause to account for it. *Ex nihilo nihil fit*; out of nothing, nothing can happen. Nothing can be uncaused in the universe. If a war breaks out, there must be a cause for it; if the moon is eclipsed, there must be a cause for the eclipse; if an earthquake happens, there must be a cause for its happening; if a famine occurs, there must be a cause for its occurrence. Thus, for every event that occurs,

there must be a cause. Sometimes we are ignorant of the cause of an event, and say that it happened by *chance*. But "chance" does not mean absence of causation; it simply means that we do not *know* the cause. When, for example, a person tosses a coin, sometimes the head turns up, and sometimes the tail; and we say that it is just by chance that one or the other side of the coin turns up. But, truly speaking, the position of the coin at starting, the movement of the fingers in tossing the coin, the pressure of the air, the turns of the coin before it falls, etc., are the causes for the head or the tail to appear uppermost. Similarly, when a student in the examination hall suddenly begins feeling an intense pain of griping in his bowels and leaves the examination paper unfinished, we say that the poor candidate is a victim of a chance happening. But is it really so? Is not the food that he took just before the examination or overnight, the real cause? Is not the heat and worry of the examination responsible for this happening? And if they are not, then there must be some other cause which we do not know. Thus, when the cause of an event is not known, we regard that event as accidental. The savages regarded the eclipse of the sun as accidental owing to their imperfect knowledge. But as our knowledge of things advances, chance is gradually eliminated. What at first appears as a chance or casual occurrence is later on found to be due to a definite cause. Thus, the Law of Causation states that all is *causal* and nothing *casual* in this world. The world is not an inchoate heap of phenomena in which

events jump up accidentally, but is a well-ordered system in which whatever occurs must be due to some cause. Now, the question arises : What do we mean by "cause" ? A good deal of discussion has turned on this question, and there exists no agreement as to the sense in which the term "cause" is to be understood. Let us study the various views of causation.

Aristotle's view of Causation

Aristotle has given a four-fold scheme of causation. He distinguished four kinds of causes, namely, *Material Cause*, *Formal Cause*, *Efficient Cause* and *Final Cause*. The Material Cause of a thing is the matter, stuff or substance of which it is made. The Formal Cause of a thing is the form or shape which is given to it. The Efficient Cause of a thing is the labour, energy or efficiency spent in making it. The Final Cause of a thing is the purpose, end or object for which it is made. Thus, taking the example of a chair, we can say that wood is its material cause ; the form of the chair is its formal cause ; the labour of the carpenter is its efficient cause ; and the purpose for which the carpenter made the chair, *e g.*, earning his living, is the final cause.

This was the view of Aristotle in ancient times. His four-fold distinction is very helpful in our definitions of terms. We often define terms by indicating the material, formal, efficient or final cause. For example, we define our rupee as a round coin of silver of a certain weight, minted by the Government to serve as a medium

of exchange; we define a statue as a lifelike figure made of some solid substance like iron, marble, bronze or wood, by a sculptor to commemorate a hero.

In medieval times, emphasis was laid on efficiency or power, and cause was taken to mean the efficient cause only. Matter was regarded as too passive to be called a cause. In other words, it was believed that *cause is a force or power which produces the effect*.

Hume's view of Causation

Hume criticised this efficiency view af causation. He says that cause is not a producer but an *antecedent* of the effect; it does not *produce* the effect but simply *precedes* it. Similarly, the effect is not a product but a *consequent* of the cause. Thus, the causal relation, according to Hume, is just a relation of sequence, a relation of *before* and *after*. One event happens before and we call it the cause; another event happens afterwards and we call it the effect. What we actually observe in the causal relation is not the power exercised by the cause in producing the effect, but only the *priority* of the cause and the *futurity* of the effect. If, for example, a drought results in a famine, then according to Hume, the drought has not produced the famine, but has only occurred before it. Thus, cause and effect are simply two events, one happening earlier and the other later.

The cause, then, is a phenomenon that occurs before the effect. In other words, it is an antecedent. But not all antecedents are causes. If

for example, a solar eclipse takes place before the breaking out of a war, we cannot say that the eclipse is the cause of the war. Similarly, the rising of the sun may be an antecedent to the burning of a house, but it cannot be regarded as the cause because the house would burn equally well at night when there is no sun. Hence only that antecedent is the cause which is indispensable or necessary for the effect, *i.e.*, without which the effect would not take place. Out of the whole set of antecedents, that antecedent, according to Hume, is the cause which *invariably* or *always* precedes the effect. If a phenomenon sometimes precedes the effect and sometimes does not, it will be a variable antecedent, and hence not the cause.

To sum up : *Hume says that the cause is an invariable antecedent of the effect, and the effect is an invariable consequent of the cause.* Thus, according to Hume, cause possesses two marks, namely, *antecedence* and *invariability*.

Mill's view of Causation

We have seen that according to Hume, the causal relation is an invariable relation. But Mill introduces an amendment in this view. He says that invariable relation *alone* does not constitute causation. An event may invariably precede another and yet it may not be the cause of it. Monday invariably precedes Tuesday ; the day invariably precedes the night ; but we cannot say that Monday is the cause of Tuesday or that the day is the cause of the night. With Hume,

Mill does believe that cause is an invariable antecedent, but he further holds that invariability, though *necessary*, is not a *sufficient* mark of the cause. According to him, cause is not only invariable but also *unconditional*. By the unconditionality of the cause what is meant is that it is *by itself* sufficient to bring about the effect, without depending upon any other condition. In the words of Bain, it is "the sole sufficing circumstance whose presence makes the effect and whose absence arrests it." Thus, the day cannot be regarded as the cause of the night, because it is not the unconditional cause of the night, but is *subject to the condition* that the earth rotates round its axis in the presence of the sun. Similarly, if we say that hard work brings success *if* a person is lucky, then we cannot call hard work the cause of success because it is not unconditional. So the cause must be unconditional, "if-less". The unconditionality of the cause simply means its *self-sufficiency*.

But it must also be remembered that by calling the cause unconditional, Mill does not mean to say, like Hume, that it is just one antecedent. On the contrary, he holds that the cause is a sum-total or set of antecedents. By the cause of an event Mill means all the circumstances which must precede in order that the event should happen. We cannot say that an event is due to a single condition only. There are usually many conditions or circumstances which are necessary to give rise to an effect, and all of them must be taken and considered as necessary parts of

the cause. Thus, heredity *alone* is not the cause of a man's character ; the appearance of clouds *alone* is not the cause of rain ; the negligence of the watchman *alone* is not the cause of a theft. Hence cause is not *an* antecedent but a *group of antecedents*. When a person eats of a certain dish and dies " in consequence ", not only the food but also the person's constitution, his health, climate, etc., constitute the whole group of conditions which are responsible for the fatal result. It is possible that the same dish which caused death under certain conditions may simply make another person or the same person ill under other conditions. Thus, *Mill defines cause as the sum-total or group of invariable and unconditional antecedents*. To the two qualities of cause given by Hume, namely, antecedence and invariability, Mill adds two more, namely, *unconditionality* and *complexity*.

The views of Hume and Mill are called the *Sequence View of Causation*.

Causation viewed as Conservation of Energy or Matter

Under the influence of the Law of Conservation of Energy and Matter, an attempt has been made in recent times to quantify cause and effect. The Law of Conservation of Energy and Matter states that the total amount of energy as well as matter in the universe remains constant though it may be changed into different forms. Moreover, energy and matter are not destroyed or created in transformation from one form into another. When

a kettle full of water is sufficiently heated and becomes empty, nothing is lost; what was water before has become steam now; what apparenty seems to be lost has only assumed another form. Thus, energy and matter can be interchanged or transformed, but their total amount remains constant, *i.e.*, it can neither increase nor decrease. If two or more elements are combined chemically, the weight of the compound will be exactly equal to the weight of the component elements, neither more not less. When a certain quantity of hydrogen and a certain quantity of oxygen combine and give rise to water, their form is changed but the weight of water will be just equal to the weights of hydrogen and oxygen. Similarly, the weight of salt is exactly equal to the weights of sodium and chlorine combined in it.

The Law of Conservation has an important bearing on causation. According to it, causation is a transformation of matter or energy. That is, the cause is transformed into the effect. We say that the heat of the steam of the railway engine *produces* motion, but really speaking, the heat *itself* is converted into motion. Heat (which is the cause) and motion (which is the effect) are simply two forms of the same energy. Similarly, we say that a drop of ink on paper *produces* a blot, whereas in reality the dropping of ink on paper *is itself* the blot. Again, if we say that when heated, ice *produces* water and water *produces* steam, the fact is that ice *becomes* water, and water *becomes* steam. Ice, water and steam are not different substances, but are, in fact, the same substance under defferent forms.

Hence cause and effect are simply two forms of the same matter or energy. The cause does not *produce* the effect but simply *becomes*, or *develops into*, the effect. When electricity is switched on and the effect is light, the effect, light, is simply electricity in another form. Thus, the effect is nothing but the cause transformed. In other words, cause and effect are different names of the same event; the event *prior* to transformation is called the cause, and *after* transformation, the effect. The cause is nothing but the effect *concealed*, and the effect is nothing but the cause *revealed*.

It must also be remembered that, when the cause is transformed into the effect, no energy or matter is gained or lost in the process of transformation. This means that cause and effect are *quantitatively equal* to each other. If the cause were more than the effect, then there would be a decrease of energy or matter; and similarly, if the cause were less than the effect, there would be an increase of energy or matter. But the quantity of energy and matter can neither decrease nor increase; it remains constant. Hence, the cause and the effect cannot be more or less than each other; they must be exactly equal.

To sum up: the Law of Conservation teaches that cause does not *produce* but simply *develops* or *changes into* the effect and is equal to it. Thus, another attribute of cause is shown, namely, its *quantitative equivalence* with the effect.

Development of the Sequence View of Causation

We have discussed the various views of causation, namely, (1) the *Efficiency View* which says that cause is a force or power which *produces* the effect, (2) the *Sequence View* which says that cause is a sum-total of invariable and unconditional antecedents which precede the effect, and (3) the *Conservation View* which says that cause and effect are simply two different forms of the same energy or matter. Of these three views, the sequence view of causation has mostly found favour with logicians. This sequence view of causation, according to *Venn*, has passed through three stages of development :—

(*a*) The Popular Stage.

(*b*) The Scientific Stage.

(*c*) The Speculative Stage.

(*a*) The Popular Stage.

This is the stage of the 'plain man' or the man in the street. At this stage, no distinction is made between causation and mere co-existence. If A and B simply co-exist, their co-existence is taken for their causal connection.

Moreover, the layman singles out only one antecedent out of the complex cause and regards it as the whole cause. Again, out of the complex effect only one consequent is singled out and is regarded as the whole effect. If for example, a patient is cured by the use of a medicine, the cure is popularly regarded as due to

the medicine alone, and all other factors, such as careful nursing, better diet, hygienic conditions of the hospital, complete rest, are ignored. The real cause of the cure is all these factors taken together, and not the medicine alone. Again, victory in a match is popularly believed to be due not to the whole team but *only* to the captain of the team. Similarly, out of the whole set of consequents, the layman singles out only one consequent and calls it the effect. He says, for example, that death is the effect of plague as well as pneumonia. Here again he has singled out only one element out of the sum-total of all the consequents and called it the effect.

(*b*) The Scientific Stage.

The scientific stage represents an improvement upon the popular stage. At this stage, a distinction is made between causation and mere con-existence, and the former is believed to be of more scientific importance than the latter.

Secondly, cause at this stage is not believed to be a single factor but a group of all the factors which are responsible for the effect. In other words, cause is regarded as complex, a sumtotal of several antecedents.

Moreover, it is maintained that the sequence between cause and effect be as close as possible. If a considerable interval of time separates them, there is a chance for other causes also to intervene and the cause will not remain unconditional. Thus, the cause should *immediately*

preced the effect, and the effect should immediately follow the cause. This *immediacy* of the cause follows form its unconditionality. An antecedent, which is very remotely connected with an effect, cannot be regarded as its cause. For instance, the cause of a person's death is not his remote illness from which he suffered in his childhood, but his immediate illness. The word "immediately," however, should not be taken too strictly, because in some cases even the remote antecedents deserve consideration if they are *vitally* connected with the effect. We say, for example, that an unjust government causes rebellion. But usually the people suffer for many years before they rise against their tyrants. Their spirit of discontent keeps on smouldering and finally a certain incident, *e.g.*, the arrest of their revered leader, brings about rebellion. Now, the immediate cause of their rebellion may be the arrest of the leader, but the remote antecedents of this effect are also important. Still, the fact remains that the sequence between cause and the effect should be as close as possible. For practical scientific convenience, it is believed that the cause immediately precedes the effect, and effect immediately follows the cause. Mellone says: "We have (1) the cause, the introduction of the microbes into a living body; (2) the effect, appearance of a certain disease *some time afterwards*. The apparent separation, in the above case, arises from the fact that we have not considered the *immediate* effect, but have waited until it has reached an advanced stage of development and have called *this* effect.

Cause and effect are divided simply by a mathematical line—a line destitute of breadth—which is thrown by our thought across the current of events ; on the one side we have the cause, on the other the effect. There is no pause in reality ; the whole process is continuous ; the cause comes into action at the very moment when the effect begins to be produced."

(*c*) The Speculative Stage.

This stage goes a step farther than the scientific stage. At this stage, the effect is also regarded, like the cause, as complex, a sum-total of consequents. When a man takes a poison and dies, we say that death is the effect. But truly speaking, death is only *one* of the several consequents, and the real effect is the totality of all the consequents taken together. Hence the popular tendency to single out only one prominent consequent from the complex effect is wholly untenable.

Symbolically speaking, the difference between these three stages can be expressed as follows :—

(1) Popular stage : Cause→effect.

(2) Scientific stage : Cause→effect.

(3) Speculative stage : Cause→Effect.

N.B.—Capital ' C ' in the word ' Cause ' and Capital 'E' in the word 'Effect' indicate that they are complex ; while ' cause ' with small ' c ' indicates that only one antecedent out of the complex cause is taken ; and similarly ' effect ' with small ' e ' indicates that only one consequent is singled out from the complex effect.

Causes and Conditions.

We have read that cause is a complex fact, involving several elements in it. The effect is not due to a single circumstance only, but very often results from a group or assemblage of several factors, each one of which is called a 'condition'. Thus, cause is composed of a set or totality of all the 'conditions' which are responsible for the effect. A 'condition' is anything that exercises some influence upon the effect and is essential for bringing it about. The influence which a "condition" exercises may be either in the direction of *producing* the effect or in the direction of *preventing* or *frustrating* the effect. In other words, a "condition" may be either *positive* or *negative*. A positive condition is that which helps or promotes the effect, *i.e.*, without the *presence* of which the effect cannot happen. A negative condition is that which tends to prevent or destroy or retard the effect, *i.e.*, without the *absence* of which the effect cannot happen. Thus, a positive condition is that which must be *present* in order that the effect may happen, while a negative condition is that which must be *absent* in order that the effect may happen. In other words, a condition is positive when its *presence* is needed, and negative when its *absence* is needed for the production of the effect. For burning a piece of wood, for example, the presence of oxygen and the absence of moisture are necessary. So for burning, oxygen is a positive condition, and moisture is a negative condition. Thus, conditions may be positive as well as negative, and all of them taken together constitute the cause

In our ordinary life, however, we select one of the conditions and call it *the cause*, and refer to the others as mere *conditions*. Usually that condition is called the cause which is either the most conspicuous of all or which happens just before the effect. But this popular view, which consists in arbitrarily selecting a certain condition as the sole cause and neglecting the other ones, is scientifically untenable. *Scientifically speaking, cause is a sum-total of all the conditions, positive as well as negative.*

Plurality of Causes : Mill's Doctrine.

It is believed by all that the same cause always produces the same effect, but the reverse of this statement, *i.e.*, "the same effect is always due to the same cause" is questioned. All, for example, admit that fire always produces heat, poisoning always produces death, the sun always produces light, etc. But none will believe that heat is always produced by fire, that death is always produced by poisoning, that light is always produced by the sun. Thus, the causal relation is not believed to be *reciprocal*, *i.e.*, it is asserted that we can *argue from cause to effect*, but not *from effect to cause*. It is believed that the same effect may be produced by different causes. For example, heat may be produced by fire as well as by electricity ; death may be produced by a poison as well as by diseases like cholera, plague, pneumonia, etc. ; light may be produced by the sun or by a candle or by an electric bulb ; illness may be produced by indigestion, or overwork, or by some other cause. *All this means that for any given effect, we may find a plurality of causes.* This was the

doctrine of Mill. He writes : "It is not true that one effect must be connected with only one cause ; that each phenomenon can be produced only in one way. There are often several independent modes in which the same phenomenon could have originated...Many causes may produce motion ; many causes may produce death. A given effect may really be due to a certain cause, and yet be perfectly capable of being produced without it." Thus, *Mill urges that one and the same effect may be due to any one of several causes, that the same effect may be produced sometimes by one cause and sometimes by another.* The same effect X may be produced by different causes, A or B or C.

Plurality of Causes must be distinguished from "Composition of Causes". 'Composition of Causes' means that many causes by *working together* produce a joint effect, while Plurality of causes means that many causes working *separately* can produce the same effect. Using symbols, we can express the distinction thus : If the effect X is due to A+B+C, we have a case of Composition of Causes, but if X is due to A *or* B *or* C, we have a case of Plurality of Causes. In other words, *the doctrine of Plurality of Causes states that different causes can separately produce the same effect.* This doctrine is also sometimes called the '*Vicariousness of Causes.*'

Criticism.—(1) This doctrine of Mill is totally inconsistent with his own view of causation. He has himself defined cause as 'the invariable and unconditional antecedent of a phenomenon.' According to this definition, a cause would cease

to be 'cause' if its effect can also be produced by other causes. If, as Mill says, the essence of causation lies in invariable and unconditional sequence, then it is quite clear that the same effect cannot be produced by different causes. If it is believed that different causes can produce the same effect, then each of the different causes will be a *variable antecedent*, and hence not 'cause' according to Mill's own definition. The doctrine of Plurality of Causes says that A or B or C can be the cause of X. But how can we call A or B or C the cause of X when each one of them is a variable antecedent of X? Cause is that in the presence of which the effect must happen and in the absence of which the effect cannot happen. Now, if X can happen in the absence of A or B or C, then none of them can be called the cause of X. Hence, if cause is taken to mean an invariable antecedent of an effect, then it is not true to say that an effect may have a plurality of causes.

(2) Moreover, different causes can never bring about *exactly the same* effect. If we thoroughly analyse the effects of different causes, we find that they are not exactly the same as Plurality of Causes states. To criticise Mill's own example: death caused by poisoning is not the same as death caused by cholera or plague or pneumonia. In each case, the effect is different. Poison, cholera, plague and pneumonia produce different kinds of deaths. Similarly, the sun, the candle and the electric bulb produce different kinds of lights. Again, illness caused by indigestion is not the same as illness caused by overwork. Is it, then, right to say that

the same effect is produced by different causes? The confusion of the doctrine of Plurality of Causes arises from an oversight of the differences of the various effects which are produced by different causes. Of course, one element in different effects may be the same, but we should consider the total effect in each case rather than single out only one common element. On comparing the total effect of one cause with the total effect of another cause, we find that there remains no ground for the doctrine of Plurality of Causes. The doctrine of Plurality of Causes seems valid only if we take the effect in the popular or unscientific sense.

(3) The doctrine of Plurality of Causes is also against the Law of the Uniformity of Nature. The Law of the Uniformity of Nature says that the same cause produces the same effect, and the same effect is produced by the same cause. But this doctrine, on the contrary, holds that the same effect can be produced by different causes.

Hence, we can conclude that an effect can have only *one* cause, and that no two or more causes can ever produce exactly the same effect. In other words, the relation between cause and effect is reciprocal; just as it is true to say that the same cause always produces the same effect, so also it is true to say that the same effect is always due to the same cause.

However, the doctrine of Plurality of Causes is in accordance with our everyday view of causation. In our daily life, when we find many different causes bringing about almost the same effect, we

are bound to ackowledge a plurality of causes. Whether, for instance, a student fails on account of his negligence or illness, whether a crop is damaged by a frost or by a storm, whether a house is burnt by fire or by electricity, the effect is practically the same. Therefore Plurality of Causes, though untenable from the scientific point of view, seems quite tenable from the popular or practical point of view.

Composition of Causes and Inter-mixture of Effects.

When a number of causes combine together, we have what is called Composition or Conjunction of Causes ; and the combination of their respective effects results in what is called Inter-mixture of Effects. If causes remain separate in Nature, their corresponding effects would also remain separate. But this is by no means always the case. Nature is highly complex and we seldom find a cause or an effect all alone. We actually find several causes acting together and thus leading to an amalgamation or inter-mixture of their effects. This acting together of several causes is known as Composition of Causes, and the mixing of their effects is known as Inter-mixture of Effects. Thus, it is Composition of Causes that leads to Inter-mixture of Effects. In a cup of tea, for example, the sweetness of sugar and the flavour of tea combine together and produce a joint taste.

We must not confuse Composition of Causes with Plurality of Causes. According to Plurality of Causes several causes, *acting separately*, produce