CHAPTER XII

HYPOTHESIS

Nature of Hypothesis.

The business of Induction, as we have so often said, is to prove causal connections among facts. In other words, it has to prove the causes of events. Causes, however, are not always easily discovered, still less proved. They have to be *supposed* before they are finally proved. For instance, we see a man lying on a road, bleeding and senseless, and want to know the cause of the happening. We do not get the cause all at once, and have to make *conjectures* or *suppositions* about it. We may suppose that the person has been murdered by somebody, or run over by a motor-car. Such a supposition or assumption which is put forward as a *probable explanation* is called a hypothesis. So we may define hypothesis as *a supposition* or *conjecture* made in order to explain facts. It is a *provisional* or *temporary explanation*, a *tentative proof*, like preliminary heats which precede the real game. Hypothesis, thus, lies at the bottom of every inductive inquiry.

A hypothesis, to start with, is based on insufficient evidence, but meanwhile it guides our further steps. When we start an investigation, many hypotheses suggest themselves as possible means to the solution of the problem which we are investigating. The truth of each hypothesis

is tested. If it stands verification, it is accepted as a working hypothesis for further examination. If it fails under the test, it is rejected in favour of another which again is similarly tried. As our process of verification proceeds on, some hypotheses are dropped, while others go on gaining ground. But the process of verification is not complete until *one* of the rival hypotheses is finally proved and all others rejected.

The fact that a certain hypothesis turns out to be false and deserves to be rejected does not belittle its importance. Even a false hypothesis serves a purpose by pointing out some other hypothesis as a better clue to the solution of the problem under investigation. Every hypothesis is a *hit-or-miss* affair, and in both cases it is useful. If it "hits", well and good. If it "misses", even then it is valuable inasmuch as it points out the line to be avoided.

The process of making hypotheses, testing, accepting and rejecting them is a long and patient work. It is, so to speak, like finding out the right key to a lock out of a bunch in the dark. One key is tried, then another, then another, till the right key is found out. So with hypotheses. It is all a *trial-and-error* procedure. One hypothesis is tried, and if it errs, it is left out. Then another is taken up and tried in the same way, and accepted or rejected as the case may be, so on and so forth. Every hypothesis, then, is held subject to trial and revision. There is a lot of groping in the dark before we hit upon the the right clue.

We must, however, remember that the status of a hypothesis is only that of supposition. *Only* that ! And it is likely to be misused by our excess of confidence in it. Nevertheless, a hypothesis should not be lightly dismissed simply because it is a supposition and not a proof. It is supposition that leads to proof. Every reasonable supposition merits consideration and should not be condemned wholesale even if it does not happen to be all right; it may need to be only modified rather than totally rejected.

No rules can be laid down for making a hypothesis. The ability to frame hypotheses is a natural gift ; it is purely a matter of the investigator's inventiveness or insight. The scientific genius may hit, as if by inspiration, at hypotheses of far-reaching importance where the ordinary mind sees nothing. Newton saw the fall of an apple. Many men, before and since, have observed this phenomenon, but Newton took a hint from this simple phenomenon and discovered the law of Gravitation. Similarly, Darwin was struck by the similarity of structures in various types of life, and formulated the theory of Evolution. All great inventions are strokes of imaginative insight, the outcome of brilliant conjectures.

Conditions of a Good Hypothesis.

We have defined hypothesis as a conjecture. But not all conjectures are of the same value. In order to explain the disappearance of a book, for example, we may make many hypotheses, namely, that it has been mislaid, or that it has been stolen

by somebody, or that it has evaporated in the air, or that it has been taken away by spirits. Now, all these hypotheses are not worthy of acceptance. Some of them are silly and possess no plausibility at all. It was about such absurd and extravagant conjectures that Newton remarked in protest "*Hypotheses non fingo*" (I do not make hypotheses). This condemnation of Newton was not urged against valid hypotheses but only against random and unreasonable guesses. A hypothesis, to be valid or legitimate, must fulfil the following conditions:—

1. *It must be based on facts*. That is, it should not be created "out of nothing" but should be suggested by actual facts. And as in its origin it has to depend upon facts, so for its verification it has to be referred to facts. Thus, it must start with facts and end with facts. In other words, it must not be a fanciful guesswork but should be real and should refer to what is called by Newton a *vera causa*, a real cause. "Only *vera causa* are to be admitted in the explanation of phenomena," says Newton. Our superstitions violate this condition; as, for example, when a certain day of the week is supposed to be unlucky for starting on a journey, or when the appearance of a comet is supposed to be a sign of the death of a king. Such hypotheses do not refer to *vera causa*; hence they are not legitimate.

2. *A hypothesis must not be self-contradictory*. Freedom from self-contradiction is an essential condition of truth. What is self-contradictory can-

not be true. Thus, a hypothesis must be *self-consistent* or free from self-contradiction. We should not, for example, suppose that a certain person is a liar and also trustworthy.

3. *A hypothesis must not conflict or clash with an already established truth.* If, for example, we suppose that a man, instead of falling down from the roof of a house, soared to the sky, our hypothesis will not be entertained because it conflicts with the law of Gravitation. Similarly, if we suppose that the eclipse of the sun and the moon is caused when a monster (*Rahu*) devours them, our hypothesis will be utterly worthless because it is not consistent with the known laws of Nature.

But we should not reject a hypothesis at once unless we are thoroughly convinced that the contradiction is *real*. Sometimes there is only a *superficial conflict* between a hypothesis and other truths, and in such cases they can be reconciled with each other after mutual modification. Who knows whether our present hypothesis needs revision or the previously accepted truths?

4. *A hypothesis must be clear, definite and capable of verification.* The function of a hypothesis is to explain a certain phenomenon, but if it is vague or indefinite it leaves the phenomenon unexplained. For example, to suppose that the disease of a patient is due to *some* disturbance in his body is not a good hypothesis. A good hypothesis would *definitely* state what that disturbance is.

An indefinite hypothesis is not verifiable, *i.e.*, not capable of being proved or disproved. A hypothesis which can neither be proved nor disproved is called a *barren hypothesis*. For instance, the hypothesis that the earth is resting on the horns of a bull is a barren hypothesis because it is an unverifiable conjecture. Of course, every hypothesis is a conjecture in the beginning. But that does not mean that it should remain a conjecture *for ever*. It must admit of proof or disproof so that it may ultimately be accepted or rejected. A barren or unverifiable hypothesis is even worse than a *false* or *erroneous* hypothesis. An erroneous hypothesis is at least definite because it is verified and known to be false. A barren hypothesis is neither true nor false, but simply *unknowable and indefinite*.

Thus, a legitimate hypothesis is that from which we can draw conclusions, and see whether they tally with actual facts or not. A barren hypothesis is illegitimate and of no value whatever because nothing can be deduced from it. It defies investigation because we cannot put it to test.

5. *A hypothesis must adequately explain the phenomena under investigation*. That is, it must account for *all* the facts which it attempts to explain. A *partial* explanation is no explanation. If any fact refuses to be explained by a hypothesis, then the hypothesis needs must be rejected or remodelled, and not the fact. Facts are stubborn realities and we should not distort them to suit a hypothesis any more than we should cut or twist

our arm or leg to suit a garment which has been prepared. Any discrepancy with facts is fatal to a hypothesis. "The instance of Kepler and Newton show that greatest investigators are those who are most ready to abandon cherished theories, the fruit of laborious research, if they cannot be shown to harmonise with facts" (Mellone). Thus, a hypothesis which leaves out or *explains away* any fact will be inadequate. To take examples: the hypothesis that dreams are wishfulfilments is not adequate because it fails to explain dreams of fear which do not fulfil any wishes. Similarly, the hypothesis that famines in India were a gift of the British Rule is inadequate because it does not explain all the famines that have occurred in India; it cannot account for those famines which broke out when there was no British Rule in India

To sum up, a hypothesis, to be valid, must be *real, consistent with itself and with other established truths, definite, verifiable and adequate.*

Verification or confirmation of Hypothesis.

A hypothesis is verified by an appeal to facts. Facts are essential in hypothesis, first and last. If the conclusions deduced from a hypothesis agree with facts, the hypothesis is said to be *confirmed* or *verified*. The greater the agreement, the stronger the evidence in favour of accepting it as true. The truth of a hypothesis altogether depends upon subsequent verification and agreement with facts. To invent a hypothesis and then not to put it to the test of facts, *i.e.*, to neglect its verification, is to defeat the very purpose

of hypothesis: Mill says : "An hypothesis is any supposition which we make (either without actual evidence, or on evidence avowedly insufficient) in order to endeavour to deduce from it conclusions in accordance with facts which are known to be real ; under the idea that if the conclusions to which the hypothesis leads are known truths the hypothesis itself either must be, or at least is likely to be, true." That a hypothesis must be verified by comparison of the consequences deduced from it with actual facts is obviously an essential thing.

Verification may be *direct* or *indirect*. When a direct appeal is made to facts, our verification is direct. It may be by means of simple Observation or by Experiment. For example, if I suppose that I have left my books in the class-room and then go there to see whether my hypothesis is true or not, it would be a *direct verification by Simple Observation*. To take another example : the planet Uranus was found to deviate from its calculated path and it was supposed that its deviation was due to the influence of some as yet unknown planet. This hypothesis was verified when by telescopic observation the supposed planet, Neptune, was discovered in the expected region of the sky in 1846. Similarly, we can have a *direct verification by Experiment*. For example, the hypothesis that water is composed of two units of hydrogen and one unit of oxygen can be verified by decomposing water with the help of Experiment. To take a further example : if we suspect that the water supplied by our municipality con-

tains germs of cholera, we can have its chemical analysis done by Experiment and verify whether our hypothesis is true or not.

Indirect verification is *verification by deduction*. We deduce, as accurately as possible, all the consequences which logically follow from our hypothesis, and then compare the deduced consequences with actual facts. In other words, we expect that such and such consequences should follow if our hypotheses were true. If those consequences are actually there, the truth of the hypothesis is verified ; and if they are not there, the truth of the hypothesis is overthrown. Thus, indirect verification does not depend on direct observation or experiment, but on a *roundabout way* of deducing consequences from the supposed hypothesis and then seeing their agreement or disagreement with facts.

We depend on indirect verification where direct observation and experiment are out of the question.

Proof of Hypothesis.

We must distinguish between the *verification* of a hypothesis and its *proof*. Verification is not complete proof but a stage on the road to proof. If the consequences deduced from a hypothesis tally with facts, the hypothesis is confirmed or verified, but not yet proved. To prove a hypothesis is a step farther than verification. In order to be *proved* or *established*, a hypothesis must stand as the *only* hypothesis, excluding all rival hypotheses which are in the field. So long as this condition is not fulfilled, a hypothesis cannot be regarded as *proved*. Clifford