

make all the 999 cases so undistinguishably alike, that there is hardly a possibility of any cause of falsehood or error operating in favor of any of them, which would not operate in the same manner if there were only one. Alter this supposition, and the whole argument falls to the ground. Let the balls, for instance, be numbered, and let the white ball be No. 79. Considered in respect of their color, there are but two things which the witness can be interested in asserting, or can have dreamed or hallucinated, or has to choose from if he answers at random, viz., black and white; but considered in respect of the numbers attached to them, there are a thousand; and if his interest or error happens to be connected with the numbers, though the only assertion he makes is about the color, the case becomes precisely assimilated to that of the thousand tickets. Or instead of the balls suppose a lottery, with 1000 tickets and but one prize, and that I hold No. 79, and being interested only in that, ask the witness not what was the number drawn, but whether it was 79 or some other. There are now only two cases, as in Laplace's example; yet he surely would not say that if the witness answered 79, the assertion would be in an enormous proportion less credible, than if he made the same answer to the same question asked in the other way. If, for instance (to put a case supposed by Laplace himself), he has staked a large sum on one of the chances, and thinks that by announcing its occurrence he shall increase his credit; he is equally likely to have betted on any one of the 999 numbers which are attached to black balls, and so far as the chances of mendacity from this cause are concerned, there will be 999 times as many chances of his announcing black falsely as white.

Or suppose a regiment of 1000 men, 999 Englishmen and one Frenchman, and that of these one man has been killed, and it is not known which. I ask the question, and the witness answers, the Frenchman. This was not only as improbable *a priori*, but is in itself as singular a circumstance, as remarkable a coincidence, as the drawing of the white ball; yet we should believe the statement as readily, as if the answer had been John Thompson. Because, though the 999 Englishmen were all alike in the point in which they differed from the Frenchman, they were not, like the 999 black balls, undistinguishable in every other respect; but being all different, they admitted as many chances of interest or error, as if each man had been of a different nation; and if a lie was told or a mistake made, the misstatement was as likely to fall on any Jones or Thompson of the set, as on the Frenchman.

The example of a coincidence selected by D'Alembert, that of sixes thrown on a pair of dice ten times in succession, belongs to this sort of cases rather than to such as Laplace's. The coincidence is here far more remarkable, because of far rarer occurrence, than the drawing of the white ball. But though the improbability of its really occurring is greater, the superior probability of its being announced falsely can not be established with the same evidence. The announcement "black" represented 999 cases, but the witness may not have known this, and if he did, the 999 cases are so exactly alike, that there is really only one set of possible causes of mendacity corresponding to the whole. The announcement "sixes *not* drawn ten times," represents, and is known by the witness to represent, a great multitude of contingencies, every one of which being unlike every other, there may be a different and a fresh set of causes of mendacity corresponding to each.

It appears to me, therefore, that Laplace's doctrine is not strictly true of any coincidences, and is wholly inapplicable to most; and that to know whether a coincidence does or does not require more evidence to render it credible than an ordinary event, we must refer, in every instance, to first principles, and estimate afresh what is the probability that the given testimony would have been delivered in that instance, supposing the fact which it asserts not to be true.

With these remarks we close the discussion of the Grounds of Disbelief; and along with it, such exposition as space admits, and as the writer has it in his power to furnish, of the Logic of Induction.

Book IV.

OF OPERATIONS SUBSIDIARY TO INDUCTION.

"Clear and distinct ideas are terms which, though familiar and frequent in men's mouths, I have reason to think every one who uses does not perfectly understand. And possibly it is but here and there one who gives himself the trouble to consider them so far as to know what he himself or others precisely mean by them; I have, therefore, in most places, chose to put determinate or determined, instead of clear and distinct, as more likely to direct men's thoughts to my meaning in this matter."--LOCKE'S *Essay on the Human Understanding*; Epistle to the Reader.

"Il ne peut y avoir qu'une méthode parfaite, qui est la *méthode naturelle*; on nomme ainsi un arrangement dans lequel les êtres du même genre seraient plus voisins entre eux que ceux de tous les autres genres; les genres du même ordre, plus que ceux de tous les autres ordres; et ainsi de suite. Cette méthode est l'idéal auquel l'histoire naturelle doit tendre; car il est évident que si l'on y parvenait, l'on aurait l'expression exacte et complète de la nature entière."--CUVIER, *Règne Animal*, Introduction.

"Deux grandes notions philosophiques dominant la théorie fondamentale de la méthode naturelle proprement dite, savoir la formation des groupes naturels, et ensuite leur succession hiérarchique."--COMTE, *Cours de Philosophie Positive*, 42<sup>me</sup> leçon.

## Chapter I.

### Of Observation And Description.

§ 1. The inquiry which occupied us in the two preceding Books, has conducted us to what appears a satisfactory solution of the principal problem of Logic, according to the conception I have formed of the science. We have found, that the mental process with which Logic is conversant, the operation of ascertaining truths by means of evidence, is always, even when appearances point to a different theory of it, a process of induction. And we have particularized the various modes of induction, and obtained a clear view of the principles to which it must conform, in order to lead to results which can be relied on.

The consideration of Induction, however, does not end with the direct rules for its performance. Something must be said of those other operations of the mind, which are either necessarily presupposed in all induction, or are instrumental to the more difficult and complicated inductive processes. The present Book will be devoted to the consideration of these subsidiary operations; among which our attention must first be given to those, which are indispensable preliminaries to all induction whatsoever.

Induction being merely the extension to a class of cases, of something which has been observed to be true in certain individual instances of the class; the first place among the operations subsidiary to induction, is claimed by Observation. This is not, however, the place to lay down rules for making good observers; nor is it within the competence of Logic to do so, but of the art of intellectual Education. Our business with observation is only in its connection with the appropriate problem of logic, the estimation of evidence. We have to consider, not how or what to observe, but under what conditions observation is to be relied on; what is needful, in order that the fact, supposed to be observed, may safely be received as true.

§ 2. The answer to this question is very simple, at least in its first aspect. The sole condition is, that what is supposed to have been observed shall really have been observed; that it be an observation, not an inference. For in almost every act of our perceiving faculties, observation and inference are intimately blended. What we are said to observe is usually a compound result, of which one-tenth may be observation, and the remaining nine-tenths inference.

I affirm, for example, that I hear a man's voice. This would pass, in common language, for a direct perception. All, however, which is really perception, is that I hear a sound. That the sound is a voice, and that voice the voice of a man, are not perceptions but inferences. I affirm, again, that I saw my brother at a certain hour this morning. If any proposition concerning a matter of fact would commonly be said to be known by the direct testimony of the senses, this surely would be so. The truth, however, is far otherwise. I only saw a certain colored surface; or rather I had the kind of visual sensations which are usually produced by a colored surface; and from these as marks, known to be such by previous experience, I concluded that I saw my brother. I might have had sensations precisely similar, when my brother was not there. I might have seen some other person so nearly resembling him in appearance, as, at the distance, and, with the degree of attention which I bestowed, to be mistaken for him. I might have been asleep, and have dreamed that I saw him; or in a state of nervous disorder, which brought his image before me in a waking hallucination. In all these modes, many have been led to believe that they saw persons well known to them, who were dead or far distant. If any of these suppositions had been true, the affirmation that I saw my brother would have been erroneous; but whatever was matter of direct perception, namely the visual sensations, would have been real. The inference only would have been ill grounded; I should have ascribed those sensations to a wrong cause.

Innumerable instances might be given, and analyzed in the same manner, of what are vulgarly called errors of sense. There are none of them properly errors of sense; they are erroneous inferences from sense. When I look at a candle through a multiplying glass, I see what seems a dozen candles instead of one; and if the real circumstances of the case were skillfully disguised, I might suppose that there were really that number; there would be what is called an optical deception. In the kaleidoscope there really is that deception; when I look

through the instrument, instead of what is actually there, namely a casual arrangement of colored fragments, the appearance presented is that of the same combination several times repeated in symmetrical arrangement round a point. The delusion is of course effected by giving me the same sensations which I should have had if such a symmetrical combination had really been presented to me. If I cross two of my fingers, and bring any small object, a marble for instance, into contact with both, at points not usually touched simultaneously by one object, I can hardly, if my eyes are shut, help believing that there are two marbles instead of one. But it is not my touch in this case, nor my sight in the other, which is deceived; the deception, whether durable or only momentary, is in my judgment. From my senses I have only the sensations, and those are genuine. Being accustomed to have those or similar sensations when, and only when, a certain arrangement of outward objects is present to my organs, I have the habit of instantly, when I experience the sensations, inferring the existence of that state of outward things. This habit has become so powerful, that the inference, performed with the speed and certainty of an instinct, is confounded with intuitive perceptions. When it is correct, I am unconscious that it ever needed proof; even when I know it to be incorrect, I can not without considerable effort abstain from making it. In order to be aware that it is not made by instinct but by an acquired habit, I am obliged to reflect on the slow process through which I learned to judge by the eye of many things which I now appear to perceive directly by sight; and on the reverse operation performed by persons learning to draw, who with difficulty and labor divest themselves of their acquired perceptions, and learn afresh to see things as they appear to the eye.

It would be easy to prolong these illustrations, were there any need to expatiate on a topic so copiously exemplified in various popular works. From the examples already given, it is seen sufficiently, that the individual facts from which we collect our inductive generalizations are scarcely ever obtained by observation alone. Observation extends only to the sensations by which we recognize objects; but the propositions which we make use of, either in science or in common life, relate mostly to the objects themselves. In every act of what is called observation, there is at least one inference--from the sensations to the presence of the object; from the marks or diagnostics, to the entire phenomenon. And hence, among other consequences, follows the seeming paradox, that a general proposition collected from particulars is often more certainly true than any one of the particular propositions from which, by an act of induction, it was inferred. For, each of those particular (or rather singular) propositions involved an inference, from the impression on the senses to the fact which caused that impression; and this inference may have been erroneous in any one of the instances, but can not well have been erroneous in all of them, provided their number was sufficient to eliminate chance. The conclusion, therefore, that is, the general proposition, may deserve more complete reliance than it would be safe to repose in any one of the inductive premises.

The logic of observation, then, consists solely in a correct discrimination between that, in a result of observation, which has really been perceived, and that which is an inference from the perception. Whatever portion is inference, is amenable to the rules of induction already treated of, and requires no further notice here; the question for us in this place is, when all which is inference is taken away what remains? There remains, in the first place, the mind's own feelings or states of consciousness, namely, its outward feelings or sensations, and its inward feelings--its thoughts, emotions, and volitions. Whether any thing else remains, or all else is inference from this; whether the mind is capable of directly perceiving or apprehending any thing except states of its own consciousness--is a problem of metaphysics not to be discussed in this place. But after excluding all questions on which metaphysicians differ, it remains true, that for most purposes the discrimination we are called upon practically to exercise is that between sensations or other feelings, of our own or of other people, and inferences drawn from them. And on the theory of Observation this is all which seems necessary to be said for the purposes of the present work.

§ 3. If, in the simplest observation, or in what passes for such, there is a large part which is not observation but something else; so in the simplest description of an observation, there is, and must always be, much more asserted than is contained in the perception itself. We can not describe a fact, without implying more than the fact. The perception is only of one individual thing; but to describe it is to affirm a connection between it and every other thing which is either denoted or connoted by any of the terms used. To begin with an example,

than which none can be conceived more elementary: I have a sensation of sight, and I endeavor to describe it by saying that I see something white. In saying this, I do not solely affirm my sensation; I also class it. I assert a resemblance between the thing I see, and all things which I and others are accustomed to call white. I assert that it resembles them in the circumstance in which they all resemble one another, in that which is the ground of their being called by the name. This is not merely one way of describing an observation, but the only way. If I would either register my observation for my own future use, or make it known for the benefit of others, I must assert a resemblance between the fact which I have observed and something else. It is inherent in a description, to be the statement of a resemblance, or resemblances.

We thus see that it is impossible to express in words any result of observation, without performing an act possessing what Dr. Whewell considers to be characteristic of Induction. There is always something introduced which was not included in the observation itself; some conception common to the phenomenon with other phenomena to which it is compared. An observation can not be spoken of in language at all without declaring more than that one observation; without assimilating it to other phenomena already observed and classified. But this identification of an object--this recognition of it as possessing certain known characteristics--has never been confounded with Induction. It is an operation which precedes all induction, and supplies it with its materials. It is a perception of resemblances, obtained by comparison.

These resemblances are not always apprehended directly, by merely comparing the object observed with some other present object, or with our recollection of an object which is absent. They are often ascertained through intermediate marks, that is, deductively. In describing some new kind of animal, suppose me to say that it measures ten feet in length, from the forehead to the extremity of the tail. I did not ascertain this by the unassisted eye. I had a two-foot rule which I applied to the object, and, as we commonly say, measured it; an operation which was not wholly manual, but partly also mathematical, involving the two propositions, Five times two is ten, and Things which are equal to the same thing are equal to one another. Hence, the fact that the animal is ten feet long is not an immediate perception, but a conclusion from reasoning; the minor premises alone being furnished by observation of the object. Nevertheless, this is called an observation, or a description of the animal, not an induction respecting it.

To pass at once from a very simple to a very complex example: I affirm that the earth is globular. The assertion is not grounded on direct perception; for the figure of the earth can not, by us, be directly perceived, though the assertion would not be true unless circumstances could be supposed under which its truth could be so perceived. That the form of the earth is globular is inferred from certain marks, as for instance from this, that its shadow thrown upon the moon is circular; or this, that on the sea, or any extensive plain, our horizon is always a circle; either of which marks is incompatible with any other than a globular form. I assert further, that the earth is that particular kind of a globe which is termed an oblate spheroid; because it is found by measurement in the direction of the meridian, that the length on the surface of the earth which subtends a given angle at its centre, diminishes as we recede from the equator and approach the poles. But these propositions, that the earth is globular, and that it is an oblate spheroid, assert, each of them, an individual fact; in its own nature capable of being perceived by the senses when the requisite organs and the necessary position are supposed, and only not actually perceived because those organs and that position are wanting. This identification of the earth, first as a globe, and next as an oblate spheroid, which, if the fact could have been seen, would have been called a description of the figure of the earth, may without impropriety be so called when, instead of being seen, it is inferred. But we could not without impropriety call either of these assertions an induction from facts respecting the earth. They are not general propositions collected from particular facts, but particular facts deduced from general propositions. They are conclusions obtained deductively, from premises originating in induction: but of these premises some were not obtained by observation of the earth, nor had any peculiar reference to it.

If, then, the truth respecting the figure of the earth is not an induction, why should the truth respecting the figure of the earth's orbit be so? The two cases only differ in this, that the form of the orbit was not, like the form of the earth itself, deduced by ratiocination from facts which were marks of ellipticity, but was got at by

boldly guessing that the path was an ellipse, and finding afterward, on examination, that the observations were in harmony with the hypothesis. According to Dr. Whewell, however, this process of guessing and verifying our guesses is not only induction, but the whole of induction: no other exposition can be given of that logical operation. That he is wrong in the latter assertion, the whole of the preceding book has, I hope, sufficiently proved; and that the process by which the ellipticity of the planetary orbits was ascertained, is not induction at all, was attempted to be shown in the second chapter of the same Book.(206) We are now, however, prepared to go more into the heart of the matter than at that earlier period of our inquiry, and to show, not merely what the operation in question is not, but what it is.

§ 4. We observed, in the second chapter, that the proposition "the earth moves in an ellipse," so far as it only serves for the colligation or connecting together of actual observations (that is, as it only affirms that the observed positions of the earth may be correctly represented by as many points in the circumference of an imaginary ellipse), is not an induction, but a description: it is an induction, only when it affirms that the intermediate positions, of which there has been no direct observation, would be found to correspond to the remaining points of the same elliptic circumference. Now, though this real induction is one thing, and the description another, we are in a very different condition for making the induction before we have obtained the description, and after it. For inasmuch as the description, like all other descriptions, contains the assertion of a resemblance between the phenomenon described and something else; in pointing out something which the series of observed places of a planet resembles, it points out something in which the several places themselves agree. If the series of places correspond to as many points of an ellipse, the places themselves agree in being situated in that ellipse. We have, therefore, by the same process which gave us the description, obtained the requisites for an induction by the Method of Agreement. The successive observed places of the earth being considered as effects, and its motion as the cause which produces them, we find that those effects, that is, those places, agree in the circumstance of being in an ellipse. We conclude that the remaining effects, the places which have not been observed, agree in the same circumstance, and that the *law* of the motion of the earth is motion in an ellipse.

The Colligation of Facts, therefore, by means of hypotheses, or, as Dr. Whewell prefers to say, by means of Conceptions, instead of being, as he supposes, Induction itself, takes its proper place among operations subsidiary to Induction. All Induction supposes that we have previously compared the requisite number of individual instances, and ascertained in what circumstances they agree. The Colligation of Facts is no other than this preliminary operation. When Kepler, after vainly endeavoring to connect the observed places of a planet by various hypotheses of circular motion, at last tried the hypotheses of an ellipse and found it answer to the phenomena; what he really attempted, first unsuccessfully and at last successfully, was to discover the circumstance in which all the observed positions of the planet agreed. And when he in like manner connected another set of observed facts, the periodic times of the different planets, by the proposition that the squares of the times are proportional to the cubes of the distances, what he did was simply to ascertain the property in which the periodic times of all the different planets agreed.

Since, therefore, all that is true and to the purpose in Dr. Whewell's doctrine of Conceptions might be fully expressed by the more familiar term Hypothesis; and since his Colligation of Facts by means of appropriate Conceptions, is but the ordinary process of finding by a comparison of phenomena, in what consists their agreement or resemblance; I would willingly have confined myself to those better understood expressions, and persevered to the end in the same abstinence which I have hitherto observed from ideological discussions; considering the mechanism of our thoughts to be a topic distinct from and irrelevant to the principles and rules by which the trustworthiness of the results of thinking is to be estimated. Since, however, a work of such high pretensions, and, it must also be said, of so much real merit, has rested the whole theory of Induction upon such ideological considerations, it seems necessary for others who follow to claim for themselves and their doctrines whatever position may properly belong to them on the same metaphysical ground. And this is the object of the succeeding chapter.