observation outward, we also find that light and darkness, sound and silence, motion and quiescence, equality and inequality, preceding and following, succession and simultaneousness, any positive phenomenon whatever and its negative, are distinct phenomena, pointedly contrasted, and the one always absent where the other is present. I consider the maxim in question to be a generalization from all these facts.

In like manner as the Principle of Contradiction (that one of two contradictories must be false) means that an assertion can not be *both* true and false, so the Principle of Excluded Middle, or that one of two contradictories must be true, means that an assertion must be *either* true or false: either the affirmative is true, or otherwise the negative is true, which means that the affirmative is false. I can not help thinking this principle a surprising specimen of a so-called necessity of Thought, since it is not even true, unless with a large qualification. A proposition must be either true or false, *provided* that the predicate be one which can in any intelligible sense be attributed to the subject; (and as this is always assumed to be the case in treatises on logic, the axiom is always laid down there as of absolute truth). "Abracadabra is a second intention" is neither true nor false. Between the true and the false there is a third possibility, the Unmeaning: and this alternative is fatal to Sir William Hamilton's extension of the maxim to Noumena. That Matter must either have a minimum of divisibility or be infinitely divisible, is more than we can ever know. For in the first place, Matter, in any other than the phenomenal sense of the term, may not exist: and it will scarcely be said that a nonentity must be either infinitely or finitely divisible. In the second place, though matter, considered as the occult cause of our sensations, do really exist, yet what we call divisibility may be an attribute only of our sensations of sight and touch, and not of their uncognizable cause. Divisibility may not be predicable at all, in any intelligible sense, of Things in themselves, nor therefore of Matter in itself; and the assumed necessity of being either infinitely or finitely divisible, may be an inapplicable alternative.

On this question I am happy to have the full concurrence of Mr. Herbert Spencer, from whose paper in the *Fortnightly Review* I extract the following passage. The germ of an idea identical with that of Mr. Spencer may be found in the present chapter, on a preceding page; but in Mr. Spencer it is not an undeveloped thought, but a philosophical theory.

"When remembering a certain thing as in a certain place, the place and the thing are mentally represented together; while to think of the non-existence of the thing in that place implies a consciousness in which the place is represented, but not the thing. Similarly, if instead of thinking of an object as colorless, we think of its having color, the change consists in the addition to the concept of an element that was before absent from it--the object can not be thought of first as red and then as not red, without one component of the thought being totally expelled from the mind by another. The law of the Excluded Middle, then, is simply a generalization of the universal experience that some mental states are directly destructive of other states. It formulates a certain absolutely constant law, that the appearance of any positive mode of consciousness can not occur without excluding a correlative negative mode; and that the negative mode can not occur without excluding the correlative positive mode: the antithesis of positive and negative being, indeed, merely an expression of this experience. Hence it follows that if consciousness is not in one of the two modes it must be in the other."(99)

I must here close this supplementary chapter, and with it the Second Book. The theory of Induction, in the most comprehensive sense of the term, will form the subject of the Third.

Book III.

OF INDUCTION.

"According to the doctrine now stated, the highest, or rather the only proper object of physics, is to ascertain those established conjunctions of successive events, which constitute the order of the universe; to record the phenomena which it exhibits to our observations, or which it discloses to our experiments; and to refer these phenomena to their general laws."--D. STEWART, *Elements of the Philosophy of the Human Mind*, vol. ii.,

chap. iv., sect. 1.

"In such cases the inductive and deductive methods of inquiry may be said to go hand in hand, the one verifying the conclusions deduced by the other; and the combination of experiment and theory, which may thus be brought to bear in such cases, forms an engine of discovery infinitely more powerful than either taken separately. This state of any department of science is perhaps of all others the most interesting, and that which promises the most to research."--SIR J. HERSCHEL, *Discourse on the Study of Natural Philosophy*.

Chapter I.

Preliminary Observations On Induction In General.

§ 1. The portion of the present inquiry upon which we are now about to enter, may be considered as the principal, both from its surpassing in intricacy all the other branches, and because it relates to a process which has been shown in the preceding Book to be that in which the investigation of nature essentially consists. We have found that all Inference, consequently all Proof, and all discovery of truths not self-evident, consists of inductions, and the interpretation of inductions: that all our knowledge, not intuitive, comes to us exclusively from that source. What Induction is, therefore, and what conditions render it legitimate, can not but be deemed the main question of the science of logic--the question which includes all others. It is, however, one which professed writers on logic have almost entirely passed over. The generalities of the subject have not been altogether neglected by metaphysicians; but, for want of sufficient acquaintance with the processes by which science has actually succeeded in establishing general truths, their analysis of the inductive operation, even when unexceptionable as to correctness, has not been specific enough to be made the foundation of practical rules, which might be for induction itself what the rules of the syllogism are for the interpretation of induction: while those by whom physical science has been carried to its present state of improvement--and who, to arrive at a complete theory of the process, needed only to generalize, and adapt to all varieties of problems, the methods which they themselves employed in their habitual pursuits--never until very lately made any serious attempt to philosophize on the subject, nor regarded the mode in which they arrived at their conclusions as deserving of study, independently of the conclusions themselves.

§ 2. For the purposes of the present inquiry, Induction may be defined, the operation of discovering and proving general propositions. It is true that (as already shown) the process of indirectly ascertaining individual facts, is as truly inductive as that by which we establish general truths. But it is not a different kind of induction; it is a form of the very same process: since, on the one hand, generals are but collections of particulars, definite in kind but indefinite in number; and on the other hand, whenever the evidence which we derive from observation of known cases justifies us in drawing an inference respecting even one unknown case, we should on the same evidence be justified in drawing a similar inference with respect to a whole class of cases. The inference either does not hold at all, or it holds in all cases of a certain description; in all cases which, in certain definable respects, resemble those we have observed.

If these remarks are just; if the principles and rules of inference are the same whether we infer general propositions or individual facts; it follows that a complete logic of the sciences would be also a complete logic of practical business and common life. Since there is no case of legitimate inference from experience, in which the conclusion may not legitimately be a general proposition; an analysis of the process by which general truths are arrived at, is virtually an analysis of all induction whatever. Whether we are inquiring into a scientific principle or into an individual fact, and whether we proceed by experiment or by ratiocination, every step in the train of inferences is essentially inductive, and the legitimacy of the induction depends in both cases on the same conditions.

True it is that in the case of the practical inquirer, who is endeavoring to ascertain facts not for the purposes of science but for those of business, such, for instance, as the advocate or the judge, the chief difficulty is one in which the principles of induction will afford him no assistance. It lies not in making his inductions, but in the selection of them; in choosing from among all general propositions ascertained to be true, those which furnish marks by which he may trace whether the given subject possesses or not the predicate in question. In arguing a doubtful question of fact before a jury, the general propositions or principles to which the advocate appeals are mostly, in themselves, sufficiently trite, and assented to as soon as stated: his skill lies in bringing his case under those propositions or principles; in calling to mind such of the known or received maxims of probability as admit of application to the case in hand, and selecting from among them those best adapted to his object. Success is here dependent on natural or acquired sagacity, aided by knowledge of the particular subject, and of subjects allied with it. Invention, though it can be cultivated, can not be reduced to rule; there is no science

which will enable a man to bethink himself of that which will suit his purpose.

But when he *has* thought of something, science can tell him whether that which he has thought of will suit his purpose or not. The inquirer or arguer must be guided by his own knowledge and sagacity in the choice of the inductions out of which he will construct his argument. But the validity of the argument when constructed, depends on principles, and must be tried by tests which are the same for all descriptions of inquiries, whether the result be to give A an estate, or to enrich science with a new general truth. In the one case and in the other, the senses, or testimony, must decide on the individual facts; the rules of the syllogism will determine whether, those facts being supposed correct, the case really falls within the formulæ of the different inductions under which it has been successively brought; and finally, the legitimacy of the inductions themselves must be decided by other rules, and these it is now our purpose to investigate. If this third part of the operation be, in many of the questions of practical life, not the most, but the least arduous portion of it, we have seen that this is also the case in some great departments of the field of science; in all those which are principally deductive, and most of all in mathematics; where the inductions themselves are few in number, and so obvious and elementary that they seem to stand in no need of the evidence of experience, while to combine them so as to prove a given theorem or solve a problem, may call for the utmost powers of invention and contrivance with which our species is gifted.

If the identity of the logical processes which prove particular facts and those which establish general scientific truths, required any additional confirmation, it would be sufficient to consider that in many branches of science, single facts have to be proved, as well as principles; facts as completely individual as any that are debated in a court of justice; but which are proved in the same manner as the other truths of the science, and without disturbing in any degree the homogeneity of its method. A remarkable example of this is afforded by astronomy. The individual facts on which that science grounds its most important deductions, such facts as the magnitudes of the bodies of the solar system, their distances from one another, the figure of the earth, and its rotation, are scarcely any of them accessible to our means of direct observation: they are proved indirectly, by the aid of inductions founded on other facts which we can more easily reach. For example, the distance of the moon from the earth was determined by a very circuitous process. The share which direct observation had in the work consisted in ascertaining, at one and the same instant, the zenith distances of the moon, as seen from two points very remote from one another on the earth's surface. The ascertainment of these angular distances ascertained their supplements; and since the angle at the earth's centre subtended by the distance between the two places of observation was deducible by spherical trigonometry from the latitude and longitude of those places, the angle at the moon subtended by the same line became the fourth angle of a quadrilateral of which the other three angles were known. The four angles being thus ascertained, and two sides of the quadrilateral being radii of the earth; the two remaining sides and the diagonal, or, in other words, the moon's distance from the two places of observation and from the centre of the earth, could be ascertained, at least in terms of the earth's radius, from elementary theorems of geometry. At each step in this demonstration a new induction is taken in, represented in the aggregate of its results by a general proposition.

Not only is the process by which an individual astronomical fact was thus ascertained, exactly similar to those by which the same science establishes its general truths, but also (as we have shown to be the case in all legitimate reasoning) a general proposition might have been concluded instead of a single fact. In strictness, indeed, the result of the reasoning *is* a general proposition; a theorem respecting the distance, not of the moon in particular, but of any inaccessible object; showing in what relation that distance stands to certain other quantities. And although the moon is almost the only heavenly body the distance of which from the earth can really be thus ascertained, this is merely owing to the accidental circumstances of the other heavenly bodies, which render them incapable of affording such data as the application of the theorem requires; for the theorem itself is as true of them as it is of the moon.(100)

We shall fall into no error, then, if in treating of Induction, we limit our attention to the establishment of general propositions. The principles and rules of Induction as directed to this end, are the principles and rules of all Induction; and the logic of Science is the universal Logic, applicable to all inquiries in which man can

engage.