

# CHAPTER I

## INTRODUCTORY

Section 1. Logic is the science that explains what conditions must be fulfilled in order that a proposition may be proved, if it admits of proof. Not, indeed, every such proposition; for as to those that declare the equality or inequality of numbers or other magnitudes, to explain the conditions of their proof belongs to Mathematics: they are said to be *quantitative*. But as to all other propositions, called *qualitative*, like most of those that we meet with in conversation, in literature, in politics, and even in sciences so far as they are not treated mathematically (say, Botany and Psychology); propositions that merely tell us that something happens (as that *salt dissolves in water*), or that something has a certain property (as that *ice is cold*): as to these, it belongs to Logic to show how we may judge whether they are true, or false, or doubtful. When propositions are expressed with the universality and definiteness that belong to scientific statements, they are called laws; and laws, so far as they are not laws of quantity, are tested by the principles of Logic, if they at all admit of proof.

But it is plain that the process of proving cannot go on for ever; something must be taken for granted; and this is

usually considered to be the case (1) with particular facts that can only be perceived and observed, and (2) with those highest laws that are called 'axioms' or 'first principles,' of which we can only say that we know of no exceptions to them, that we cannot help believing them, and that they are indispensable to science and to consistent thought. Logic, then, may be briefly defined as the science of proof with respect to *qualitative* laws and propositions, except those that are axiomatic.

Section 2. Proof may be of different degrees or stages of completeness. Absolute proof would require that a proposition should be shown to agree with all experience and with the systematic explanation of experience, to be a necessary part of an all-embracing and self-consistent philosophy or theory of the universe; but as no one hitherto has been able to frame such a

philosophy, we must at present put up with something less than absolute proof. Logic, assuming certain principles to be true of experience, or at least to be conditions of consistent discourse, distinguishes the kinds of propositions that can be shown to agree with these principles, and explains by what means the agreement can best be exhibited. Such principles are those of Contradiction ([chap. vi.](#)), the Syllogism ([chap. ix.](#)), Causation ([chap. xiv.](#)), and Probabilities ([chap. xx.](#)). To bring a proposition or an argument under them, or to show that it agrees with them, is logical proof.

The extent to which proof is requisite, again, depends upon the present purpose: if our aim be general truth for its own sake, a systematic investigation is necessary; but if our object be merely to remove some occasional doubt that has occurred to ourselves or to others, it may be enough to appeal to any evidence that is admitted or not questioned. Thus, if a man doubts that *some acids are compounds of oxygen*, but grants that *some compounds of oxygen are acids*, he may agree to the former proposition when you point out that it has the same meaning as the latter, differing from it only in the order of the words. This is called proof by immediate inference.

Again, suppose that a man holds in his hand a piece of yellow metal, which he asserts to be copper, and that we doubt this, perhaps suggesting that it is really gold. Then he may propose to dip it in vinegar; whilst we agree that, if it then turns green, it is copper and not gold. On trying this experiment the metal does turn green; so that we may put his argument in this way:—

*Whatever yellow metal turns green in vinegar is copper;  
This yellow metal turns green in vinegar;  
Therefore, this yellow metal is copper.*

Such an argument is called proof by mediate inference; because one cannot see directly that the yellow metal is copper; but it is admitted that any yellow metal is copper that turns green in vinegar, and we are shown that this yellow metal has that property.

Now, however, it may occur to us, that the liquid in which the metal was dipped was not vinegar, or not pure vinegar, and that the

greenness was due to the impurity. Our friend must thereupon show by some means that the vinegar was pure; and then his argument will be that, since nothing but the vinegar came in contact with the metal, the greenness was due to the vinegar; or, in other words, that contact with that vinegar was the cause of the metal turning green.

Still, on second thoughts, we may suspect that we had formerly conceded too much; we may reflect that, although it had often been shown that copper turned green in vinegar, whilst gold did not, yet the same might not always happen. May it not be, we might ask, that just at this moment, and perhaps always for the future gold turns, and will turn green in vinegar, whilst copper does not and never will again? He will probably reply that this is to doubt the uniformity of causation: he may hope that we are not serious: he may point out to us that in every action of our life we take such uniformity for granted. But he will be obliged to admit that, whatever he may say to induce us to assent to the principle of Nature's uniformity, his arguments will not amount to logical proof, because every argument in some way assumes that principle. He has come, in fact, to the limits of Logic. Just as Euclid does not try to prove that 'two magnitudes equal to the same third are equal to one another,' so the Logician (as such) does not attempt to prove the uniformity of causation and the other principles of his science.

Even when our purpose is to ascertain some general truth, the results of systematic inquiry may have various degrees of certainty. If Logic were confined to strict demonstration, it would cover a narrow field. The greater part of our conclusions can only be more or less probable. It may, indeed, be maintained, not unreasonably, that no judgments concerning matters of fact can be more than probable. Some say that all scientific results should be considered as giving the average of cases, from which deviations are to be expected. Many matters can only be treated statistically and by the methods of Probability. Our ordinary beliefs are adopted without any methodical examination. But it is the aim, and it is characteristic, of a rational mind to distinguish degrees of certainty, and to hold each judgment with the degree of confidence that it deserves, considering the evidence for and against it. It takes a long time, and much self-discipline, to make some progress

toward rationality; for there are many causes of belief that are not good grounds for it—have no value as evidence. Evidence consists of (1) observation; (2) reasoning checked by observation and by logical principles; (3) memory—often inaccurate; (4) testimony—often untrustworthy, but indispensable, since all we learn from books or from other men is taken on testimony; (5) the agreement of all our results. On the other hand, belief is caused by many influences that are not evidence at all: such are (1) desire, which makes us believe in whatever serves our purpose; fear and suspicion, which (paradoxically) make us believe in whatever seems dangerous; (2) habit, which resists whatever disturbs our prejudices; (3) vanity, which delights to think oneself always right and consistent and disowns fallibility; (4) imitateness, suggestibility, fashion, which carry us along with the crowd. All these, and nobler things, such as love and fidelity, fix our attention upon whatever seems to support our prejudices, and prevent our attending to any facts or arguments that threaten to overthrow them.

Section 3. Two departments of Logic are usually recognised, Deduction and Induction; that is, to describe them briefly, proof from principles, and proof from facts. Classification is sometimes made a third department; sometimes its topics are distributed amongst those of the former two. In the present work the order adopted is, Deduction in chaps. ii. to xiii.; Induction in chaps. xiii. to xx.; and, lastly, Classification. But such divisions do not represent fundamentally distinct and opposed aspects of the science. For although, in discussing any question with an opponent who makes admissions, it may be possible to combat his views with merely deductive arguments based upon his admissions; yet in any question of general truth, Induction and Deduction are mutually dependent and imply one another.

This may be seen in one of the above examples. It was argued that a certain metal must be copper, because every metal is copper that turns green when dipped in vinegar. So far the proof appealed to a general proposition, and was deductive. But when we ask how the general proposition is known to be true, experiments or facts must be alleged; and this is inductive evidence. Deduction then depends on Induction. But if we ask, again, how any number of past experiments can prove a general proposition, which must be

good for the future as well as for the past, the uniformity of causation is invoked; that is, appeal is made to a principle, and that again is deductive proof. Induction then depends upon Deduction.

We may put it in this way: Deduction depends on Induction, if general propositions are only known to us through the facts: Induction depends on Deduction, because one fact can never prove another, except so far as what is true of the one is true of the other and of any other of the same kind; and because, to exhibit this resemblance of the facts, it must be stated in a general proposition.

Section 4. The use of Logic is often disputed: those who have not studied it, often feel confident of their ability to do without it; those who have studied it, are sometimes disgusted with what they consider to be its superficial analysis of the grounds of evidence, or needless technicality in the discussion of details. As to those who, not having studied Logic, yet despise it, there will be time enough to discuss its utility with them, when they know something about it; and as for those who, having studied it, turn away in disgust, whether they are justified every man must judge for himself, when he has attained to equal proficiency in the subject. Meanwhile, the following considerations may be offered in its favour:

Logic states, and partly explains and applies, certain abstract principles which all other sciences take for granted; namely, the axioms above mentioned—the principles of Contradiction, of the Syllogism and of Causation. By exercising the student in the apprehension of these truths, and in the application of them to particular propositions, it educates the power of abstract thought. Every science is a model of method, a discipline in close and consecutive thinking; and this merit Logic ought to possess in a high degree.

For ages Logic has served as an introduction to Philosophy that is, to Metaphysics and speculative Ethics. It is of old and honourable descent: a man studies Logic in very good company. It is the warp upon which nearly the whole web of ancient, mediæval and modern Philosophy is woven. The history of thought is hardly intelligible without it.

As the science of proof, Logic gives an account of the *general*

nature of evidence deductive and inductive, as applied in the physical and social sciences and in the affairs of life. The *general* nature of such evidence: it would be absurd of the logician to pretend to instruct the chemist, economist and merchant, as to the *special* character of the evidence requisite in their several spheres of judgment. Still, by investigating the general conditions of proof, he sets every man upon his guard against the insufficiency of evidence.

One application of the science of proof deserves special mention: namely, to that department of Rhetoric which has been the most developed, relating to persuasion by means of oratory, leader-writing, or pamphleteering. It is usually said that Logic is useful to convince the judgment, not to persuade the will: but one way of persuading the will is to convince the judgment that a certain course is advantageous; and although this is not always the readiest way, it is the most honourable, and leads to the most enduring results. Logic is the backbone of Rhetoric.

It has been disputed whether Logic is a science or an art; and, in fact, it may be considered in both ways. As a statement of general truths, of their relations to one another, and especially to the first principles, it is a science; but it is an art when, regarding truth as an end desired, it points out some of the means of attaining it—namely, to proceed by a regular method, to test every judgment by the principles of Logic, and to distrust whatever cannot be made consistent with them. Logic does not, in the first place, teach us to reason. We learn to reason as we learn to walk and talk, by the natural growth of our powers with some assistance from friends and neighbours. The way to develop one's power of reasoning is, first, to set oneself problems and try to solve them. Secondly, since the solving of a problem depends upon one's ability to call to mind parallel cases, one must learn as many facts as possible, and keep on learning all one's life; for nobody ever knew enough. Thirdly one must check all results by the principles of Logic. It is because of this checking, verifying, corrective function of Logic that it is sometimes called a Regulative or Normative Science. It cannot give any one originality or fertility of invention; but it enables us to check our inferences, revise our conclusions, and chasten the vagaries of ambitious speculation. It quickens our sense of bad reasoning both in others and in ourselves. A man who reasons

deliberately, manages it better after studying Logic than he could before, if he is sincere about it and has common sense.

Section 5. The relation of Logic to other sciences:

(a) Logic is regarded by Spencer as co-ordinate with Mathematics, both being Abstract Sciences—that is, sciences of the *relations* in which things stand to one another, whatever the particular things may be that are so related; and this view seems to be, on the whole, just—subject, however, to qualifications that will appear presently.

Mathematics treats of the relations of all sorts of things considered as quantities, namely, as equal to, or greater or less than, one another. Things may be quantitatively equal or unequal in *degree*, as in comparing the temperature of bodies; or in *duration*; or in *spatial magnitude*, as with lines, superficies, solids; or in *number*. And it is assumed that the equality or inequality of things that cannot be directly compared, may be proved indirectly on the assumption that 'things equal to the same thing are equal,' etc.

Logic also treats of the relations of all sorts of things, but not as to their quantity. It considers (i) that one thing may be like or unlike another in certain attributes, as that iron is in many ways like tin or lead, and in many ways unlike carbon or sulphur: (ii) that attributes co-exist or coinhere (or do not) in the same subject, as metallic lustre, hardness, a certain atomic weight and a certain specific gravity coinhere in iron: and (iii) that one event follows another (or is the effect of it), as that the placing of iron in water causes it to rust. The relations of likeness and of coinherence are the ground of Classification; for it is by resemblance of coinhering attributes that things form classes: coinherence is the ground of judgments concerning Substance and Attribute, as that iron is metallic; and the relation of succession, in the mode of Causation, is the chief subject of the department of Induction. It is usual to group together these relations of attributes and of order in time, and call them qualitative, in order to contrast them with the quantitative relations which belong to Mathematics. And it is assumed that qualitative relations of things, when they cannot be directly perceived, may be proved indirectly by assuming the

axiom of the Syllogism ([chap. ix.](#)) and the law of Causation ([chap. xiv.](#)).

So far, then, Logic and Mathematics appear to be co-ordinate and distinct sciences. But we shall see hereafter that the satisfactory treatment of that special order of events in time which constitutes Causation, requires a combination of Logic with Mathematics; and so does the treatment of Probability. And, again, Logic may be said to be, in a certain sense, 'prior to' or 'above' Mathematics as usually treated. For the Mathematics assume that one magnitude must be either equal or unequal to another, and that it cannot be both equal and unequal to it, and thus take for granted the principles of Contradiction and Excluded Middle; but the statement and elucidation of these Principles are left to Logic ([chap. vi.](#)). The Mathematics also classify and define magnitudes, as (in Geometry) triangles, squares, cubes, spheres; but the principles of classification and definition remain for Logic to discuss.

(b) As to the concrete Sciences, such as Astronomy, Chemistry, Zoology, Sociology—Logic (as well as Mathematics) is implied in them all; for all the propositions of which they consist involve causation, co-existence, and class-likeness. Logic is therefore said to be prior to them or above them: meaning by 'prior' not that it should be studied earlier, for that is not a good plan; meaning by 'above' not in dignity, for distinctions of dignity amongst liberal studies are absurd. But it is a philosophical idiom to call the abstract 'prior to,' or 'higher than,' the concrete (see Porphyry's Tree, chap. xxii, sec 8); and Logic is more abstract than Astronomy or Sociology. Philosophy may thank that idiom for many a foolish notion.

(c) But, as we have seen, Logic does not investigate the truth, trustworthiness, or validity of its own principles; nor does Mathematics: this task belongs to Metaphysics, or Epistemology, the criticism of knowledge and beliefs.

Logic assumes, for example, that things are what to a careful scrutiny they seem to be; that animals, trees, mountains, planets, are bodies with various attributes, existing in space and changing in time; and that certain principles, such as Contradiction and



Causation, are true of things and events. But Metaphysicians have raised many plausible objections to these assumptions. It has been urged that natural objects do not really exist on their own account, but only in dependence on some mind that contemplates them, and that even space and time are only our way of perceiving things; or, again, that although things do really exist on their own account, it is in an entirely different way from that in which we know them. As to the principle of Contradiction—that if an object has an attribute, it cannot at the same time and in the same way be without it (*e.g.*, if an animal is conscious, it is false that it is not conscious)—it has been contended that the speciousness of this principle is only due to the obtuseness of our minds, or even to the poverty of language, which cannot make the fine distinctions that exist in Nature. And as to Causation, it is sometimes doubted whether events always have physical causes; and it is often suggested that, granting they have physical causes, yet these are such as we can neither perceive nor conceive; belonging not to the order of Nature as we know it, but to the secret inwardness and reality of Nature, to the wells and reservoirs of power, not to the spray of the fountain that glitters in our eyes—'occult causes,' in short. Now these doubts and surmises are metaphysical spectres which it remains for Metaphysics to lay. Logic has no direct concern with them (although, of course, metaphysical discussion is expected to be logical), but keeps the plain path of plain beliefs, level with the comprehension of plain men. Metaphysics, as examining the grounds of Logic itself, is sometimes regarded as 'the higher Logic'; and, certainly, the study of Metaphysics is necessary to every one who would comprehend the nature and functions of Logic, or the place of his own mind and of Reason in the world.

(*d*) The relation of Logic to Psychology will be discussed in the next section.

(*e*) As a Regulative Science, pointing out the conditions of true inference (within its own sphere), Logic is co-ordinate with (i) Ethics, considered as assigning the conditions of right conduct, and with (ii) Æsthetics, considered as determining the principles of criticism and good taste.

Section 6. Three principal schools of Logicians are commonly

recognised: Nominalist, Conceptualist, and Materialist, who differ as to what it is that Logic really treats of: the Nominalists say, 'of language'; the Conceptualists, 'of thought'; the Materialists, 'of relations of fact.' To illustrate these positions let us take authors who, if some of them are now neglected, have the merit of stating their contrasted views with a distinctness that later refinements tend to obscure.

(a) Whately, a well-known Nominalist, regarded Logic as the Science and Art of Reasoning, but at the same time as "entirely conversant about language"; that is to say, it is the business of Logic to discover those modes of statement which shall ensure the cogency of an argument, no matter what may be the subject under discussion. Thus, *All fish are cold-blooded, some cold-blooded things are fish*: this is a sound inference by the mere manner of expression; and equally sound is the inference, *All fish are warm-blooded, therefore some warm-blooded things are fish*. The latter proposition may be false, but it follows; and (according to this doctrine) Logic is only concerned with the consistent use of words: the truth or falsity of the proposition itself is a question for Zoology. The short-coming of extreme Nominalism lies in speaking of language as if its meaning were unimportant. But Whately did not intend this: he was a man of great penetration and common-sense.

(b) Hamilton, our best-known Conceptualist, defined Logic as the science of the "formal laws of thought," and "of thought as thought," that is, without regard to the matter thought about. Just as Whately regarded Logic as concerned merely with cogent forms of statement, so Hamilton treated it as concerned merely with the necessary relations of thought. This doctrine is called Conceptualism, because the simplest element of thought is the Concept; that is, an abstract idea, such as is signified by the word *man, planet, colour, virtue*; not a representative or generic image, but the thought of all attributes common to any class of things. Men, planets, colours, virtuous actions or characters, have, severally, something in common on account of which they bear these general names; and the thought of what they have in common, as the ground of these names, is a Concept. To affirm or deny one concept of another, as *Some men are virtuous*, or *No man is perfectly virtuous*, is to form a Judgment, corresponding to the

Proposition of which the other schools of Logic discourse. Conceptualism, then, investigates the conditions of consistent judgment.

To distinguish Logic from Psychology is most important in connection with Conceptualism. Concepts and Judgments being mental acts, or products of mental activity, it is often thought that Logic must be a department of Psychology. It is recognised of course, that Psychology deals with much more than Logic does, with sensation, pleasure and pain, emotion, volition; but in the region of the intellect, especially in its most deliberate and elaborate processes, namely, conception, judgment, and reasoning, Logic and Psychology seem to occupy common ground. In fact, however, the two sciences have little in common except a few general terms, and even these they employ in different senses. It is usual to point out that Psychology tries to explain the subjective *processes* of conception, judgment and reasoning, and to give their natural history; but that Logic is wholly concerned with the *results* of such processes, with concepts, judgments and reasonings, and merely with the validity of the results, that is, with their truth or consistency; whilst Psychology has nothing to do with their validity, but only with their causes. Besides, the logical judgment (in Formal Logic at least) is quite a different thing from the psychological: the latter involves feeling and belief, whereas the former is merely a given relation of concepts. *S is P*: that is a model logical judgment; there can be no question of believing it; but it is logically valid if *M is P* and *S is M*. When, again, in Logic, one deals with belief, it depends upon evidence; whereas, in Psychology belief is shown to depend upon causes which may have evidentiary value or may not; for Psychology explains quite impartially the growth of scientific insight and the growth of prejudice.

(c) Mill, Bain, and Venn are the chief Materialist logicians; and to guard against the error of confounding Materialism in Logic with the ontological doctrine that nothing exists but matter, it may suffice to remember that in Metaphysics all these philosophers are Idealists. Materialism in Logic consists in regarding propositions as affirming or denying relations (*cf.* Section 5) between matters-of-fact in the widest sense; not only physical facts, but ideas, social and moral relations; it consists, in short, in attending to the

meaning of propositions. It treats the first principles of Contradiction and Causation as true of things so far as they are known to us, and not merely as conditions or tendencies of thought; and it takes these principles as conditions of right thinking, because they seem to hold good of Nature and human life.

To these differences of opinion it will be necessary to recur in the next chapter (Section 5); but here I may observe that it is easy to exaggerate their importance in Logic. There is really little at issue between schools of logicians as such, and as far as their doctrines run parallel; it is on the metaphysical grounds of their study, or as to its scope and comprehension, that they find a battlefield. The present work generally proceeds upon the third, or Materialist doctrine. If Deduction and Induction are regarded as mutually dependent parts of one science, uniting the discipline of consistent discourse with the method of investigating laws of physical phenomena, the Materialist doctrine, that the principles of Logic are founded on fact, seems to be the most natural way of thinking. But if the unity of Deduction and Induction is not disputed by the other schools, the Materialist may regard them as allies exhibiting in their own way the same body of truths. The Nominalist may certainly claim that his doctrine is indispensable: consistently cogent forms of statement are necessary both to the Conceptualist and to the Materialist; neither the relations of thought nor those of fact can be arrested or presented without the aid of language or some equivalent system of signs. The Conceptualist may urge that the Nominalist's forms of statement and argument exist for the sake of their meaning, namely, judgments and reasonings; and that the Materialist's laws of Nature are only judgments founded upon our conceptions of Nature; that the truth of observations and experiments depends upon our powers of perception; that perception is inseparable from understanding, and that a system of Induction may be constructed upon the axiom of Causation, regarded as a principle of Reason, just as well as by considering it as a law of Nature, and upon much the same lines. The Materialist, admitting all this, may say that a judgment is only the proximate meaning of a proposition, and that the ultimate meaning, the meaning of the judgment itself, is always some matter-of-fact; that the other schools have not hitherto been

eager to recognise the unity of Deduction and Induction or to investigate the conditions of trustworthy experiments and observations within the limits of human understanding; that thought is itself a sort of fact, as complex in its structure, as profound in its relations, as subtle in its changes as any other fact, and therefore at least as hard to know; that to turn away from the full reality of thought in perception, and to confine Logic to artificially limited concepts, is to abandon the effort to push method to the utmost and to get as near truth as possible; and that as to Causation being a principle of Reason rather than of Nature, the distinction escapes his apprehension, since Nature seems to be that to which our private minds turn upon questions of Causation for correction and instruction; so that if he does not call Nature the Universal Reason, it is because he loves severity of style.