But while we enquire of Nature, we must also think on what she tells us. We can hardly be good observers even, unless we are good reasoners too, not only inductively but deductively. It is not enough to take the laws which Nature gives us; we must, by the highest and fullest exercise of our reasoning faculty, find law again among these. If we do not, investigation becomes barren, and discovery almost accidental. It is all very well to know that acids turn blue litmus paper red, but it is more to have well developed in us the capacity of asking why; and this demand for the deductive explanation leads us to look more closely into the mysteries of Nature. Inductive enquiry asks, "Why is it true, and what follows from it?" and thus, at the same time, stimulates inductive enquiry and develops its results. One sometimes hears deductive reasoning depreciated in comparison with its younger sister; but it was not so that the discoverer of the laws of Inductive Logic regarded it. "The mode of investigation," he says, "which, from the proved inapplicability of direct methods of observation and experiment, remains to us as the main source of the knowledge we possess or can acquire, respecting the conditions and laws of the more complex phenomena, is called, in its more general expression, the Deductive Method, and consists of three operations: the first one, of direct induction; the second of ratiocination; the third of verification."

We must then, as a main point, become competent ratiocinists, unless we intend to be satisfied with substituting verification for proof, as beginners in geometry sometimes are, for want of the requisite logical development. Now all sciences and much language study gives some training in deductive reasoning or ratiocination, to use Mr. Mill's word. The logic of consistency, as it is sometimes called, is so necessary to all continued and precise thinking, that any continued and precise thinking, affords a development of it. Thus it happens that men and women who have had no real training in any well-marked deductive science, can yet be vigorous deductive reasoners. In fact, if one has many and various thoughts to arrange, it becomes a necessity to arrange them consistently. But, surely, no one would trust the development of this demand for inner consistency to occasional employment in the less exact sciences, and in the study of language, or in practical life, when there exists, ready to hand, a group of sciences which, starting from the simplest intuitions of Space and Time, or, if any one prefers it, from the simplest and most elementary inductions, develop themselves solely according to laws of mental consistency. I speak of occasional employment in the less exact sciences, because, though these require strict deduction for their satisfactory development, reasoning and statements of facts are of necessity so mixed up together in their subject matter, that it generally requires a mind already trained to follow closely the ratiocinative process in them. In truth, Mathematics is the one science that has put on completely a logical aspect, the one field in which embryo reasoners are compelled to perceive that they must be accurate reasoners, or—nothing. If we want to make the left hand strong and facile, we exercise it, not letting the right hand interfere. If we want to be deft, and powerful, and precise in thought, should we not use as means this science, that does not offer the distraction of external particulars, or admit doubt as to the reliability of its conclusions in other circumstances. The beginner may be very well pleased, at first, with showing (by verification) that the three angles of a triangle are equal to two right angles, but, he or she soon becomes aware of the fact that if the triangle were among the stars, for instance, this method of proof would not apply, and that there is no real proof at all except that which is universal and absolutely certain; and beginners do not take so very long to appreciate the truth, that, in comparison with the conclusions of Mathematics, all other scientific conclusions are only true conditionally—the conditions being those of the actual experience which supplied the data; whereas the conclusions of Mathematics are certain, absolutely and universally, so long as our minds are constituted as they are; and for us, of course, there is no other measure of certainly. Now, it appears to me that this inner and certain and self-contained nature of mathematical science has an educational significance, and marks it at once as a not-to-be-equalled instrument in training the mind to consistency with itself, and to direct and precise habits of thinking on all subjects whatsoever.

And the less logical a pupil is, and the less given to precise way of thinking and speaking, the more unpromising therefore as a mathematical pupil, and the more likely to attempt escape behind the plea of want of taste for the subject, the more necessary is it to persevere or else give up the hope of a complete training altogether. This, I confess, we may have to do sometimes, but only because training has been neglected too long—so long that it has become impossible even to make the best of very poor material. We never ought to do it without the inward humiliating confession of failure; and I am sure, that very often we may lose even brilliant after-results by having been too easily discouraged at first, or by continuing our work without faith in its ultimate success. For there is not in education any implement more powerful than faith: the measure of what we get from our pupils is very often the measure of what we believe that we shall get. We all know what it is to be believed in, and how, if there be sufficient time, and the belief be within rational bounds, it is certain to end in confirmation of itself.

We certeinly ought not to expect that the generality of young untrained minds, the fathers and mothers of whose owners were not properly trained before them, should take at once to pure abstract reasoning, even when introduced by a careful and not overdone elaboration of the abstract ideas involved, and made interesting by applications to experience, and fascinating by appeals to the imagination. Some persons do thus take to it, as ducks take to the water, without reference to experience, and even without need of the imaginative charms. The logical interest has indeed carried many through a first course of Geometry, with dim enough geometrical notions. But, very often, there will be difficulty at first, difficulty in concentrating attention, difficulty in connecting steps of thought, difficulty in inventing ways in which proof becomes attainable, difficulty, not least, in expression. Not difficulty so much in following another person's demonstration,—the most backward pupils will say, "I quite understand it when you do it, but I can't work it out myself."

But every time a difficulty is conquered, a chain of reasoning accurately carried out, or an easy problem rightly solved, there is a real glow of triumph which invests after difficulties with the pleasure of pursuit, and makes the troublesome art of reasoning interesting, if not easy, to acquire. A little more practice, and the necessary sequence of the reasoning becomes clearer, and the mind more on the alert to see, as well as to understand, the consequences of any one given fact with another. Then the science begins to unfold itself easily and naturally, and the beauty of this natural sequence of thought from thought begins to be really enjoyed.

So the logical charm comes into efficacy. Meanwhile,