

esting and simple experiments. I am inclined to place the subject of electricity and magnetism under the same head; and, beginning with the fact that electricity is generated by a voltaic cell, I should trace its simple manifestations until they conduct one to the law that all motion can be converted into electricity, and that electricity can be entirely converted again into heat and light. Having then shown that light can be produced by motion, the undulatory theory can be cautiously introduced. As a review of the subject of physics, one could take as a text the impossibility of perpetual motion, and enforce it with a variety of illustrations. The utility of the study of physics in the grammar schools is often questioned, and indeed the larger question of the value of scientific training except to the few in the world at large is often mooted. There is no doubt that the study of the humanities, in which the great story of men's deeds in the past is recorded, will always prove the most fascinating to the majority; and it can be maintained with reason that those subjects which readily excite an interest in the largest number will prove the readiest means of intellectual training. Science is regarded by many scholars merely as a practical branch of human knowledge, and, although its great value in contributing to the good of the world is acknowledged, yet its study is regarded as inferior in intellectual results to that of language or philosophy. It cannot be denied, however, that the study of physical science gives a certain definiteness to our modes of thinking, even if it will not be granted that it affords a better method of intellectual training than philological study. It supplies a tonic which minds much accustomed, from the exclusive study of language, to take things for granted and to look no further than the grammar and dictionary, stands much in need of, and also

corrects a certain credulity and superstition which is rampant even in our time, and to which it is well to devote a few words in connection with the subject of scientific training. There is a strong undercurrent of superstition and belief in supersensible or wonderful and not-to-be-explained marvels which makes its way beneath the crust of society. Occasionally it bursts forth in so-called manifestations of spiritualism and animal magnetism, or belief in mesmerism and clairvoyance. There is hardly a family of which some member has not applied to a clairvoyant for relief in diseases of which the regular practitioner has failed to treat successfully. A literary education does not cope successfully with the insidious advances of this form of ignorance; for the very element of education which can do so is not generally cultivated among even so-called liberally educated persons. This lost element is the spirit of investigation. The students who come to a physical laboratory for the first time can be rapidly classified into three classes: 1. Those who can reason from A to B over what may be termed a straight line with considerable ease. 2. Those who naturally reverse their process of reasoning and test the way from B to A; this is a rarer class of mind. Copernicus was unable to explain the motions of the planets by supposing that all the visible stars revolved around the earth: he reversed his process of reasoning, and explained the facts by supposing the earth to turn and the stars to remain at rest. Kant, in his "Critique of Pure Reason," speaks of the revolution which he had brought about in philosophy, and likens it to the logical process which led Copernicus to his discovery. "Hitherto," he says, "it had been assumed that all our knowledge must regulate itself according to the objects; but all attempts to make anything out of them *à priori*, through