

very few men would be able to frame one of the simpler chemical theories even after years spent in experiments. If the theory could be established mathematically, which I believe will be done some day, the case would be different. Theories have their roots in experiment, but they are the growth of ages and of generations. Theories rise on stepping stones of their dead selves. The ground upon which a theory rests is strewn with the skeletons of those which are exploded and defunct. The process by which a scientific theory is established is experimental, and for that very reason the theory is but tentative, and may possibly at any time be proved to be more or less untrue and suffer the fate of dozens of its ancestors. How absurd then to put a lot of apparatus into the hands of boys, and to ask them to work out the explanation of phenomena. To do so requires the matured mind of men, and even ten of these fail for every one that succeeds. The theories must be given to the boy dogmatically, and then rendered probable by experiment.

In all that I have said I do not mean that experimenting will do a lad any harm; or that it will weary him in the least to carry about all the facts thus obtained; or if he wants worthy amusement, that experimentation is not incomparably superior to many leading amusements indulged in. But I do mean to assert that scientific experiment is not as great an educator of the young mind as many people suppose it to be. The character of the answers returned to the science papers showed very clearly that the knowledge of the subject possessed by the candidates was mostly of the parrot kind. Where the question could be answered by the statement of a fact, the answer was generally forthcoming. But where the question required a deeper insight into underlying principles, the answers

were given in a very uncertain voice, and were generally either nonsensical or astray. Again, in the beginning of an education, certainty and accuracy, accompanied by simplicity of statement, should be attempted if possible. To make every statement doubtful is to engender universal scepticism. But the majority of theories in science are only approximative, and have to be burdened by exceptions and minor qualifications, if accuracy of statement is aimed at. Take, for example, the chemico-physical theorem known as Boyle and Marriotte's law, "the volume of a gas is inversely proportional to its tension." This is not accurately true for any gas, and it fails signally, under certain circumstances, for every gas. Why then is it called a law? Because the real law, if completely known, would be too complex to be of much utility. Compare with this the mathematical theorem "that every prime number differs by unity from a multiple of 6." This theorem has no exceptions and no limitations, and is true for every prime number that could be written, even could you cover the vault of heaven with such numbers.

Again, the convalescent invalid who to regain his strength of limb takes a walk in the morning air, and finds it necessary to ascend a hill, does not vainly strive to clamber up to some projecting crag, but chooses a gentle acclivity and rises from a lower to a higher position by that slow and easy ascent which brings strength and vigour to his needy system. Even so should the undeveloped and plastic mind of the pupil be led on to its healthy development, by the safe and natural process of rising gradually from the simple to the complex, from the plain and the easily intelligible to the intricate and the abstruse. But science has no simple part. It requires no great powers of observation to see that a horse has four legs with one