to systematize and arrange it; to give it extension here, and accuracy there; to connect scraps of knowledge that seem isolated; to point out where progress is stopped by ignorance of facts; and to show how to remedy the ignorance. Rapidly knowledge crystallizes round a solid nucleus; and anything the master gives that is suited to the existing knowledge is absorbed and assimilated into the growing mass and if he is unwise and impatient enough (as I have been scores of times) to say something which is to him perhaps a truth most vivid and suggestive, but for which his boys are unripe, he will see them, if they are really well trained, reject it as the cock despised the diamond among the barley (and the cock was quite right), or still worse, less wise than the cock, swallow it whole as a dead and choking formula.

On these grounds then, in addition to other obvious ones, Botany and Experimental Physics claim to be the standard subjects for the scientific teaching at schools. In both there pre-exists some solid and familiar knowledge. Both can so be taught as to make the learner advance from the known to the unknown—from his observations and experiments to his generalizations and laws, and ascend by continuous steps from induction to induction, and never once feel that he is carried away by a stream of words, and is reasoning about words rather than things. The logical processes they involve are admirable and complete illustrations of universal logic, and yet are not too difficult. These considerations mark the inferiority, in this respect, of Geology and Physiology, in which the doctrines must far outrun the facts at a boy's command, and which require so much knowledge before the doctrines can be seen to be well founded. And these considerations exclude Chemistry, as an elementary subject at least, since there is so little pre-existing knowledge in the learner's mind on which the foundations can be laid. On all grounds the teaching of Chemistry should follow that of Experimental Physics.

Unless this method of investigation is followed, the teaching of science may degenerate, with an amazing rapidity, into cramming. To be crammed is to have words and formulæ given before the ideas and laws are realized. Geology and Chemistry are frightfully crammable. But Botany and Experimental Physics are by no means so easy to cram. What they might become with bad text-books and a bad teacher, I cannot, indeed, say; but it is a very important consideration. For it is possible to teach even Botany and Experimental Physics with exquisite perversement, so as to deprive them of all their singular advantages as subjects for elementary training in science. It is possible to compel the learning of the names of the parts of a flower before the condition or existence of a name, viz., that it is seen to be wanted, is fulfilled, to cumber the learner with a terminology that is unspeakably repulsive when given too soon—given before the induction which justifies the name has been gone through; to give the principles of classification before a sufficient acquaintance with species has called out the ideas of resemblance and difference, and has shown the necessity of classification; to give theories of typical form when it seems a wild and grotesque romance; to teach, in fact, by the method of authority. And this may be done by truly scientific men, fully believing that this is the true and only method. Witness Adrien de Jessieu's "Botanique."

The true method is assuredly to begin by widening for your boys the basis of facts, and instantly to note uniformities of a low order, and let them hazard a few generalizations. The boys will far outrun their master. Their tendency to make generalizations of the most astounding kind is both amusing and instructive, it constantly reminds me of the ancient Greek Philosophy; it is the proof that there is both the power to be trained, and a need of the training. A theory is necessary to observation Make them verify, and expurgate, and prune, and, if need be, reject their theories by a constant appeal to facts; sympathize with them in their search for truth, and so search for more facts and more accurate observations, and thus the crystal pyramid of their science grows, its base ever widening, its summit ever rising

The art of the school master is a maieutic art now, as it was in the days of Socrates: it is still his business to make his boys bring their notions to the light of day, to the test of facts, constantly to require verification; but as often as possible to give them the pleasure of discovery He may guide them to the treasure, but let him unselfishly give them the delight of at least thinking they have found it. This is the charm that tempts them on, and is the highest reward they can win At first the seeming progress is slow, but it soon accelerates, and the avidity for learning soon compensates for the apparent poverty of results at first.

I insist upon this point because I am convinced that it is very important, and very likely to be overlooked; and as Botany seems the best subject for beginning to train boys in scientific methods, and as no English work is thoroughly to be recommended as a guide to botanical teaching, I shall devote a brief paragraph or two to the illustration from Botany of what I hold to be the true method of *beginning* to teach science.

Suppose then your class of thirty or forty boys before you, of ages from thirteen to sixteen, as they sit at their first botanical lesson; some curious to know what is going to happen, some resigned to anything, some convinced that it is all a folly. You hand round to each boy several specimens, say of the Herb Robert; and taking one of the flowers, you ask one of them to describe the parts of it. "Some pink leaves," is the reply. "How many?" "Five." "Any other parts?" "Some little things inside." "Anything outside?" "Some green leaves." "How many?" "Five." "Very good. Now pull off the five green leaves outside and lay them side by side, next pull off the five pink leaves, and lay them side by side; and now examine the little things inside. What do you find?" "A lot of little stalks or things." "Pull them off and count them:" they find ten. Then show them the little dust bags at the top, and finally the curiously constructed central column, and the carefully concealed seeds. By this time all are on the alert. Then we resume: the parts in that flower are, outer, outer green envelope, inner coloured envelope, the little stalks with dust bags, and the central column with the seeds. Then you give them all wall-flowers: and they are to write down what they find: and you go around and see what they write down. Probably some one has found six "*storks*" inside his wall-flower and you make him write on the blackboard, for the benefit of the class, the curious discovery, charging them all to note any accidental varieties in feature; and you make them very minutely notice all the structure of the central column. Then you give them all the common pelargonium and treat it similarly; and by the end of the hour they have learnt one great lesson, the existence of the four whorls, though they have yet not heard the name.

Next lesson time they come in looking more in earnest, and you give them single stocks and white alyssum, which they discover to be wonderfully like the wall-flower; and you have a lot of flowers of valuable marrow, some of which are being passed round while you draw two of them on the board. The difference is soon discovered, and you let them guess about the uses of the parts of the flower. The green outer leaves protect it in the bud, the central organ is for the seeds, but what is the use of the others? Then you relate stories of how it was found out what the use of the dust bags is. how patient Germans lay in the sun all day to wait for the insects coming: and how the existence of a second rare specimen of some foreign tree was found out in Paris, by its long-widowed spouse in the Jardin des Plantes at last producing perfect seeds. A little talk about bees, and moths, and midges, and such creatures, finding out what they have seen, and your second lecture is over.

In the third lecture you take the garden geranium, and be them to examine it very closely to see if it is symmetrical. Several will discover the unsymmetrical outer green leaves; one or two will discover the hollow back of the stem: then the pelargonium, and its more visible unsymmetry; then the common tropæolum: in each of which they find also the same parts, and count and describe them; and lastly the tropæolum Canariense, with its grotesque irregularity; and they are startled to find that the curious-looking flower they know so well is constructed on the same type, and is called by the same name; and by the end of the lesson they have learned something of irregular flowers, as referred to regular types—something of continuity in nature.

So in succession, for I cannot give more detail, you lead them through flowers where the parts cohere, as in the campanula, through plants deficient or odd, through roses, mignionette, and honeysuckle, and all the simple flowers you can find, till they thoroughly know the scheme on which a simple flower is made. Then you challenge them to a dandelion or daisy, and each has to write down his ideas. Your one or two geniuses will hit it; some will be all wrong, without a shadow of doubt, the majority fairly puzzled. You give them no hint of the solution, tell them to lay it aside; and you give them the little thrift, and challenge them to find its seeds, and how they are attached. This many will do, and pick out the little seed with its long thread of attachment, and then they will go back to their dandelions with the key to their structure, and find its seeds too, and be charmed to discover the remains of its poor outer green envelope, and even its little dust bags. How proud they are of the discovery! they think they have the key of knowledge now. And then you begin a little terminology—calyx and sepals, corolla and petals, stamens and pollen, pistil and stigma, and so on, and test their recollection of the forms of all the flowers they have examined. Then you notice the spiral arrangement of leaves on a twig of oak, or thorn, or willow, and the internodes, and the overlapping of the sepals of the rose and Herb Robert; the alternance of the parts, and finally they work out the idea that the floral whorls grow on the stem, and are a sort of depressed spiral of leaves with the internodes suppressed. A few monstrosities and pictures are shown, and the grand generalization is made, the pistils are re-examined with fresh interest to test the theory; and all their old knowledge is raked up once more. Then, too, the value of the theory is criticised, and a lesson of caution is learnt.

Then a step forward is made toward classification, by cohesion and adhesion of parts; and the floral schedule is worked; and so, step by step, to fruit, and leaves, and stems, and roots, and the wondrous modifications of parts for special uses, as in climbing-plants, add the orchids, which are a grand puzzle, till a series of pictures from Darwin step in to explain the use of the parts and plan of the flower. Then some chemistry of the plant is introduced with some experiments, and the functions of all the organs are discussed. And lastly, strict descriptive terms are given and the rest of the course is occupied by the history and the systems of classification, with constant reference, however, to the other conceptions that the class has gained.

Such a method as this has many advantages. It is thoroughly scientific, however irregular it may seem, and a professor of Botany may smile or shed tears over it for anything I care; and the knowledge is gained on a sound basis of original observation. Whatever