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SCIENCE AND LITERATURE IN GENERAL EDUCATION.

INVESTIGATION VS. CRAMMING.

In Mr. Farrar's volume of *Essays on a Liberal Education* is one contributed by Mr. J. M. Wilson, mathematical and natural science master in the celebrated Rugby School, which to our mind is one of the best contributions to the discussion of the vexed question of the relations of Science and Literature in general education that has been published.

In the course of his argument, Mr. Wilson makes some suggestions as to the spirit and method of teaching natural science in schools—a subject on which, he justly remarks, there is much misconception; and his suggestions are so eminently sensible and practical, that we transcribe the following for the sake of commending both the spirit and the method to certain American teachers who flatter themselves that they are teaching science, and teaching it scientifically, while they are really doing neither.

This class of teachers is well represented in a fashionable young ladies' seminary that we have in mind. A pupil of this school—it ranks among the first in the country—one day remarked to us that she could not "endure" Botany. It was "perfectly horrid," she said. We knew her to be fond of flowers: why then should she hate the study of them? A few questions solved the difficulty. Her first plunge into Botany (?) had been into the Linnæan System of Classification, which she had been set to commit to memory! And all her study of the "horrid" science had resulted merely in the acquisition of a

gibberish of *-andrias*, *-æcias*, *-gynias*, and so on, that would have frightened a disciple of Jussieu.

The extensive sale of the text-book of Botany used in that school is proof that the "exquisite perverseness" of its method is not disapproved in more than one school, and by more than one teacher. In fact, the greater part of our science teaching is, we fear, equally unscientific.

"There are two different methods of teaching science: one, the method of investigation; the other, the method of authority. The first starts with the concrete and works up to the abstract; starts with facts and ends with laws; begins with the known and proceeds to the unknown. The second starts with what we call the principles of the science; announces laws and includes the facts under them: declares the unknown and applies it to the known. The first demands faith, the second criticism. Of the two, the latter is the easier, and the former by far the better. But the latter is seen in most text-books and is the method on which many unscientific people ground their disapproval of science. What this former method is, and why it is the better, will be seen by the following remarks.

In the first place, then, *knowledge must precede science*: for science is nothing else but systematized experience and knowledge. In its extreme applications this principle is obvious enough: it would be absurd to teach boys classification from minerals, or the power of experimental science by an investigation into the organic bases. A certain broad array of facts, must pre-exist before scientific methods can be applied, this order cannot be reversed. And this is illustrated by the profound analogy that exists between the growth of scientific knowledge in an individual and in the world. Generation after generation of men passed away, and the world patiently accumulated experience and observation of facts; and then there sprang up in the world the uncontrollable desire to ascertain the sequences in nature, and to penetrate to the deep-lying principles of natural philosophy. And the same desire is based in the individual on the same kind of experience. Where there is wide knowledge of facts, science of some kind is sure to spring up. After centuries of experience the *Philosophiæ Naturalis principia* were published.

And, secondly, this knowledge must be homogeneous with pre-existing knowledge. It is of no use to supply purely