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On Teaching Natural Sience in Schools.

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Moreover, the kind of knowledge that science offers is not only wide, and interesting, and elevating, but it is also exact; and this exactness is a very great merit. It is a knowledge of things, and not of words. In the education of the upper classes there is too little of positive and exact knowledge, and too much of mere training and drill: we have too much distrusted the virtue of knowledge. In a purely classical education there is something of the *bellè et probabiliter opinari* as opposed to the *certò et ostensivè scire* of Bacon. For the ultimate conceptions of grammar are by their nature only to be attained by self-analysis and metaphysical introspection; and though boys sometimes attain great knowledge of usage, yet it is empirical and not demonstrative. And natural science supplies this want of clearness and certitude better than arithmetic or geometry: its exactness amid its diversity serves as a kind of standard in the mind of what knowledge is. Arithmetic, geometry, and natural science represent positive knowledge in a boy's education; they have the 'know how' and the 'know why," and this gives confidence and certainty.

But there is another and even a stronger ground for advocating the introduction of science as an element in all liberal education, and that is, its peculiar merit as a means of educating the mind. Science is not only knowledge, but it is also power. The mind is not only an instrument for advancing science, but, what is more to our present point, science is an instrument for advancing the mind. All that can be said of this point has been said over and over again, and I can contribute nothing except my daily experience that what is said is true. Mill speaks of "the indispensable necessity of scientific instruction, for it is recommended by every consideration which pleads for any high order of intellectual education at all." Science is the best teacher of accurate, acute, and exhaustive observation of what is; it encourages the habit of mind which will rest on nothing but what is true; truth is the ultimate and only object, and there is the ever-recurring appeal to facts as the test of truth. And it is an excellent exercise of memory: not the verbal, formal memory, but the orderly, intelligent, connected, accurate storing up of knowledge. And of all processes of reasoning it stands alone as the exhaustive illustration. It is pre-eminently the study that illustrates the art of thinking. "The processes by which truth attained," to quote again from Mill, "reasoning and observation, have been carried to their greatest known perfection in the physical sciences." In fact, the investigations and reasoning of science, advancing as it does from the study of simple phenomena to the analysis of complicated actions, form a model of precisely the kind of mental work which is the business of every man, from his cradle to his grave; and reasoning, like other arts, is best learnt by pratice and familiarity with the highest models. Science teaches what the power and what the weakness of the senses is; what evidence is, and what proof is. There is no characteristic of an educated man so marked as his power of judging of evidence and proof. The precautions that are taken against misinterpretation of what is called the evidence of the senses, and tracing the thoughts backward down to the ground of belief; the constant verification of theories; the candid suspension of judgment where evidence is still wanting; that wedding of induction and deduction into a happy unity and completeness of proof, the mixture of observation and ratiocination—are precisely the mental processes which all men have to go through somehow or other in their daily business, and which every human being who is capable of forming an intelligent opinion on the subject sees