Systematic science teaching. A manual of inductive elementary work for all instructors

Howe Edward Gardiner
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INTERNATIONAL EDUCATION SERIES

SYSTEMATIC SCIENCE TEACHING

A MANUAL OF INDUCTIVE ELEMENTARY WORK FOR ALL INSTRUCTORS

BY

EDWARD GARDNIER HOWE

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1900
EDITOR'S PREFACE.

A manual of instruction in natural science for use in the elementary schools has long been in request; but attempts to supply this have hitherto failed, for one of two reasons. Either they were one-sided, giving too much prominence to some narrow field of science and apparently assuming that other fields had no claim on the attention of the pupil, or else they have given too little assistance to the teacher or the pupil, and have limited themselves to offering vague general directions as to matter and method. The teacher's manual should give much of the matter to be taught, and make definite references to other sources of information for much more material. Above all, it should illustrate methods of instruction; it should show the method of investigation adapted to each province of Nature. A dry list of topics, although arranged in the proper sequence, does not make a sufficient manual. It should give enough of the results of scientific research to set the teacher and pupil on the right track of inquiry. It should direct his investigation in a twofold direction: First, to authoritative books written by competent scientific men, and setting forth in a clear and succinct manner the results of the observations and experiments of scientific specialists in each field. Second, it should direct the
teacher and pupil how to get access to the real objects in Nature, and how to verify for one's self the discoveries that have been made by the specialists. For this purpose the book must illustrate by a sufficient variety of experiments the method of discovery in each field of research. The school attempts to place the pupil on the point of advantage where he can profit by the results and by the methods of his predecessors. He must get not only the dead results, but also the living method—the method of observation and discovery.

The powers of observation are strengthened chiefly by learning to think about what one sees. It is often held that observation is cultivated only by using the senses. But sharpness of the senses is a different matter from the capacity for scientific observation. The latter is a matter of apprehension, and not of mere perception. It is the act of recognizing, and not the act of mere seeing, that gives us scientific knowledge. The acute seeing of the hawk or the greyhound does not lead to science. The dim eyes of the aged Humboldt see a thousand circumstances in the object which escape the eyes of the bird and dog, because Humboldt's eyes are armed with the experience of the human race and with the methods discovered by a long line of scientific men. He brings with him their results and their methods, and a swift glance interprets the object even when dimly seen. From the details partially seen the observer knows the rest. Louis Agassiz or Theodore Gill could make a drawing of the entire fish from seeing only a scale; this has been done even when only the scale, and not the fish itself, had ever yet been seen by the one or the other. The geologist Lyell could read its history in a pebble. The archaeologist Winckelmann could recognize a Juno, a Diana, or