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Improved Methods in Science Teaching

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EDITORIAL

Scientific standardization, both of materials and labor, is one of the most outstanding developments of the last decade in the industrial world. Apparently the last group of people to apply this method to their own problems are the very ones who originated the principle. We refer to the scientists and especially to the teachers of science. Our study of the science course offered in secondary schools and our experience with college students in science emphasize the entire lack of uniformity among high school science courses.

The year 1929 promises to mark a great advance for Iowa's high school science. There is hope that the shoemaker's children are soon to be shod. The state department, at the instigation of Superintendent of Public Instruction Agnes Samuelson, has enlisted the services of a large number of teachers and supervisors of science. These groups are preparing outlines of a course of study embracing all of the high school sciences, such outlines to include the lists of topics, suggestions for presentations and desirable outcomes. The same plan is being carried out for all high school subjects. Science Bulletin hopes to list all of its readers among the users of this syllabus when it appears from the press next fall.

IMPROVED METHODS IN SCIENCE TEACHING

Teacher Training

Pasteur has said that "in our century science is the soul of the prosperity of nations and the living source of all progress." Teachers of this important branch of knowledge, then, should carefully consider the methods of instruction in the science departments of our secondary schools. As these methods vary considerably, no general criticism of them will be attempted here. However there are certain fundamentals that merit attention, and in this paper we will examine three of them.

High school science teachers commonly are criticized for requiring their pupils to memorize a large mass of unrelated facts. This criticism is pertinent only when the word **unrelated** is applied with entire justice. Too often it is rightly applied, especially when the teacher is inexperienced or inadequately trained. But under no teacher or system of learning can the well instructed child escape the acquisition of a large number of facts if he is to be properly grounded in any science. However the work should be so directed that as the child learns facts he is led to an understanding of the principles that underlie them. To make this more effective, each small unit of facts or group of units should be organized around some scientific principle intimately related to the life of the pupil. The memory requirements may be limited to the laws or principles until the pupil becomes familiar with their application.

This leads us to another point of criticism: that the pupils are not taught to make practical use of the scientific laws and principles which they learn. Downing states: "We do not transfer our training readily. The knowledge acquired in school is kept for school use - -. A student in biology may learn Mendel's laws, but unless the teacher takes pains to show how these laws apply to the human situation, not in a single instance, but repeatedly, the law remains a bit of interesting school science but has no effect on life's problematic situations." (Page 102 of Teaching Science in the Schools, by Elliot R. Downing, University of Chicago Press.) The need then is that the teachers of high school science shall teach the pupils to apply the principles of science to the things they are doing and thinking outside the class room. The teachers need a broadness of interest, an alertness of mind, and a proficiency in the fundamental principles in order to accomplish this. The success of this transfer of knowledge depends almost entirely upon the teachers, nor can they rely solely on the textbook or on a file of old lectures to make their teaching practical and effective.

In the third place, methods used in laboratory work have been a target for criticism. With some teachers, the enthusiasm for individual experiment has resulted in much wasted time; with others, the lack of laboratory work has made the course degenerate into a mere reading of the textbook. We need to strike a happy medium between these two extremes. The laboratory enthusiasts must remember that it is not necessary to rediscover all the chief facts of science in the laboratory, and that such a method is the slowest possible way of learning. They must also appreciate that pupils retain definite ideas of work demonstrated and explained by the teacher for quite as long a time as they do those ideas which they themselves have worked out individually. Investigation has shown that in many instances the child's ideas are clearer when the demonstration method is used than when he works individually. When he works alone he is so absorbed by the mechanical difficulties he encounters in his experiment that he cannot see the bearing it has on other phases of his science work. On the other hand, the teachers who depend on the textbook almost entirely need to be reminded that no science course can be effective unless the child comes in contact with and sees in operation the objects under discussion. If we believe that the functions of the laboratory are: (1) to teach our pupils to think, (2) to teach them to observe, and (3) to clarify facts that are not easily understood without concrete demonstration, then we cannot go far astray in our work.

Researches have indicated that in General Science and Physics courses, the most satisfactory results in laboratory work come from demonstrations performed by the teacher rather than by the individual student. These investigations have also indicated that pupils retain definite ideas of work demonstrated and explained, for a longer period of time than they do those which are merely read from the textbook. In Biology, the study of living things out of doors or in the laboratory offers a great incentive to the pupils, and is an excellent means of training in observation. (Note: excellent discussions of this question have appeared in earlier issues of the Bulletin.)

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PLANT STUDY IN GENERAL SCIENCE

(Continued from page 27)

with alcohol and test the leaves for starch as described above. The leaf from plant (A) will show an abundance of starch while the one from (B) will show no starch.

These two demonstrations, if properly presented, should call forth discussion. Many questions should be asked. How do green plants differ from animals in the way they secure their food? What is the peculiar place of the green plant in relation to the food suply of the world? Why are we so dependent upon agriculture? How do plants, such as molds, secure their food? Are the green algae, such as pond scums, of any significance to aquatic animals? The necessity of sunlight and the storage of energy in manufactured food should be discussed in connection with the second demonstration. The conservation and transformation of energy in nature is illustrated here. Trace the origin of the energy by which our homes are heated in a discussion of coal and its origin. Photosynthesis might be considered in relation to the energy that a locomotive uses in pulling a train of cars.

We are now led to a study of the method by which plants and animals secure their energy from food in the process of respiration. A few simple experiments can now be used to demonstrate plant respiration.

Problem 3. Do germinating seeds release energy in their growth?

Use two thermos bottles. In one place dry seeds and in the other germinating seeds. Oats or barley are quite satisfactory. Germination should be started on blotting paper before the seeds are placed in the bottle. Place a thermometer in each bottle and plug with cotton. After a few hours, note the temperatures. A decided rise in temperature will be caused by the germinating seeds. If the seeds are not sterilized, bacteria and molds will cause part of this rise, but even this action is a type of respiration by which these micro-organisms secure energy.

Problem 4. Do growing seeds use oxygen?

Obtain two bottles, (A) and (B). Place germinating seeds, oats or barley, in (A) and dry seeds in (B).