PROBLEMS IN TEACHING PRACTICAL BIOLOGY.¹

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With the popular demand to make everything in our high school curriculum serve the individual or the community, we find that the subject matter of biology must undergo some radical changes. In general there is no subject in the high school curriculum that can afford a more extensive field of material for better and saner living than biology.

In making these changes in the subject matter to suit the practical purposes of the student, educators seem to disagree greatly. Local conditions should govern to a great extent the selection of this material, but generally the pet hobby of the teacher is exploited. However, this controversy may come out in regard to the selection of subject matter, there are now in most schools certain lines of biological work that might be classed under practical biology. There has arisen too, in these schools, certain general problems in connection with this work which are worth the time for discussion.

In our high school, biology is not a required study. There are many high schools where the same is true. This makes the matter of election of biology largely a matter of popularity of the teacher. In some schools local conditions will increase the number electing the subject. This is particularly true of the smaller schools. But in the large city schools there still lurks that old superstition that Latin, French and History are the only polite studies to engage in. This makes only a comparative few who elect domestic science, manual training and biology as compared with the immense expenditures required to carry on these subjects.

Along with the fact that this old superstition in regard to value of studies exists, comes another fact about the present system of choosing subjects in high school. This does not apply to those schools where the first two years work is laid out definitely for the students. However, many elect their studies because their friends have elected those studies and they wish to be together in the same classes. In working with the freshmen during the past five years in advising them in regard to election of studies, I have seen whole groups of from ten to fifteen students elect a certain

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subject because their leader did, irrespective of the fact that the principals in the grades had carefully made out their programs of studies according to their individual needs. This promiscuous election of studies in the first years of high school work, often finds the student coming in his senior year to the department of biology and asking that he be allowed to crowd in three years work in one. As a scientific body we should make an effort to see that high schools in our states are laying sufficient emphasis on the requirements in biology.

Another reason why the number electing biology is comparatively small is that as yet the biologist seems to have been too busy with his own personal investigations to exploit his work, or even to sufficiently inform the public as to the value of this work. The public schools must wake up to the fact that almost every phase of our daily life is governed by biological factors. How then are we going to present these facts? So far we have traversed only a short distance on this road of presentation of biological facts. We are still groping about on this road as though we had lost our way. Granting, now, that groups of students have made the election of biology, have overcome the prejudice against practical things, have seen the possibilities opened up in this work, we find that problems arise first, in the attitude of the pupil; second, in the administration of the school; third, in the attitude of the parent; fourth, in the aims of the teacher.

On this road of the presentation of biological facts, I mentioned before, there is one obstacle that looms up before the teacher in that students want to be bookish. If a textbook or lesson sheets are not furnished the students, they demand them with a much injured expression, as though the teacher were cheating them of their personal rights. Last year as a matter of experiment, I deprived my pupils of any text whatever throughout the year. This experiment greatly strengthens my impression that students are made more self-reliant, are better able to use reference work, and, of still more value, are able to use their own personal faculties. I loaded them down with individual problems to work out by themselves. This personal responsibility of presenting a subject to the class well worked out, was a remarkable stimulus to investigation. In my own estimation one problem thoroughly worked out alone by the student is worth more than all the dozens of problems conducted in the class room or laboratory where the student is propped up by the teacher, by manuals or by class room notes.

Another obstacle confronts us in the matter of notebooks. Too many notebooks are mere picture books. The student draws a figure to make a good picture, and frequently does not know one part of the figure from another part. There is a tendency to make this notebook, not a *notebook* but a treatise on a number of subjects.

Then again this notebook work may be mere copying from books, and does not represent the personal observations of the student. This has in it the element of dishonesty which grows as a seed to greater untruths, and practically defeats all the aim of science work. The matter of the large amount of time consumed in the production of a notebook has already been discussed at some of our previous meetings.

A wall which we have to confront and demolish is the lack of consecutive periods of sufficient length to accomplish any real work. Take gardening as an illustration. Two double periods each week are insufficient to accomplish anything in this line. Conditions of weather sometimes demand immediate attention to certain plants. Nature works continually, and many times the weeds get such a growth in the interim between laboratory periods that the allotted time is not enough to overcome them. On the other hand, plants need attention after sundown, and here again the pupil thinks his time his own. In some schools this sundown work is given over to a special school gardener. This defeats the purpose of the work entirely, since it does not represent the work of the student. There is, too, a general tendency on the part of the student to turn his work almost entirely over to the school gardener.

It is imperative that the attitude of those who have to do with the administration of school hours be changed, in order that the practical work in biology be carried out. The attitude of the student toward the time they devote to this work must also be changed. To study nature, we must work with nature. If during commencement week the country becomes infested with army worms, then is the time to study army worms. If plants have to be cared for during the summer months, students should be held for work at this time. These are everyday biological factors which must be met in the home life, why should they not be taken up in the school life?

The inclination of the teacher to want to help the student too much is likely to turn us back a long way on this road of teaching practical biology. It is the parent instinct of wishing to give all

the help that one can, which is very disastrous to the student. The teacher gets impatient to show results, and many times does most of the work. The idea that a certain number of subjects must be covered in a given time, is also disastrous to the best results from the student. Much of the work given at the present time is impatiently skimmed over, without the pupil obtaining the ability to utilize the material.

Another stumbling block in the way of teaching practical biology is the lack of co-operation of parents, and the lack of sympathy of the parents toward the subject. Perhaps sympathy is not the word to use, but rather information. The parents have very little idea of what is actually being done in our schools today. Recently a small boy asked his mother to show him how to do a problem in arithmetic. The mother looked at the problem and answered, "Well, I don't know what they are trying to get at, they didn't do these problems in my day." That was all the thought given the matter, and the boy refusing to consult his teacher, is still stumbling along not understanding a thing he is doing in arithmetic.

Most of the parents do not know what we are trying to do in teaching practical biology. We should work as hard to educate the parents as we do their children. Nearly all schools now have their Parents' or Patrons' Clubs. This is where the parent and teacher should talk things over. Too many teachers consider it a social club, where the mothers can get together for a little amusement.

We should acquaint the public about our work through the newspapers. The poor reporters are fairly desperate at times for copy. Give them something to talk about. This material will be surely more valuable than the tales of murder, the suicides, and much of the sensational news with which our papers are loaded. Let me give you a few personal illustrations.

One day, while walking along the street past the office of one of our local papers, a former student stepped from the office and joined me. He said, "I wish to thank you for the copy you furnished me the other day." I replied, "I don't understand." Then he explained how he had been hard pressed to write an article. After much thought he recalled his experiences in one of my classes where I had set him to the task of photographing all the leaves of trees he could find in the vicinity. This gave him a subject, "Use of the Kodak in School." This boy, who was considered a good-for-nothing in school, had found real pleasure in

much of his work in botany. He will no doubt be able to furnish many a subject for his work in journalism from this source of his experiences.

Last year our class in zoölogy began a campaign against the fly. We started out with the idea that advertising would be our main means of getting the campaign started, and we were right, for very soon the campaign seemed to fairly take care of itself. Students from the class made speeches before all the Patrons' Clubs in the city during the month of February. One of our prominent daily papers promised to print everything we handed in on the subject. The class working together wrote weekly articles that were spicy and interesting. These attracted such attention that other papers demanded articles on the house fly. An insurance company requested that they be allowed to print pictorial posters on the subject, and that these be distributed about the city. The Electric Company asked to be allowed to give away fly swatters. One of the local theatres presented moving pictures of the fly, especially for the school children. Later the various clubs of the city asked to be represented in the movement. Finally a federation of clubs was formed to make this campaign an annual event. But right here is where disaster came to the enterprise, for the work of last year at least. Two factions arose, each demanding that certain officers be elected and certain policies be carried out. The feeling waxed so strong that when officers were finally elected, and policies were finally presented, everyone was far too angry to carry out anything. This smacks somewhat of other campaigns in our national affairs where very little is accomplished for the general good. This all goes to show that even though the teacher interests the parents most keenly, the parents are harder to work with than the children.

Another illustration of the lack of co-operation from the parents: The students in our general science classes were given the problem of determining the general sanitary conditions of the grocery stores and the meat shops in the city. Several parents refused to have their children make this inspection. These parents were interviewed by the teachers and in some cases the teachers gained their point. It is interesting to note that in no places where inspections were made did the merchants object or oppose the inspection. In two grocery stores the students sent to inspect were thought to be state inspectors.

No objections arose from our tests made on purity and vitality of seeds. The students bought seeds from every store in town

where they could be obtained. They carried on their tests and tabulated their results. Two eminent seed houses requested that the results of our tests be sent to them as they wished to have their seeds rate high.

Frequently teachers fall into pitfalls of their own making, when they fail to see the purpose and scope of their work. Probably half of the teachers today are teaching to carry out college requirements. Some per cent of the other half are teaching for dollars and cents, and a small per cent are teaching to develop the child. The term, *practical biology*, sounds as if it were designed to develop the child, and at present we are trying to interpret practical biology as the science which makes for better living. We teach personal hygiene, sanitary conditions of the home and the city, plants and animals as necessary products, and finally we teach of those forces which war against these necessary conditions. I made a somewhat feeble attempt to determine what the general idea was among the biologists of the state, as to the exact aim of their work. My questionnaire did not meet with favor so I gave it up as a bad job. I happened to remember that for five years I had asked my classes on completing their work to write a brief statement of what they considered they had been able to gain from their study of biology, so I turned to these papers to see if any of my aims had been achieved in this work.

Here are some of the results obtained after consulting thirty papers taken at random from the pack which I obtained in the last five years. One student had been able to develop his brain power. Another had learned to be neat. Still another had increased his vocabulary. These certainly reflected the theories of some educators of an early date. I wondered if I had instilled these ideas. Two different students said they would be able to make classifications of plants and animals. Two others stated that biology had taught them not to be ignorant of common things. To quote the exact words of one of these pupils, "To distinguish different strange trees and plants of all kinds. The composition of different plants, the parts of all trees, grasses, vegetables, and flowers. This helps because if some one should happen to ask you the name of a certain kind of a plant, and you could not answer them, they would think that you didn't know much." Two other students claimed that biology satisfied their curiosity in regard to things. Again I questioned myself if I had belonged to this age of teaching. There was greater uniformity in the answers given by the remaining students. *Three* students

had discovered a purpose for everything on the earth. *Eight* students were better able to understand the meaning of life. *Nine* had found out how to take care of their bodies.

Quoting from one of these papers I find, "A knowledge of biology enables the student to appreciate more fully the value of the lower animals, and these facts create a feeling of sympathy toward all of God's creatures even though it be the dumb brutes, the insects and the beautiful birds which make life full and more glorious."

Sixteen students were better able to see things in nature, to enjoy the beautiful and to enjoy travel. One of these papers expresses the matter very tersely in these words, "The study of biology brings to your attention many things which you thought of as nothing, if you had thought of them at all."

Twenty-two students said biology had helped them to know how to be helpful to plants and animals so they might be kept from injury.

One student found that biology had enabled her to help spend the time while waiting for a car.

Last but not least one girl said she had learned how to grow sweet peas. Quoting from her paper we have, "Before taking up the study of botany I didn't have a very great desire to bother with flowers. Now I sacrifice some of my sleeping hours to water my asters, sweet peas, geraniums, and ferns. I really enjoy this work now. After transplanting my asters I tried dry farming which is working well."

This data may show how some of the aims I have already presented have filtered through the minds of my students. As a matter of experiment try this little method I have used to see how the aim of *your* work is reflected in the student.

Now that schools in general have come as it were to a parting of the ways where they must choose their pathway for an entirely new regime in high school work, let us as biologists use our utmost influence to direct the choosing of the pathway so that schools may require students to study more biology. Let us urge that schools no longer place the matter in the hands of the pupil entirely in regard to the selection of their work.

Let us carefully analyze the work of the pupil to determine whether there is a tendency toward "bookishness," whether the notebooks are mere picture books, as extensive treatises or copy work. Let us be sure the student is making the work his own. That the work is making him more self-reliant, able to use pub-

lic reference work, and above all is able to use to the utmost his own personal faculties.

Let us further urge as a scientific body that teachers advertise their work so that the public may know more fully how vital biology is to personal welfare. Let us endeavor to interest parents as well as students, and thereby obtain the time necessary to carry on the work.

Let us as teachers analyze our own work to determine whether we are aiming to produce weaklings in life, or whether these students will be resourceful, and able to cope with problems of the home and the community.

A USEFUL PIECE OF APPARATUS.

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I have found the electric combustion furnace made by the Hoskins Mfg. Co., of Detroit, Mich., an exceedingly useful piece of apparatus for demonstration work in the teaching of chemistry. A two-foot length of silica combustion tubing is very desirable for use with the furnace. Following are some of the experiments that can be performed:

I. By placing iron filings in the combustion tube and passing steam over them large quantities of hydrogen may be easily obtained. You run no risk of breaking the silica tube by condensing steam in any portion of it and the silica is so poor a conductor of heat that the rubber stoppers used are but little affected by the high temperature of the portion within the furnace itself.

II. Atmospheric nitrogen may be obtained by passing air in a slow stream over copper trimmings. For producing the current of air I use a small rotary air blast driven by an electric motor.

III. Coal gas, coke, coal tar and ammonia may be obtained by the destructive distillation of coal. The coal tar may be condensed in a U tube immersed in cold water and the test for ammonia obtained with litmus paper, or this may be removed from the gas by a suitable gas washing tower. The hydrogen sulphide is tested for with lead acetate paper. The gas plant may be made as elaborate in its essential parts as the time and interest of the instructor permit.

IV. The contact process for making sulphuric acid is easily demonstrated.