

A TEXTBOOK FOR GENERAL SCIENCE.

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In discussing a textbook for general science in high schools, I shall touch upon the following three points:

- (1) Justification for a textbook;
- (2) Content;
- (3) Method of presentation.

JUSTIFICATION FOR A TEXTBOOK.

It seems to me that the opinion is altogether too common that each teacher of general science should make his own course and adapt it to the needs of his pupils. Theoretically this is fine, but it is not practical from the administrator's, teacher's, or pupil's standpoint.

I am quite in sympathy with the administrators of schools, who are becoming impatient with the indefiniteness of general science. How are they to give the proper perspective to a subject in the curriculum if that which is in the course is going to be determined entirely by the teacher?

It may be feasible for teachers in model schools or universities with allotted time for creative work to devise wonderfully adapted courses in general science, but how about the teacher who is teaching six periods a day for five days in the week? I am sure that during his vacant period he has something else to do besides devising work for the following day in general science.

Then there is the novice and faddist. They mean well, but their efforts, as a rule, are tending to make general science very indefinite and leading the administrators to demand with a great deal of justice, "What do you mean by general science?"

The students who are at the mercy of faddists, novices, and inadequately prepared teachers are surely not getting as good training, if they are being taught without a book, as they would from a correctly prepared book.

As a rule, if a teacher has specialized in one subject, she will feel that this science is better for the student than any other, and hence her course will become very one-sided. All sciences have their halls of charm, beauty, and usefulness, for the student, and the reason that we cannot see it, is that we have not taken the time or had the inclination to push open the doors that lead into these wonderful halls in other sciences.

High schools cannot hope to get the credit that they should for

general science until the period of fluctuation has passed and the high school has defined, at least in part, just what they mean by general science.

CONTENT OF THE COURSE.

It seems to me that C. M. Howe, of Hughes High School of Cincinnati, Ohio, has tackled this "content problem" in the right spirit. He sent out a questionnaire including a list of topics for general science. The teachers were asked to mark these topics as Fundamental (F) or Supplementary (S), according to their belief that they were essential to the subject or only possible value as optional material. You may find these results scored up in the reference cited.¹ The concordant fashion in which the teachers responded was rather significant. Could not each State profit by this advancement made by Ohio? And by means of State Teachers' Associations, each State could soon fix upon a standard minimum requirement. I say minimum requirement, for I feel that there should be a certain latitude of freedom for the teacher to put in local coloring. Such action would standardize the course while making it sufficiently adaptable to the needs of the community, and allow the teacher to develop any pet subjects to a safe extent.

Now, when the content of the course has been decided, the textbook should be written to envelop this minimum requirement so that it will make it as easy as possible for the teacher, while giving the student the maximum development.

METHOD OF PRESENTATION.

The method of presenting this minimum content will never have its maximum value to the student if books are written up the way that most of the general science books are today. The very way that they are written demands that they be taught by a textbook-memory method, where all projective or laboratory work of the student is given the subordinate position of merely illustrating the text, and any questions which arise are answered by reference to the text or from memory. There isn't any question that such a method is highly artificial, affords little training and tends to spoil the keen observation and exact reasoning of the student. On the other hand, I do not believe that the other extreme or project method, as commonly understood, is practical, i. e., where the student is given the project and required to work it out alone except from hints given by the

¹SCHOOL SCIENCE AND MATHEMATICS, Vol. XIX, p. 248-255.

teacher. The average teacher either gives the student too much or too little help. Either is fatal to ideal teaching.

One solution of this problem is this. Write up a book on these minimum requirements so that it will be possible for the teacher to present the subject from a projective method standpoint without working herself to death, and at the same time saving the scientific mind of the student. The book should contain such information, in the form of hints and questions as far as possible, so that the student will receive just the right kind of help and just enough so that the average student may carry out his project intelligently and without loss of valuable time. This information should have the following aim: to give the student a clear insight into the purpose of the project; and to throw light on any complications that are beyond the range of the average student. It should also contain any information that is necessary for a continuous understanding of the project, and lastly it should contain reference to some literature upon the project under consideration.

The major project may be broken up into minor projects, and each minor project may be done only by one student or a group of students. A major project as "Matter and Force" might include the minor projects gravity, weight, density, inertia, capillarity, etc. These should be put in the form of questions, as:

1. Is air matter?
2. Why does a candle burn?
3. Why do bodies fall to the earth?
4. Why does water rise in a towel?
5. How does a separator separate cream from milk?

Space should be left in the book to tabulate all observations and answer all questions so that the project will be a continuous story. To illustrate briefly:

Project: How does a separator separate cream from milk?

Apparatus: Pail (about ten quart), heavy cord, water, sawdust, separator.

Is the density of cream greater or less than that of milk?

What daily experience gives you the reason for your answer?

In the preliminary study of the project, water and sawdust will be used in the place of cream and milk.

Which will you have represent the cream and which the milk?

Give reason for your choice.

Place about two quarts of water in a ten quart pail and suspend it by means of a heavy cord so that it will be free to swing. Place some sawdust on the surface of the water. Turn the pail until the cord has acquired considerable twist. Now, let go of the pail and allow the cord to untwist.

What position does the water take in the pail?

What position does the sawdust take?

What would be the relative positions of the cream and milk were they subjected to the same experiment as the water and sawdust?

This preliminary laboratory work has put the student in a position to attack his project with intelligence. They are now ready to suggest how cream is separated from the milk in a cream separator. If this experiment is carried on in the city where the children cannot see a separator in actual use on a farm, it would be possible to have them examine one at some farm implement dealer's. It would be much better to loan one and have it at the school. Then all pupils who are interested might glean some knowledge of such an apparatus. Some of the pupils should be asked to demonstrate and describe the cream separator to the class. The Babcock butter tester will almost always come up with the cream separator. One student might be asked to make a test with this apparatus before the class.

At this time it would be quite fitting for the teacher to do some demonstrations on centrifugal apparatus, and to enlarge upon the meaning of centrifugal force.

The project may end here, for you have accomplished all and more than you started out to find, but in the purposed book you will find after this project, references in literature about the centrifuges in which crystals of sugar and salt are dried in the process of refining, and also references to explain the fact that planets revolve about the sun in nearly circular orbits because of the combined influence of gravity and inertia. The project should be enlarged upon by the students reading as many of these references as time will permit.

When the material gathered from the laboratory, textbook, demonstration exercises of the students and teacher, from the pupils' observations of commercial apparatus, and from reading references, has all been finished and digested, the student should be asked to write up a report on the project in order to clarify his ideas. The day that these reports are handed in, should be given over to the discussion of the project as a whole. The recitation should be the means of unifying, expanding, and illustrating what the pupil has learned in an experimental, vital way.

I feel confident that, if general science teachers would decide upon this minimum requirement, and a textbook were written up on these requirements by a good high school man or committee of such men, along the lines suggested above, it would make it possible for teachers with their crowded schedules to carry out this project method, which, undoubtedly, is the best method before the teaching world today.