CONTRIBUTION OF THE COLLEGE TO HIGH SCHOOL SCIENCE TEACHING

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At the last Springfield meeting the speaker presented to the Academy a report on behalf of the committee on Secondary School Science. As he recalls that report he feels that he would like to state again its last sentence, to the effect that however great the benefits of the Academy may be in its stimulation of amateur and professional investigation, the members of the Academy can perform no greater service for the science of the future than to improve the quality of high school science teaching in their communities. The Academy has not been unmindful of the resources of the state, in the persons of the high school teachers of science. But in the attempt to realize upon these resources it has been peculiarly unfortunate. Many of those present will remember our last experience. After sending out to science teachers some hundreds of notices regarding the work of the Academy, together with sample copies of the Transactions, the net return was, possibly, two or three applications for membership. The result seemed to prove conclusively that the teachers of the state are not in sympathy with science.

To say that the Academy was disappointed over the failure of science teachers to respond to its efforts is to state the case mildly. But instead of consoling ourselves with having done our duty, it behooves us to study the science situation more deeply and to learn the status of the average science teacher. The lists of accredited schools issued by the State Department of Public Instruction and by the Examiner of the State University are a revelation to one who is not familiar with high school conditions. Especially is this true if one considers the number of teachers in many of the schools, with the resultant large number of subjects to each teacher. Nowhere is the burden heavier and the effect more deplorable than in the science department, with its supposed laboratory method. A visit to a few of the smaller high schools and, alas, to some of the larger ones as well, verifies abundantly the suspicion aroused by the accredited lists. The fact is that only here and there can one find high school science being taught in a really efficient and inspiring manner.

Let us look at the situation at closer range. Let us suppose that the teacher was trained to teach chemistry. He will be found teaching physiography, physiology, zoology, botany, perhaps also physics, in all of which he has had practically no preparation! He is fortunate if he is not called upon to teach science after preparing himself especially in English or history. I know whereof I speak. If you ask the teacher how he comes to be so far from home, he responds that he is expected to take the work assigned him. Since he had studied something of one science, he is expected to know science in general, especially if the school cannot afford more than one science teacher. Or if the school boasts of a science "faculty," he happened to be the last one engaged and was obliged to take what the other science teachers wished upon him.

But what of the pupil under this regime? Taught by a teacher who does not know his subject, who does not discriminate between the essential and the non-essential (it would be laughable, if it were not pitiable, to hear some of the absurd things stressed in such cases), a teacher who is merely holding his job until he can get into a position in which he can teach his specialty, the pupil learns science as he too often learns algebra and Caesar and composition, as things to receive grades upon, to pass off, and never to be bothered with again. Nothing of science as a life to be lived, a home to be improved, a community to be inspired, a great quest to engage in for the years to come! Is it not true that only vision and enthusiasm on the part of the teacher are at all likely to arouse vision and enthusiasm in the pupil, as only life can beget life?

But this is only one side of the subject. Suppose that the student prepared in chemistry gets his chosen job and has the opportunity to teach chemistry only; what kind of chemistry shall he teach? Shall he teach it as chemistry adapted to the life of the community, or as the ideal philosophy of the investigator? Shall it be a chemistry that takes account of the child's point of view, that fits the child's progress in science, or is the teacher to feel that the first thing to teach the pupil is the last thing he himself learned at college?

Let us understand at this point that it is of no use for us to blame the young high school teacher for the situation in which he finds himself. He is but adapting himself to conditions as

best he can. If the speaker has seemed to any to be spending too much time in criticizing the existing order, let such take note that the criticism is not intended to be carping, but has a constructive reason for its justification. For the imaginary, yet real, picture drawn in earlier paragraphs of this paper has its background in statistics. From an article by Professor Carl Hartman in School Science and Mathematics for the current month (February, 1917) it appears that 13 per cent of the teachers of Texas teach one or two subjects; 22 per cent teach all the science offered; 20 per cent teach all the science and all the mathematics, and 50 per cent teach all the science and at least one other subject.

These figures are not peculiar to Texas; they only corroborate results obtained two years ago for Illinois. Moreover, they show conclusively that there are practically no science specialists in the high schools. If we wish to seek an improvement in the quality of the teaching done, we must go back of the teacher to the public that takes advantage of his inexperience to pay him a small salary, and above all we must go back to the college or university that prepares the teacher for his profession. In this connection Dr. Hartman observes that "the universities and colleges are, in the main, failing to take advantage of their opportunity of training teachers for these schools, for the reason that they tend to train specialists rather than high school teachers of science."

This last observation brings us directly to the subject of the paper. What can the college contribute to science teaching in the high school? It can, in the first place, recognize the problem. Here, in an organization devoted to *all* science, we can see it more clearly, perhaps, than in the college faculties from which we come. The self-evident remedy, if experience and reason teach us anything, is that the college and the undergraduate departments of the university must adapt a part of their instruction in science to the training of their graduates to be *teachers of science* rather than teachers of *a* science. But how can this be done? One way that suggests itself is that the college can expect those of its students who have any idea of teaching to take elementary courses in several sciences rather than to specialize in one. This will break the hearts of some instructors in advanced courses, but these may have to stand aside.

There is, however, a still better way of solving the problem. The college can select from its faculty a man who can appreciate the specialist's point of view and who can yet see the science field as a whole, a man who can make for this purpose a re-synthesis of science out of the fragments into which, for purposes of intensive study, it has been broken. This man can present to students of the third or fourth year a course in the "Teaching of Science." As a prerequisite, students should be required to take courses in both the physical and biological branches of science. The course could include a rapid survey of the special sciences from the high school point of view. The salient principles of the sciences, the text books available, the laboratory facilities to be expected, the adaptation of simple apparatus where the more technical is not present, the methods of presentation, the results to be expected from students—all these could form part of such a course. In this way the elements of some sciences not ordinarily taken by college students, such as astronomy, may be added to the graduates' equipment.

The adoption of such a course will mean that in many colleges a specialist in one science will have to give the course in science teaching; in the larger schools a man will be found who can devote himself to this work. And the student in the larger school need not give up specialization, either. But to the student who majors in biology the teaching course will give aid in the physical sciences, while to the student of physical science it will give the necessary minimum of biology. To both classes the course will give the equipment and point of view needed for the presentation of introductory science, or general science, in the junior high school or in the first year of the ordinary high school—a need not met by any college science courses of the present time.

Some may suggest that several members of the faculty should join in giving such a course, each presenting his specialty. To such the reply is that this ought not to be a vaudeville performance; there must be *one* teacher. If the college is unable to muster enough unification of purpose to give such a course, it can not fairly expect the student to do so. Another objection will be that the specialist will not be willing to devote himself to such work, yet every month or two, even now, we hear of a science specialist who goes over into science education in a university school of education. The arrangement

proposed means that it will no longer be necessary for the teacher of science to leave the university in order that he may become a specialist in the teaching of science.

As the inexperienced high school teacher will inevitably teach in the high school the thing last studied in college, let that last thing studied be a unifying course rather than a specialized one. The result will be a rounding out of all the preparatory work done by the teacher. As a high school pupil he will have begun with an introductory science and will then broaden out into the special sciences of the later high school and college years. Last of all, without abandoning the special skill he has gained, he will yet come to feel, before he goes out to present to the next generation the truths of science, their essential unity. This will make of the graduate not only a better teacher, but a better man or woman.