

Science Education—A Cooperative Venture

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Perhaps one of the greatest problems in sharing one's ideas and thoughts with his colleagues is in the selection of an appropriate title. I chose two words—cooperative and venture—because I believe they identify the two aspects of present-day science education needing the most attention.

This is especially true in view of the pressures now being exerted to strengthen this area of our educational system as well as the financial support being given to it. It has become almost trite to say that we live in a world of science and that science will become increasingly more important to our lives in the future. I believe we are irrevocably committed to a scientific society because man, having tasted the sweet fruits of present-day science, will not relish a return to the past.

Because of these and other factors, it seems imperative that we pause and rethink our basic philosophy of science education—because misjudgment in this area might seriously affect the future of science in America—indeed, our very lives.

One would expect that with the increased support for and interest in science, the task of science education would be greatly facilitated; but, as you well know, this has not been the case in all instances.

The increasing complexity of science, the impatience of some educational reformers, the increasing importance of science, and the need for additional personnel in science—to name a few—have compounded the problem and points to the need for a realization that we all share a greater responsibility in the matter.

At this point it may appear that we have developed a "vicious circle" in science education during the period from 1945 to 1955. An unnecessarily free elective system in the high school virtually assured that the majority of students would have little or no contact with science or mathematics during three critical, formative years. When these students entered colleges they were likely to major in almost any subject but the sciences. In turn, the college output included only a small percentage of young men and women with science majors. And finally, this output was not sufficiently large to insure the perpetuation of an effective teaching corps, especially if we insist that the teacher possess superior teaching skills and a good knowledge of his subject.

Since 1955 there have been increasing signs that improvement is on the way. Therefore, indications are that many more high school students are now enrolling in the sciences than was the case in the mid-fifties. Apparently there has also been an upward trend in college science enrollments. The United States Office of Education figures for 1958 showed a 10.4 per cent increase over 1957 in college juniors majoring in science and mathematics. These are favorable indications, for it is clear that we shall not find a solution for the science manpower problem until larger numbers of students elect high school and college courses in the sciences, the college output of science majors is increased, and larger numbers of these majors become available as teachers. Then, and only then, will it be fully possible to insure the selection of superior new science instructors. In the meantime we must do the best we can with the qualified or partially qualified teacher candidates who become available, and with stop-gap training programs.

If we succeed in developing an adequate flow of superior candidates for the teaching profession we solve one problem, but we are immediately

confronted by others, and chief among them are the programs for teacher training. These programs are necessarily dissimilar for elementary school teachers on the one hand and teachers of the special subjects on the other, and undoubtedly they should be.

At the elementary school level the vast majority of teacher candidates are young women, and they attend a variety of teacher-training institutions. Gross numbers of these candidates appear to be reasonably adequate, but average quality and the type of pre-service education provided are continuing problems. Such pre-service education has generally been designed to provide breadth rather than depth, and this policy has been based upon three general premises: (1) that elementary school teachers should have a good general education; (2) that their work will involve the various broad fields of human knowledge; and (3) that they should receive basic instruction in methods. A case may be made for all of these arguments, but the plain fact is that many elementary school teachers say that they minimize science studies in their classrooms because their own backgrounds in science are so limited.

But when the occasional elementary school teacher does have a reasonably adequate knowledge of science, and does maintain a science program, the response of many pupils is enthusiastic. In other words, pupil ability to learn is there, and so is interest, but as long as elementary science programs do not really exist in many schools, or are largely just exercises in reading about science, the over-all effectiveness of science education will be impaired.

It is at the secondary level that we have teachers of special subjects. In a large junior high school a teacher's assignment may be limited to general science classes, and in a large senior high school he may be either a biology, physics, or chemistry teacher. When such is the case the teacher may hope to have reasonably good command of the subject matter with which he deals.

In the smaller school units, however, the senior high school teacher may be called upon to represent all of the sciences, and this places him in a predicament because he probably has been educated in the liberal arts pattern, which generally means that he has majored in one science to the virtual exclusion of the other sciences. Moreover, the instruction that he has received in subject-matter courses has been designed to serve quite a different purposes from that of educating secondary school teachers.

The acceptable candidate for secondary school science teaching is also very likely to be diverted into some other walk of life because he represents potential scientific manpower, and various types of employment beckon to him, particularly if he is personable, possessed of leadership qualities, and has a reasonably good academic record. Thus a complex problem of recruitment, selection, and education exists, and if we are realistic, we must consider both short-range and long-range solutions. For the immediate future it seems probable that present unsatisfactory conditions of supply and demand will continue, although the effects of these conditions may be modified by the achievement of certain very desirable improvements in practices, including the following:

1. A better understanding of the problem by science professors at the college level, leading to the development of courses to meet the teacher-education need, and the establishment of majors which provide depth in one science but some familiarity with the other sciences.
2. Better guidance by members of college and university education departments, including clear recognition that the candidate must know what he is going to teach and how to teach it.
3. A genuine cooperative effort on the part of the college science

teachers and other educators to encourage promising candidates to enter upon secondary school teaching careers, including careers in the teaching of science.

4. A larger flow of new candidates for the teaching profession, which will make possible a real program of selection and education at the graduate level. Today we too often take refuge in the attitude that "any teacher is better than no teacher," which is a reaction to chronic teacher shortages. But actually, we must recognize that the will to teach is not enough—desire must be associated with ability.

Looking somewhat into the future, it may be anticipated that the current need for superior secondary school teachers of all subjects will lead to the development of a new type of teacher-training institution, and that this institution will provide the long-range solution for much of the present problem. Such an institution would be neither the teachers college nor the liberal arts college of the moment, but one in which the curriculum would be designed to educate prospective secondary school teachers so that they have adequate knowledge of the particular subject they are going to teach, and are well grounded in the psychology, guidance, administration, and methodology that make for professional competence.

Many existing courses designed for these purposes are of limited value. On the one hand, subject-matter courses in science are often designed primarily for students who plan to develop a research specialty, and incorporate many details that have little or no relationship to school science programs. On the other hand, too many professional courses are inflated with general materials which also have only remote association with the job in prospect. There is no real reason why these shortcomings must continue, other than the inertia of college faculties.

With respect to the existing corps of high school science teachers, our main concern must be that they are kept up to date with the march of scientific and educational progress. Across the length and breadth of the land various agencies are now attempting to accomplish this goal through the medium of special subject-matter offerings backed up by scholarship and fellowship programs. The general effect of this effort should be very good, and especially so in times when so many emergency licenses have been granted. Moreover, these special programs should not be regarded entirely as stop-gap measures. The high school science teacher is not a person who has leisure in the working day to read extensively in the current research literature or to devote long hours to the origination of new demonstrations and laboratory procedures. He is more likely to be a person who is assigned too many overcrowded classes, and any time that remains will probably be devoted to study hall supervision, club activities, and a variety of minor but requisite duties. Consequently, the teacher clearly needs an opportunity to engage in refresher training at periodic intervals.

The brief review of the science teacher problem presented here should make it evident that these teachers are vital factors in any effort to increase our scientific manpower resources. We do not have well qualified science teachers in adequate numbers. The problem is critical at the senior high school level today, and will be equally urgent at the college level in the near future. *One of the great needs of the day is a more adequate science teaching corps.*

This then brings us back to the key words—*cooperative venture*. We can define "venture" as—a risky or dangerous undertaking—especially when there is danger of loss as well as a chance for profit.

We all share in the responsibility for science education. We must work together—the various science departments—those responsible for teacher training—the public schools and the teachers themselves.

When future generations look back on the period of the late fifties and the sixties I hope they will not say that we were guilty of conducting *Indian research*—which can be defined as saying “All Indians walk in a straight line—at least the one I saw did.”