Glenn O. Blough

Improving the Science Program

WHENEVER one discipline of the curriculum is singled out for special attention and emphasis by way of added financial aid, more time allotment, and intensive considerations in many other ways, there is every reason to expect change for the better. In the immediate past years science has been receiving a lion's share of what there is to give from many sources. There has been an urgency attached to science teaching that overshadows most, if not all, other areas of the curriculum at all levels. And there has been some progress.

Countless numbers of school systems are assessing their science offerings, methods of instruction, and materials available. Courses of study or curriculum guides are appearing. Summer and year-long institutes for the training of in-service teachers are being sponsored by various interested groups and these are definitely raising the standards of instruction for those who participate. Through the National Defense Education Act, large amounts of apparatus have become available for schools. Concentrated efforts sponsored by foundations and other means are producing curriculum materials in biology, chemistry and physics. There is scarcely a school system that has not at least recognized that it is expected to improve its science program and teaching. But:

There are still more teachers at the elementary school level who save their science teaching until the last (which means that they do only a little and do it poorly) than there are who do such teaching willingly and well.

There are still more schools that do not have a prescribed course of study in elementary science than there are that do. Many schools still leave their teachers free to select content and activities within such a broad framework that it provides insufficient guidance for their inadequately prepared teachers.

There are still comparatively few schools that have a K-12 program in science worthy of that designation.

There are still far too many college freshmen who are prospective teachers in the elementary schools who ask of their advisors, "What's the minimum amount of science that I can get by with?" or "Do I *have* to take physics?"

There are still far too many high school graduates who take only general science and biology and are never exposed to physics and chemistry.

There is too much poor science teaching at every level of our school system.

Yet progress comes through an analysis of needs and devising a program for meeting them, and not through dwelling on the faults. It seems appropriate, then, to take inventory to discover our needs and concentrate on plans to meet them. This procedure is in progress in every

state department of education and countless numbers of local school systems.

Inventory of Needs

Following are some of the needs that seem paramount in the minds of many who are concerned with improving the science program at all levels.

First, there is a real need for a K-12 or 14-year science program that goes beyond the bulletin stage. The first yearbook of the National Society for the Study of Education that dealt with the problems of science teaching in 1942 pointed out this need and we have been talking and writing about it ever since. There are still comparatively few places where such a program actually exists—where what happens in the junior high school depends on what has happened in K-6, where the senior high school curriculum is altered in light of what has come before, where there have been assessing, planning and teaching that take every level into account in relation to a total sequence.

Everyone admits that to plan and put into effect such a program takes time. There is a real question, though, as to whether we have as much time as we appear to be taking. Experience seems to indicate that much of the time is spent in attempting to create a mutual respect for the importance of the contributions at each level by all concerned. Here there is need for intelligent leadership that can utilize talents and backgrounds at all levels and give them purposeful direction. This situation is not peculiar to the area of science. Other disciplines are in need of similar consideration to produce programs with continuity that will provide, for children and young people, learning experiences that are not repetitious but are continually expanding.

There is considerable evidence to indicate that we need a better understanding of what science really is—or is not—at various levels. It is not just a collection of facts about the moon and magnets but it does involve information. It involves learning facts that can be used to formulate a meaningful generalization. Perhaps it is time to stop apologizing for requiring the learner to acquire the facts. Facts must be learned, then pupils can be expected to piece them together into something that is important and meaningful—a principle or generalization that he can use in interpreting the environment.

The presence of an aquarium and a terrarium in an elementary schoolroom is not evidence of a science program. It is the use that is made of these that constitutes the science. We will not unpack a program with the shipment of equipment that comes at half price. Science is not equipment.

Science is a method of discovery—it is a creative intellectual activity—it is learning how to find the answers—it is an attitude—and it is the body of organized subject matter that is the result of this intellectual activity. Understanding this is the first step toward achieving a real science program. It must be understood by the administrator, the supervisor and the teacher, for it influences every molecule of the science program.

An understanding of the true nature of science is urgent at every level of the curriculum. The first grade teacher who lacks such an understanding will not be a good teacher of children and science. Neither will the high school biology teacher.

There is great need for a thorough understanding of what the study of science

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is expected to do for the learners. Unless those who plan the program and those who teach it have a real understanding of its intention, there is little hope for the success we need. Unless we know where we intend to go we cannot know when or whether we arrive—nor can we measure our progress. Although there is growth in this area, there is still much aimless teaching.

In the elementary school, piles of nonsense have been committed in the name of science. Unless an activity actually contributes toward the attainment of one or more of the objectives for science teaching it is a waste of time. It may even be worse, for there are many children who develop a negative attitude toward both work and science because of inappropriate activities and busywork. The same is true at all levels of instruction.

An informal survey of several hundred elementary school teachers was made over the past few years. This study indicates that very few of the teachers taking in-service classes had, in their high school and college science experiences, ever heard of a scientific attitude or had experienced more than a casual brush with the meaning of scientific problem solving. Only about 10 percent had ever connected a dry cell to a light. They had only watched someone else do it. They were surprised to learn that they would not get shocked by using such a dry cell. Yet these are some of the teachers who currently are directing the first science experiences of today's children. Similar, although different, deficiencies in preparation of teachers exist at other levels.

Again, who is to blame is less important than is the procedure that may correct this situation. Science teaching at every level intends to bring about certain desirable changes in those studying science. These recommended behavioral changes can be read in countless numbers of yearbooks, professional magazines, teachers manuals and other print. These changes are less obvious when we observe science teaching in the classroom —from kindergartens to universities. In review, these intentions include: growth in ability to identify and solve problems in a scientific manner so that the result may be relied upon, growth in understanding and use of a scientific attitude (don't jump to conclusions, do withhold judgment, evaluate evidence, be open-minded, etc.), growth in learning facts and associating them to see relationships in order to understand science principles and generalizations useful in interpreting the scientific world, growth in interest and appreciation for the physical and natural world. There are several other desired outcomes. However, these are generally considered to be the most urgent ones.

Unfortunately these intentions are not automatically achieved just because they have become required reading. They are not instinctive with learners. Their achievement is not mechanical. They must be understood by curriculum makers, supervisors, principals and above all by teachers in the classroom and they must become urgent. They must become a permanent part of the curriculum just as the subject matter is. Growth in problem solving, scientific attitudes, interest and appreciation come about only if the teacher intends that they shall and plans experiences that will bring them about. Such growth is likely to be slow at its best. It may never start in the classroom unless the teacher sees that it does. Perhaps the greatest growth ever made in improving the effectiveness of science teaching will come about the year we concentrate on really understanding our

objectives and bending our full efforts toward intending to achieve them.

It is obvious that this need is universal from K through 12. The need exists as much at one level as at another and there is every reason to hope that teachers may increase their scope of understanding to include other levels as well as the one on which they concentrate in their teaching.

Observation would indicate that there is great need for increased intelligent leadership in program planning and curriculum making. The emphatic words here are "intelligent leadership." Thousands of teacher-hours are spent locally in allocating science concepts to various grades, designing curricula and making similar decisions by teachers who are the first to admit that they have meager backgrounds of training or experience to do so. There is little sound curriculum-making accomplished through pooling inexperience and exchanging lack of knowledge. Especially is this true if the leadership is equally inadequate.

Some persons believe that unless there are qualified local teachers and leaders to carry on science curriculum construction, the needs of such a school system may be better served by using a scope and sequence from some reliable source and adapting it to local needs. After-school hours of the teacher may then be spent in improving the teaching—an area in which there is much work to be done. There would still be plenty of opportunity for groups to work together, to use the talent of the staff, to give teachers a feeling of having participated in what is to be done, but the hours will be spent at tasks that can be accomplished by the available talent.

Whenever possible, where there is no one locally to act as a leader in science curriculum making, there is much to be said in favor of importing science specialists to exercise leadership to guide the efforts of teachers and others in the task of curriculum construction. The foregoing is not intended to imply that curriculum construction in science cannot be done locally. It can be in situations where there is talent for it—and especially where there are leaders with background and experience to direct the project.

It will be noted again that the need for trained leadership is a K-12 need. It is here that the leadership can perhaps make its greatest contribution because it sees the whole school picture, whereas many teachers are likely to see and to know only their own specific grade (in elementary school) and subject (in secondary school). The skillful leader succeeds in using his broad knowledge of the total school objectives and of the science field in particular to bring about an improvement in the teaching at all levels.

The following statement is perhaps an oversimplification but it is probably true that: There is really nothing wrong with science in our schools today that some excellent teaching will not cure. We probably write and talk a better program than we teach.

There is great need for improving what goes on in the classrooms where children and young people are supposed to be achieving the objectives outlined for science teaching. Here again leadership is important. A supervisor who cannot recognize good science teaching when he sees it, and who has even less than a desirable general education background in science is hardly in position to help a teacher who needs assistance in this area. There is much good science teaching today. There is more than there was even five years ago. But even yet there

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lem areas, knowing that growth of content knowledge will follow richly in the wake of inquiry.

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is not enough. A year set aside for concentration on what constitutes good classroom teaching and how to bring it about would be a year well spent.

In connection with classroom teaching, *there is need at every level for better informed teachers.* The subject matter of science is indeed vast. No teacher at any level of instruction can possibly answer all of the questions asked of him. He is not expected to do so. If he recognizes his objectives he does not intend to be an automatic answering service. He exercises his leadership in helping students devise scientific plans for solving the problem but he cannot teach science if he does not know any, any more than he can teach arithmetic if he does not know the fundamental processes. A basic background that makes sensible leadership possible is necessary for success in teaching. There is no adequate substitute for a knowledge of science if the teacher expects success in teaching at any level of instruction.