Letters

Research at the Grass Roots?

In the past year or so, most scientists have become aware of the declining percentages of young people who enter the fields of science and science teaching. Most articles decry the decline in physics, chemistry, and mathematics students, but the number of students entering the life sciences and even the number of applicants to medical schools also are declining. Clearly, young people are taking a dim view of both basic and applied sciences as a career.

Many diagnoses and correctives have been suggested. Some of these are stopgap, emergency solutions that give no assurance of changing the fundamental public attitudes from which this problem arises. It is plain that the solution depends on the average man's developing an understanding and appreciation of, and therefore, an interest in the importance and value of science to him personally. So far, no successful way of achieving this objective has been reported.

It might help us approach this problem if we recall that people could not always be divided into scientists and nonscientists, as at present. In the early days of modern science, scientists were generally part-time, amateurs. Many earned their living as druggists, physicians, engineers, teachers, or farmers, in daily contact with their fellow-citizens. Many lived in small communities and no doubt performed many of their leisure-time experiments before the very eyes of their friends and neighbors. Pasteur's famous anthrax experiment took place at the edge of town before a group of curious villagers in the year 1881. Franklin's famous kite experiment also comes to mind. In those times scientists were not full-time specialists working with gadgets, instruments, and ideas totally alien to the everyday experience of their neighbors and associates.

Early scientists performed valuable fundamental research with the crude (but adequate) instruments that they could build personally or afford to buy. There were few scientific books and publications. Library needs were simple. Thus, research was possible at almost any place. As science has developed since then, research has become centralized in our universities, in government and industrial laboratories, and in a few institutes generally located in large cities. Science has become the full-time work of a relatively few specialists working in comparative isolation from the rest of society. This historical change, plus the official secrecy surrounding atomic and other military science, has isolated scientists and their work from the day to day experience of the nonscientist.

But much valuable research still is done with simple, inexpensive instruments. One way of restoring public understanding of, and interest in, science would be to decentralize scientific research so that the average citizen would once again have personal contact with it as he did in earlier times. Modest research centers could be developed in our high schools and perhaps in some of our small-town hospitals as well. Science can be returned to the grass roots. With present-day communication and transportation facilities, no high school or hospital in the United States is more than a few hours from a university or other research center, which could provide the library and other technical support and guidance necessary to develop such a program. Funds from local or national foundations interested in fostering science could yield tremendous dividends in public interest and support, not to mention the direct discoveries that would also result.

If we hope to get and maintain the interest of good science teachers in the future, we must give them a chance to participate in research, as this plan would do. Anyone today who has the desire and the energy to master a science well enough to teach it is not likely to be satisfied to teach for long, unless he also has a chance to participate in the pleasures and stimulation of research. We know that this is true of university science teachers. Who would attempt to staff a university science department where no research was possible? Why should we imagine that the dreams and aspirations of high-school teachers are different? Likewise, if science is to have intelligent public support it must operate in a "glass house."

Warren Weaver has recently stated, "many would treat scientists one-third of the time as amusing but beneficial eccentrics, one-third of the time as sorcerers, and one-third of the time as irresponsible rascals" [*Science* **122,** 1258 (1955)].

Most scientists will agree that this is a fair description of the attitude of the general public. How then can science hope to attract enough young people unless a way is found to change this public myth? Clearly, science cannot compete with business in terms of money or power, or with most other professions in terms of security. If science is to receive its proper share of the best young minds, its special challenges and pleasures must be made known to the public generally in such a way that a scientific career receives careful consideration by every bright high-school student.

The quality of research shown at science fairs indicates that many high-school teachers and students have the ability to do first-class research. If these teachers could have the necessary financial and scientific support, not only would some valuable discoveries result, but, more important, millions of youngsters and through them millions of parents would get firsthand knowledge of science at the workbench. They would be able to experience science, and not just read or hear about it. Can anyone doubt that this would make a difference in the public attitude toward science? Science fairs and exhibits can never be a substitute for personal experience.

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IGY in Denmark

While I was writing my tenth article on the International Geophysical Year and going on to my *n*th article on the shortage of scientists in Denmark, it struck me that the IGY might be used to stimulate interest in science, and that carefully planned information on Danish participation in the IGY program might interest some youngsters in choosing science as a career.

I went to my chief editor, Mogens Aller of the Aller Press, Ltd. (publishers of weeklies and magazines), and asked him to give me a free hand to act on the behalf of the Aller Press. I was allowed to dispose of "a couple of thousand dol-

lars" to start—allocation of more money is dependent on the interest it might be possible to create in the project.

Discussions followed with the Danish Association for the Advancement of Science and the Danish Association of Science Writers. It has now been agreed that the two associations, together with the Aller Press, will arrange a special IGY week in October (October 22–27). It goes without saying that particular emphasis during this week will be given to what Denmark has done and will be doing in the field of geophysics. Special arrangements will be made to interest science teachers and to provide them with material to pass on to their pupils. During the week a competition for high-school students will be announced. Students will choose a topic in the field of "Denmark and geophysics," and write a thesis about it. The student with the best thesis will be sent on an "inspection" trip to Danish geophysical stations in Greenland. From Greenland he will send "news from the front" to other Danish students, either by the Danish Broadcasting System or by ordinary radio plus teletype.

Negotiations have been started with the Danish IGY National Committee and with the ministries involved (such as the Ministry of Education) to have other prize winners directly attached to certain Danish IGY expeditions. The National Committee has approved of the idea, which, at the time of writing, is still under consideration by the ministries. Negotiations have been started to have a few science teachers direct various Danish geophysical stations in Greenland during the IGY, and to give radio talks on developments from their posts during the year. One difficulty in this connection is the serious shortage of science teachers in Denmark, and it is not yet clear whether qualified teachers can be released from their posts.

The scheme outlined here might gain in stature and importance if it could be changed from a tiny Danish plan into an international one. Perhaps someone in the United States might be interested in organizing and raising money for a bigger and better plan than mine. If this were done, there would be many opportunities for international cooperation—for instance, radio interchanges of "news dispatches" between Danish and American prize winners. I know that Danish students would be glad to hear from student members of American IGY expeditions. Would American high-school students be interested in learning what Danish students have to report on the Danish aspects of IGY? In addition, we might make arrangements for an American student to take part in a Danish expedition and for a Danish boy to take part in an American expedition.

I should welcome suggestions for collaboration not only from the United States, but also from colleagues in other countries. The more countries that might be linked up with the scheme, the more attractive it might be made. I would appreciate it if those interested in this invitation would kindly send a word or two to me at Aller Press, Ltd., Copenhagen, Valby, Denmark (Cable: Allerpress, Denmark).

BÖRGE MICHELSON
Danish Association of Science Writers

Atom Harvest

I have just received a very disturbing letter from Leonard Bertin, science editor of the *London Daily Telegraph* and author of *Atom Harvest*—a book which is critical of our role in the sharing and use of atomic information.

Bertin writes: "As far as I know there was not a single copy of the book on sale in the United States at the time when the reviews appeared in *Scientific American, Scientific Monthly,* and the *Atomic Scientists' Bulletin.*" The book has been refused for American publication by Duell, Sloan and Pearce, Rinehart, Van Nostrand, Doubleday, University of Chicago Press, Knopf, Norton, Lippincott, Praeger, and Criterion.

I do not know why *Atom Harvest* has not been published in the United States. It may be censorship, official or unofficial. Or it may be a simple case of sheer lack of interest. In any case, however, it would be interesting to learn exactly why American publishers have not responded to a book which has been so favorably reviewed in prominent American journals.

JOHN E. PFEIFFER
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Scientists: Smug and Bossy?

I have just read the editorial about the "battery additive" case [*Science* **123**, 1059 (15 June 1956)] and would like to express a slightly dissenting opinion.

I am somewhat tired of government agencies, no matter how excellent or well-intentioned, trying to tell everybody what to do. Where there exists a danger to life or the possibility of an irreversible change in health in any commercial product, I think that is a sufficient reason for interference by the state. But the slight irreversible change of thinning the pocketbook by a bad purchase does not seem to me to justify paternalistic action.

I think much of the reaction against scientists, as well as other intellectuals, is due to a very unfortunate tendency on their part to become, first, smug and, then, bossy. This sort of attitude makes everybody sore, including themselves, any time they are exposed to it from somebody else. I do not think it is possible to earn respect for one's opinions unless you leave people free to take your advice or not, as they choose, and find out what happens if they don't. The minute you put on pressure, people are going to hate you and have every right to.

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Radiation Damage

The Committee of the National Academy of Sciences reporting on genetic effects of atomic radiation [*Science* **123**, 1157 (29 June 1956)] advises: ". . . for every individual a complete history of his total record of exposure to x-rays, and to all other gamma radiation." This simply won't be done. Who can imagine a political and administrative technique by which it would be other than a farce?

"That individual persons not receive more than . . . 50 r up to age 30," and so forth. The important thing—and this is the whole burden of the report—is the average exposure to the entire population before end of child-bearing age. The exposure to any one individual is important genetically only as it increases the general average (a tiny influence). In order that radiation injure the individual himself perceptibly or his immediate offspring perceptibly, the dose must be several times larger than the limit quoted.

Let me add that I have only the greatest admiration for the body of the committee's report and wish everyone would read it.

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