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Recently I was told by a psychologist — and he ought to know — that the primary factor governing the choice of a vocation by scientists, engineers, technicians, and even teachers of science, is their preference for working with and studying about things rather than people. It was his contention that men of science, with few exceptions, prefer the relative quiet of the laboratory and the science classroom to the give-and-take of the social and political arena; that they prefer the relatively non-controversial subject matter of the natural sciences to matters of social concern in which opinions, rather than demonstrated facts and laws, are the order of the day; that they are preoccupied with the precise formulation of unimportant knowledge but not with their social responsibilities as intelligent citizens in a democracy.

Now it is not difficult to take issue with this indictment of men who are engaged in this intellectual enterprise we call science. Yet, however we may choose to quibble with the indictment as it stands, there is reason to suspect that there is some truth in the contention that we, as scientists and as teachers of science, have not always assumed our full share of the duties we incur from our profession and from our citizenship. In general, we have been inarticulate amid the fury and clamor of the social process.

Yet, despite our natural reticence, there exists an ever increasing uneasiness on the part of scientists, science teachers, and intelligent laymen concerning the possible and probable social effects of the discoveries of science and the developments of technology. Of course, this uneasiness is currently most evident in connection with recent advances in nuclear studies and their possible applications. Both laymen and professional scientists warn us of the immense destruction which can occur unless nuclear energy is properly and effectively controlled by agencies whose primary concern is the public welfare. Whether from sheer panic or as the result of sober reflection our colleagues, the teachers of the social sciences and the humanities, are seriously questioning the social and human effects of scientific research and its resulting technology. But this uneasiness is not limited to atomic science alone. Rightly or wrongly, thinking people everywhere are suggesting — some demanding — that the scientist and teacher of science look beyond his measuring rods, his test tubes, and his guinea pigs and give greater attention to the social implications of his work.

But what *is* the responsibility of the scientist toward the social implications of his work, what, if any, are the responsibilities of the industrial engineer toward the uses to which the products of his organization are put? These are provocative questions, interesting and worthy of discussion. But the more immediate problem for discussion by science *teachers* should be phrased differently: What are the social implications, if any, of the subjects we teach? Are they important? Has the science teacher any special obligations because of the nature of the subject he teaches? In what ways, if any, is he in a particularly advantageous position to make his influence felt?

There seems little doubt that most — if not all — teachers will admit the existence of certain obligations toward their students in fostering attitudes both constructive and critical concerning the problems that necessarily arise in a society which is ever changing its character because of its expanding technology. So far, this premise is easy to accept because we are, after all, educators and as educators we are supposed in some vague sort of way to share certain problems with our friends, the teachers of the humanities and of the social sciences. But to admit this without being more specific is to say little. It is like the solemn assertion that we are against sin. What can teachers actually do? What do they do?

Some teachers of science base their practice on the theory that a thorough knowledge of scientific subject matter is a necessary and sufficient condition for the wise use of that knowledge by reasonable men. The trouble with this idea is either that the theory is wrong or else that our students are not always reasonable. For it was precisely this practice, as followed by many of our colleges and most of our graduate schools, which is now directly responsible for our own present difficulty in seeing things whole. It was precisely this practice which led directly to the recent attempts at revising the curricula of many of our more forward looking colleges and the rethinking of education generally.

Another theory, better than the first but not good enough, gains credence from the comparatively difficult nature of scientific subject matter. It is argued that for students whose professional interests lie outside the scientific enterprise many of our conventional science courses are too difficult. Hence, we should dilute our course offerings for the non-science major and substitute what is termed a humanistic approach for certain of the more difficult portions of the science itself. By implication this means that the new approach will not be included in courses for our better students

for do we not always complain about the lack of time at our disposal for covering what we believe to be essential subject matter? The trouble with this idea is that if the so-called humanistic approach is good for the non-scientist — and I think it is — it is even better for the prospective scientist. What is merely interesting to the former is more clearly a necessity for the latter. The science student who is a prospective scientist must know not only what he is doing from the technical standpoint but he must know the probable consequences of his actions to other people. He must be able to decide whether such consequences are good or bad and he must have the moral stamina to base his actions on his decision.

A number of unsuspecting scientists, engineers, and teachers have been "used" to further the ends of unscrupulous individuals, corporations, and even nations. One outstanding example of what can happen to specialists who are nothing but specialists occurred in Germany between the wars. Of this Professor Sigerist of Johns Hopkins has written:

> If the German academic world surrendered so readily to reactionary forces it was largely due to the fact that it consisted of men who were specialists and nothing else. If we wish to educate a citizen to think in terms of science and a scientist prepared to participate in social action, we must change our teaching. — Science and Society No. 2, p. 3, 1938.

But Mark Van Doren is very pessimistic over the prospects for teachers seeing beyond their measuring rods, their test tubes, and their guinea pigs. He wrote:

> It will be a long time before teachers have the bravery to extend their knowledge beyond the specialties they started with. A truly coherent curriculum demands that they should and in some millennium they may. — Liberal Education, p. 113.

It is easy to see why Van Doren is pessimistic. If you examine the typical engineering curriculum you will find one reason. If you examine the courses actually taken by most science students not in engineering colleges you will find another. And if most of us look critically at our own training we find yet another.

But, if we find ourselves inadequately trained in areas outside our own particular specialties, we need not despair. By comparison with many of our colleagues we teachers of science are as able as anyone to demonstrate the social values of our respective fields. Do we not utter eloquent pleas when asking for increased appropriations for research? If the social scientists and the philosophers have made real contributions toward the task at hand — and the point could be debated — their efforts have been largely confined

to analyses of the past. They are largely unable to provide us with norms for the present and the future because they are not well enough acquainted with present developments in the special fields and cannot speak with authority about the directions these developments will take in the future. The natural scientist enjoys — in theory at least — a much better vantage point from which to view with perspective the effects of new investigations. This is one reason — and there are others — why the science teacher cannot delegate much of his responsibilities to others. True, he may have to develop some new ways of thinking for which he still considers himself quite unprepared. But, we ask: Who is any better prepared?

But a word of caution is in order. Much as students need insight into problems allied with technological advances, it is a mistake to assume that they will accept ready made answers. But given a chance to do so, most students are eager to discuss the kinds of problems we are suggesting. More often than not, the instructor's task is to keep order, to keep the discussion within bounds and to supply information when asked to do so. Appropriate assembly talks, student forums, science clubs and the like offer excellent opportunities for fostering intelligent interest and participation by students. But the teacher should not occupy the center of the stage unless his judgment is requested. To preach — or to give the appearance of preaching — is to destroy the very interest we are trying to arouse.

The speaker knows of few text and source materials which are very well adapted for stimulating interest in the broader aspects of science although there will be found in the current literature many articles on some specific questions. But lack of suitable charts has never kept the true scientist from crossing new frontiers. If he applies the same imagination to the problems of teaching that he uses in his own individual research there is good reason to suppose that his teaching will broaden and its value to the student will be enhanced.

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