

Physics and the Undergraduate

It is time for those of us teaching physics to undergraduates to reconsider what we are about. In our teaching are we guided primarily by what is professionally rewarding, or are we considering what needs to be done and doing it? What most needs to be done, it seems to me, is to develop in a majority of undergraduates an understanding of our science, its central concepts and characteristic processes, its revolutionary impact and the satisfactions it affords its pursuers.

What we *now* do (with some impressive exceptions) is put almost all our effort into teaching the small minority who major in physics or related sciences. Any dean or department chairman can testify to the negotiating value of an opportunity to teach an upper-class course for majors and the difficulty of getting a faculty member to give serious attention to an undergraduate course that offers little chance to recruit into the profession.

It is certainly legitimate for a profession to perpetuate itself, but it is doubtful that we are pursuing even that limited objective by present teaching emphasis. Flourishing of physics in decades ahead will depend more on public understanding of the value of the enterprise than on competition for undergraduate talent. If physics is to be well supported, we had better put our effort into making its significance understandable lest

it be judged an expensive game for a scientific elite.

If health of both society and the profession demands more effort in teaching physics to the general student, how can we understand our present behavior? Understanding it, how can we change?

It is understandable that we most enjoy doing what we think we do well. Few college teachers feel they are succeeding in attempts to teach physics to students who are not apprentice scientists. It seems more difficult for the physics teacher to convey satisfactions with his work and his view of the integrity of his subject to uncommitted students than for the teacher of art or literature or history. Dissatisfaction with accomplishment (often underlined by the small number of students attracted to offered courses) combined with the lack of recognition usually given to those teaching the general student goes far to account for the small effort in an activity that, in the abstract, is widely acknowledged to be crucially important.

How can we change? If teachers will do what they do well, clearly we must give them the means for successfully reaching and teaching the general student. A first step is to weaken the forces that repel students. A source of repulsion they often cite, but which teachers seldom notice, is drabness of buildings and rooms in which physics is practiced and taught. Let all those anticipating new buildings see that as much attention goes to design as to wiring! Less visible, but more effectively exclusive, is the course sequence that limits the nonmajor to a few introductory courses. Too often the general student who wants to learn about relativity or quantum mechanics has either to take a sequence of four or more physics courses or to study the ideas of these subjects in the philosophy department.

The new physics courses developed during the past ten years are strengthening the attractive forces by providing films, experiments, readings, computer and other activities for high-

school and college students. Especially where attention has been given to affective appeal through good design and variety of style, these new materials can provide the college teacher with many useful tools. But what has been done is just a beginning. For instance, little attention has been given to needs of the upper-class college student. Support of curriculum developments has been based on the narrow view of scientific manpower; little money has gone to work with students who are past the stage of recruitment into science careers. Still ahead lies effective development of possibilities opened by computers for quantitative physics by students with little mathematics.

Perhaps greatest promise is in bringing new people into teaching to work with students outside usual course settings. Young people can gain an understanding of our science by working with physicists who are leading satisfying, exciting lives relevant to modern society. By part-time engagement of physicists who will introduce students to their research and the philosophical and social problems that concern them, colleges can give their students a greater number and variety of models for possible emulation. A second way to acquaint students with scientists is to send the students off campus for one or more periods to participate in scientific work, a system that a few colleges have used successfully for some time. The general student not suited for the laboratory can support other parts of the scientist's work and get a look inside the enterprise.

If these suggestions are valid, they are likely to have cumulative effects. When some not charged with teaching undergraduates take part, others, including the reluctant college teacher, will view the task afresh. Knowledge gained from the students who are thus attracted in can help us do better. Needed now is the input of energy and talent into the important task of making our science accessible in some significant measure to the majority of our undergraduates.

—Albert B. Stewart



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