Says the editorial: "How different is the European situation. . . . ." Probably that is because there is depth already at the bachelor's level so that at the master's level worthwhile achievements become possible. Finally, I must emphasize that the views expressed here are entirely my own personal views.

G. W. Brindley
Pennsylvania State University

High-school learning

In a letter by Alfred A. Kraus Jr (PHYSICS TODAY, November, page 15) the charge is made that in the PSSC-type of high-school physics course, the content is so broad that students skim the top and "merely understand," but do not engage in enough prediction and control. Also the suggestion is made that the high-school physics course be designed to contain certain topics that will be studied in "depth" and omitted from the university physics course. It would seem to me that this suggestion has questionable merit for several reasons:

1. It appears to be based on the premise that physics consists of discrete areas of knowledge that bear little or no relation to each other. In my opinion, one of the biggest improvements in high-school physics (and high-school science in general) in recent years has been the partial obliteration of the classical division lines and, in their place, an emphasis on unity and an attempt at achieving maximum "mileage" from a minimal number of concepts.

2. A more practical problem, perhaps, is that of the students' mathematical background. To teach a topic in sufficient depth to warrant its omission from the university physics course would, I think, presuppose a level of knowledge and skill in the area of mathematics that simply is not attained by the average high-school physics student at the present time.

3. There is also the problem of the terminal high-school student. It has been my experience that the terminal student does not usually take physics, but when he does, he usually does so because he expects to find the course interesting, useful or both as a background for a vocation. As a physics teacher, I would like to see such a student learn as much physics as he can and savor some of its excitement. However, I am not so sure that an in-depth knowledge of, let us say, calorimetry is what he is looking for or what he needs.

The really revolutionary suggestion in the letter I have cited is that university-level physics teachers should recognize the possibility that their students may have learned some physics in high school!

I agree that needless duplication of material is a waste of both the students' and teachers' time. However, methods of avoiding this problem already exist. Many colleges and universities make use of proficiency examinations whereby qualified students can sidestep certain courses. This same approach is used on a larger scale by the College Entrance Examination Board in the Advanced Placement Program in Physics. Such programs merit support not only as a means of increasing efficiency at the college level, but also as a vindication of high-school physics (many high schools are doing an excellent job in the area of teaching physics) and as a step toward a sorely needed rapprochement between high-school and college physics.

Vance L. Huntsinger
Deerfield, Illinois, High School

A REPLY FROM KRAUS: The letter by Huntsinger deserves the following comments:

1. That a course of study should have a defined content does not mean there are no relations between courses. If Huntsinger really believed this, he would resign from any high school that had separate chemistry and physics courses. Yet this attitude is all too prevalent in some PSSC groups. Their postulate would say that a university that offers separate courses in electromagnetism and optics is obviously sinning because the optics instructor would not be permitted to mention the electric and magnetic fields. I think one excellent way to teach optics is to have electromagnet-

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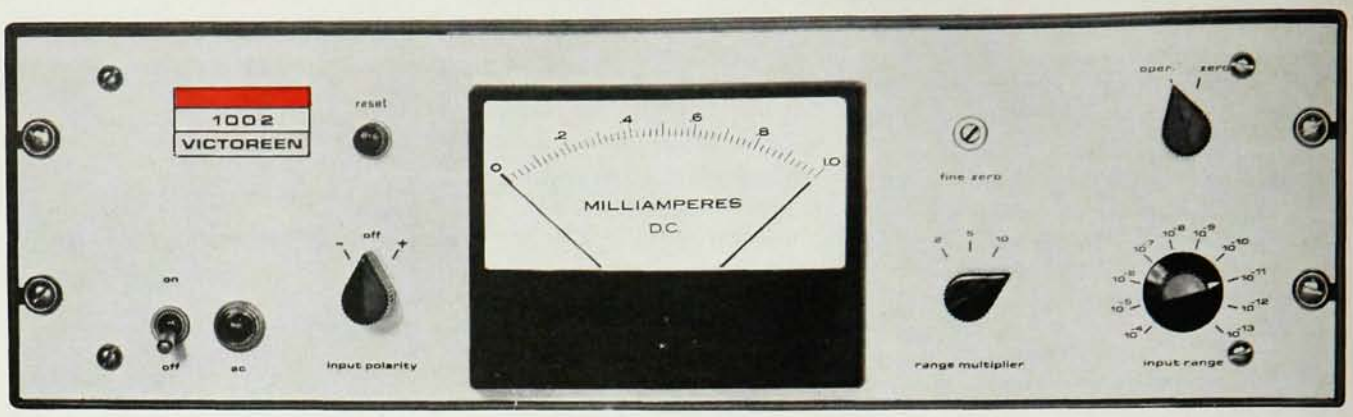

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ism as a prerequisite. But this does not mean that they have to be combined in one course. That is what I am proposing for the high-school physics course. It should be a prerequisite for the college course.

2. What high mathematics is needed for Ohm's law? If the high-school students can't work that and the lens formula, why does the PSSC text introduce them to the differentiation of vectors (page 89)? Since none of the topics mentioned as possible choices requires as much mathematics as the typical noncalculus college courses, it is appropriate to have them mastered in high school. In addition, I suspect the mathematics is frequently learned better if there is an accompanying need for it. I would rather work to increase their mathematical skill than cut down on their depth of understanding in physics.

3. I think elementary calorimetry is more useful and practical than the sum of the particle theory of light, the quadrant electrometer and nuclear scattering (all PSSC topics). Rather, I think, the charge should be that the topics named in my letter are not exciting. Perhaps they are not exciting to the instructor, but I have seldom seen a high-school boy not "existentially involved" with how to determine that his car with x horsepower can get to 60 miles per hour in y seconds. You see, to the instructor it is the same old stuff, but to the student, it might be something he has wanted passionately to know for two years. The attitude of the instructor is much more important than the subject in this matter.

4. I suspect that the situation involving advanced-standing examinations is worse than Huntsinger says. But we do agree that at present any elimination of redundancy is the exception rather than the rule. However it would be interesting to see, in those cases where it is possible for the student to take advantage of a good high-school physics course, just how many of them only let him have the fun of relearning about the coefficient of friction once instead of the normal twice in college. On the other hand, consider what happens when the university gives a three-semester physics course with calculus. Usually for the first semester of the freshman year the student takes only mathematics. Then the physics starts off with velocity as the time derivative of the displacement. Are there any places like this that grant, say, credit for the first of the three semesters because of a good high-school physics course? I doubt that there are more than a very few. If all of this is true, colleges are not taking sufficient advantage of the physics taught in high school.

Alfred A. Kraus Jr
West Texas State University

Where to find values

Your December editorial "New values for old" contains its own most poignant comment: "Just what is wrong with our world we do not know, but we feel it is fundamental, basic, causal." Physicists, as scientists only, can not know what is wrong with our world, nor can we, functioning exclusively as scientists, do anything about it. Science has no means by which to provide the *ought* of personal relationships; it can only tell what is. Science's feeble efforts toward establishing ethical guides have all too often taken the form of identifying what ought to be with what is. The hope that the scientific demonstration of "the order of scientific law, the power of logical thought, the beauty of nature understood" will lead to "new values, new purposes and even new harmony for the world" is as completely chimerical as the hope that the writer so effectively deflates, that scientists can solve all man's problems because of their superior training and mental prowess.

As long as men, and possibly scientists in particular, do not recognize the dimensions of life that lie outside the confines of the scientific discipline, the dimensions of life that determine what men will do with technological advances, then only confusion can result in seeking for answers to the basic "wrongness" of our world. Unless a phenomenon can be described within the framework of space and time, it is not properly within the domain of science. Some scientists have indeed been unable to see why there should