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have no scientific vitality in mathematics today but still have some in physics, and it is much more effective for students to learn them where they are used. What one might ask for is greater coordination between mathematicians teaching "service" courses and other scientists. Here it must be admitted that some mathematicians have rather arrogantly decided that mathematics has no further need for its traditional ties to science: but there are enough remaining with contrary views to carry on the work. However, I suspect it will be necessary that interested nonmathematicians have a much greater sophistication about the present mathematical world.

I have less professional competence to comment on Weinberg's views on high-energy physics, but by emphasizing that the impetus for new expenditures in high-energy physics comes from the universities he has provided a rebuttal to his own argument. American universities are by far the most vital part of American cultural and intellectual life. This may be undesirable in certain fields; it seems to be so in literature. One would wish that the quality of nonuniversity life were much higher. However, especially if one looks at the political alternatives in American intellectual life outside the universities, one may suspect that if a large portion of the relevant university community believes that a program is worthwhile, money is better spent on it than on most of the alternatives. . . .

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Weinberg's paper will help dissipate the smoke screen that obscures the two-way movement of ideas between research, teaching, and social change. . . . But he does not describe the implementing procedures with the degree of specificity necessary to help us move beyond head-nodding agreement with his theme, the dissonance of "the mission-discipline duality." Mathematics contributes to physics, physics to engineering, and engineering to society because someone is active at the interface and doing something to facilitate the transition. Weinberg notes that too few university professors are making this effort, and I believe he is correct and for the reason that he gives ("In the university the specialist and analyst is king"). The literature is peppered with exhortations about these and similar problems, but as teachers we are too often left without guides to the appropriate next steps. . . . With his concept of the scientist as a teacher, Weinberg has his finger on the key, but he is trying to unlock only two academic barriers—curricular purity and disesteem of applied science. I believe a better place to look for the desired change will be in the area of educational technology and especially the development of computer-assisted instructional systems. In making this suggestion I am simply trying to direct the momentum of Weinberg's logic into educational action to illustrate an instructional setting where it might be difficult for the scientist-teacher to bypass his "codifying" and "integrating" functions.

Instructional automation has the potential, at least, of bringing the teaching and researching roles of the university professor closer together. As long as the teacher feels that his primary obligation is to present information to students, he is free to follow this path of least resistance. . . . On the other hand, if the basic information and the descriptive materials were programmed into the computer as a master teaching machine and made available to the student in his automated study carrel, the classroom teacher would be freed to demonstrate the integration of one body of knowledge with another and to discuss the social implications of scientific data, research programs, and areas of investigation (including high-energy physics)—value judgments that the computer cannot handle. . . . Sooner or later the scientist-teacher must accept the explicit requirement to contrast his own presentation with the kind that can be made equally well, or better, via the computer. . . .

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Since the appearance of my article I have received several letters from scientists and teachers engaged in curriculum reform objecting to what they interpret as a blanket indictment on my part of all curriculum reform. I am disturbed by this interpretation of my views, since I qualified my indictment thus: " . . . insofar as the new curricula have been captured by university scientists and mathematicians
of narrowly puristic outlook...I consider them to be dangerous."

I am not familiar with all the new curricula. There are many that do not seem to suffer from these shortcomings, and several, notably the BSCS biology courses, have since been brought to my attention. Nevertheless, I do believe that the considerations I mentioned in my article must be taken seriously by those who have erred in the past and by those who, unless exhorted by conservatives like me, may err in the future. Educating children is a heavy and difficult responsibility—one which those who create new curricula often are unable to assess until it is too late. All of us, scientists and teachers alike, must do our best to help strike a proper balance. I hope that the debate provoked by my article will serve to clarify some of the philosophic issues underlying curricular reform and thus contribute to maintaining the necessary balance.

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Dael Wolfe's editorial "Save the world" (20 Aug., p. 819) calls for an immediate systems analysis of the problems of preserving the quality of life on Earth. He acknowledges the cause of the problems—the population explosion—and notes that governments and the Catholic Church have recognized its seriousness. He says that it must be assumed that we will succeed in stemming population growth.

The assumption is reasonable; but the question is, By what means and at what level will the world population be stabilized? The techniques used for lowering the birth rate are a product of scientific research, and it is not unreasonable to believe that more research will result in more and better techniques. Despite the recommendations of the National Academy of Sciences that research in the control of reproduction be greatly increased, there is, I believe, a remarkable inertia. We have governmental and private research institutes for the study of a great number of exotic diseases, yet to my knowledge we have not a single large, multidisciplinary institute concerned with research in reproductive biochemistry and physiology and the development of mechan-
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