Letters

Research and Education: Restoring the Balance

In his editorial "One-sided criticism of university research" (28 May, p. 1177), Abelson discusses public opinion concerning the effects on teaching of heavy federal support of research. These effects are certainly being felt, and I agree that a cut in federal grants is not a realistic solution. The solutions Abelson offers, however, seem weak to me. He says: "Scientists must cheerfully meet their responsibilities as teachers. University administrators must make it clear that their institutions value good instruction. Federal agencies must align their policies so that support of research in universities contributes to, and does not compete with, the educational function."

The first two statements are wishful thinking. As long as faculty members derive their operating funds directly from the federal government, they are, in effect, employees of the federal government and not of the university. Moreover, as long as they can continue to attract large sums of money to their institutions, administrators will continue to encourage them to do so. Any change toward restoring the professor to his proper role in his university must be initiated by the government. To that end, the granting agencies should make grants to departments instead of to individuals. Those at the local scene who are better informed about local situations would then make the necessary evaluations of faculty that are now being made by the granting agencies.

One result of the present system is that the lure of federal funds often distracts the younger faculty member from the classroom and laboratory into weeks of proposal writing. What is even worse, if his work is not along popular lines, he may be led into areas away from his main interest.

Another frequent result of grants to individuals is the large research group. It is not uncommon to find 20 graduate students under the supervision of one professor. The proper training of such a number is virtually impossible, not to mention undergraduate teaching and other professional duties. If the practice of granting funds to individuals were to a great extent replaced by grants to departments, the faculty member could again be a professor for the university and not an administrator for the granting agency.

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. . . There is no question that research and teaching can—nay, must—coexist in the modern university and that one-sided criticism of the two endeavors is, as Abelson warned, potentially destructive. It is my fervent hope that all administrators of academic research and university teaching will heed his admonition that "research in universities [must] contribute to, and [must] not compete with, the primary educational function." Only the restoration of true balance can stave off increased criticism and legislative repercussions.

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Mathematics vs. Numerical Analysis

In his article "Numerical analysis vs. mathematics" (23 Apr., p. 473), R. W. Hamming makes an attack upon "mathematical numerical analysis," by which he presumably means the attempt by mathematical techniques to solve general problems in numerical analysis. The reductionist line of argument which he puts forward demands that the concepts and techniques of theoretical science should be tied hand and foot to the technological practice of the moment, conceived in the narrowest possible sense. If this argument were to be taken seriously, it would have a devastating effect upon the development and fruitfulness of all theoretical work in science.

What concerns us even more is that Hamming bases his argument upon a critique of mathematics as a whole, which he expresses in the following form:

> Generally speaking, in the early history of mathematics long experience in the real world preceded both the abstraction of the postulates and the formulation of the definitions of geometry, and subsequent experience has validated their general usefulness. Thus early mathematics tended to follow the classical test of science, the regular (though not exclusive) appeal to observations in the real world. But it is difficult to imagine how by appeal to observations many of the postulates of current mathematics could either be verified or shown to be unsuitable, and one can only conclude that much of modern mathematics is not related to science but rather appears to be more closely related to the famous scholastic arguing of the Middle Ages.

It is our view that Hamming seriously misconceives the nature of mathematics and its role in the scientific enterprise. Mathematics is the science of structure. Where intuition and unanalyzed experience indicate the existence of common structural features in a number of varying contexts, it is the task of mathematics to formulate these basic structural features in a precise and objective form. The mathematician *abstracts* from other variant and irrelevant features of these contexts in order to focus on these basic relations, and then must ask (and find out) what consequences follow from the basic relations alone. In its baldest form, this is the so-called axiomatic method, and one must always remark that the justification of a system of axioms lies in what can be proved from them, in what insights of a significant kind they furnish about the context from which the axioms sprang. These contexts need not be, and most often are not, systems of material objects, passively observed, but rather acts and processes: the act of counting for arithmetic, the acts of measuring and drawing figures for geometry, the act of finding roots of polynomials for algebra, and so on. Once crystallized in a definite form and proved fruitful, the acts and processes and objective difficulties of a mathematical theory may provide the context for the creation of a new mathematical theory on a higher level