Cost-Research Differential

In his editorial for 22 April Wolfle discussed a recent report showing that expenditure on research has increased faster than research effort itself. Along with the inflationary influences Wolfle mentioned as causes of this differential, the fall-off in research productivity per dollar spent may be due in part also to the diluent effect of the so-called "information explosion," a natural consequence of the intensive recent work in some of the newer (or more fashionable) sciences. This effect can be described mathematically in a crude way as follows:

When an individual (or a team) sets about to do a piece of research, he has available to him a body of knowledge, x, pertinent to his field, of which some fraction, r, will be found to be helpful in the work; in other words, the larger the product, rx, the faster will the job progress. On the other hand, the larger x is, the longer it will take to sift it through in order to uncover the useful portion. Thus the time, t, required to complete the job can be written:

$$t = f_1(rx) + f_2(x) \qquad (1)$$

where f_1 is a decreasing function and f_2 an increasing function. Depending on the nature of these functions, there may be a value of x that brings about a minimum time for accomplishment, which would of course occur when:

$$(d/dx)\ [f_1(rx) + f_2(x)] = 0 \qquad (2)$$

We may now have passed this saddle-point in certain of the very active new sciences and should not therefore be surprised to see a drop in productivity. The increasing ratio of "support personnel" to "professionals" in research establishments seems to reflect this. More peons are needed to turn the sifters!

It should also be noted that under these circumstances it does not always pay to make an exhaustive search of existing knowledge, especially when the object is to get results quickly, not to compile an impressive bibliography. In effect the search is then restricted to some smaller sample, so as to approach the condition of Eq. 2. It often takes less time to do it all over again than to find out how someone else did it earlier. This is, in fact, common practice in industrial research, ordinarily conducted for internal application. Unfortunately, the result is that often very original findings lie buried in company files for years, simply because no one wants to bother with the documentation required to meet the punctilios of formal publication.

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Integration and Confrontation

Luther Carter's "Integration: Negro college hires an impatient Briton" (News and Comment, 22 April) exposes many of the problems of the Negro college striving to meet the uncertain demands of integration and to maintain a prominent place in a changing society. It is clear that as integration of Negro colleges progresses there will be many incisive observers chronicling these events and that one of the major "losses" will be the cloak of anonymity in regard to standards, practices, and scientific approach which cultural exclusion has provided. It is probably not necessary to choose sides over the specific activities of the Hodkinsons—black and white—who choose to be the focal points and spark plugs of social change, but it is necessary to choose sides over the question of the need to get on with the process of confrontation per se. That the larger scientific community chooses to be aware of and involved in the problems of this important but neglected part of the educational system bodes well for the future.

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Research Administrators, Government and University

Professor Easton West travels to Washington once every three months, where he serves on a national panel which identifies fruitful areas for research support in his field and decides on allocation of research grants to his colleagues in major universities of the nation. He communicates effectively and frequently with the responsible officers in his field at NSF, NIH, ONR, AEC, and NASA; they rely on his scientific judgment, he trusts their judgment on overall budgetary and interagency matters, and they discuss long-range plans with mutual respect if not always with agreement. Professor West begrudges the time away from his laboratory; but he has come to consider the two days per quarter he spends in Washington as an important contribution to his field and to education generally and, on the whole, a rewarding investment of time.

Meanwhile, back at the University, Professor West has watched his field of research evolve and has become increasingly aware that the structure of courses and departments in his field is badly out of date and that the relative emphasis given to undergraduate, graduate, and postdoctoral training is inappropriate. He concludes that certain courses should be revised, new laboratories built, new research and teaching appointments made in his department and in a related department. He assumes that the University administration shares his sensitivity to the changing scientific and governmental environment and is as anxious as he is to increase the University's effectiveness in teaching, research, and public service. Professor West therefore seeks out the university administrators who are likely to be concerned with his suggested changes: several deans and vice presidents, the comptroller, the coordinator of research, the business manager, the director of the physical plant, and the campus architect. Professor West realizes that the issue he presents to the administration is difficult, demanding choices between competing fields and the exercise of discriminating judgment. However, in the administrative labyrinth, he encounters little understanding of the problems which seem to him important and little of the strongly motivated search for new solutions which is characteristic of many of the key administrators he knows in Washington. He is thoroughly frustrated and concludes that the University administration is not equipped to cope with problems having a high technical content.

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This parable of contrasts illustrates a situation which exists at very many universities. Two aspects may be recognized. First, the size and complexity of the university has outgrown the system of academic deans which was created in simpler days to manage a relatively homogeneous group of scholars and scientists in a small number of stable fields. Academic administrators now seldom make the most crucial decisions affecting the active academic fields. They are fully occupied with a myriad of matters of greater immedi-