tinuity of circuit logic from 1937 down to the present time, it seems that the early "relay" computers should be included among the pioneers.

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Industry Does Retrieve Information

Fry has presented an interesting mathematical expression for the relationships of information and research (Letters, 24 June). He states: "It often takes less time to do it all over again than to find out how someone did it earlier. This is, in fact, common practice in industrial research. . . ." This is far from the case in the pharmaceutical industry. The economic consequence of spending millions of dollars on a new product, only to learn that it is unpatentable because of the existence of prior art, would be so disastrous that no research group in their right minds would knowingly take such risks. In fact, we devote considerable time and expert attention to literature searching and, from personal experience in both academic and industrial spheres, I would say that the literature is searched more broadly and in greater depth in industry than in the academic world.

In part the difference in searching efficiency in industry is due to the large files that can be searched by computer, particularly in the patent area. Any deficiencies in our literature searching performance are certainly not due to lack of trying.

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New Channels for Grants

Recent discussions about the merits of project research grants over institutional grants have failed to mention one remedy that would overcome the disadvantages of institutional grants. As Gross points out (Letters, 6 May), senior administrators of institutional grants are tempted to divert most of the awarded funds to projects which happen to interest them. Though usually retired from active investigation, they continue naturally to have their favorite ideas about what is important to investigate. They are, moreover, under other pressures to build up this or that department or project in order to please or appease critics of their institutions.

The remedy which I propose resembles a water irrigation system. In such a system, each sluice gate diverts water while allowing other water to pass on to a lower level. In application of this principle, let us imagine agency A capable of disposing of so many funds for research. Suppose that this agency divides its funds into two portions. One portion will continue to support project grants directly applied for by the individual investigators or teams; the other will be awarded to institutions directly. Institution X (for example, a School of Engineering or Medicine), then receives a substantial grant as its share of the funds devoted to institutional grants. Of this institutional grant, the dean (and his associated committee, if he has one), can retain half, but must pass on the other half to the chairmen of the different departments of the benefited school. The chairmen in turn can use half of what they receive, as they see fit, but again must disperse the other half to any applying investigator within the department. If a chairman found no individual applicant within his department, these funds would revert to the next higher level, the dean's committee. This would stimulate the chairman to find and appoint applicants likely to use the funds.

A method such as this would assure original individual investigators of some support in spite of opposition from senior committee members of the institution. At the same time, it would preserve the privileges and responsibilities of administrators in retaining control of major portions of funds. We all know the familiar predicament of original investigators whose applications for funds have been frustrated for years both by local committees at their institutions and national committees of fund-granting agencies. The local committees are usually composed of persons outside the investigator's specialty who are not in a position to judge the value of an investigator's project or his abilities. But the outside committees, composed of scientists in the same field, often include many persons who have drifted out of active investigation themselves, while enjoying committee life. These persons often have clear ideas of where the next advances in their fields will come from and may prove equally frustrating to the origi-

nal investigator when he applies for funds. Such a man needs some protection from the general conservatism of all committees. At the same time, the taxpayers or other fund-givers are entitled to some protection against waste and wildness, which protection could be provided by allowing administrators to retain control over some, but not all, the funds passing through their hands.

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On Using Inferential Statistics

Statistical tools are of two general kinds: descriptive and inferential. The first type describes the investigator's findings, summarizing raw data into more comprehensible form—numerical, graphic, or tabular. The second type aids the drawing of conclusions as based on the rules of probability.

Findings may be the result of chance fluctuations. An investigator contributes more when he indicates the degree of confidence he has that his data are not the result of chance factors. The use of inferential statistics specifies precisely this degree of confidence. In addition, readers are helped immensely when data are presented clearly. The appropriate use of inferential concepts frequently clarifies data presentation as well as legitimate conclusions.

In the 22 April issue of *Science* there were 23 reports. Of these, only four used inferential statistics. In two of these four, no statistically significant findings were reported. In a third report, over 20 statistical tests were performed but only one was significant, and this one was relatively unimportant, since the main findings of the authors (Greenberg, Atkins, and Schiffer) was the lack of significant difference in the measures of various bodily regions.

Perhaps the more critical observation is the following: of the 23 reports, 13 could have used inferential statistics—only four did. How "significant" these observations are is a matter for the reader to judge.

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