it this way, too. And China will lose interest in killing foreigners as its romantic willingness to sacrifice Chinese lives diminishes.)

In a paper (unclassified but unpublished) on integral, quick-access, multi-use shelters in new buildings, Richard I. Condit, of Stanford Research Institute, once warned that the shelter portion should be the only truly hardened part of a building, and that nothing else in the city should be hardened; an attacker should be given no incentive for increasing the intensity of his attack. Condit hypothesizes that the attacker would tend to be economical and would be willing to allow people to survive if he could deprive them of their city (and the power and wealth it embodies). I think he correctly assumes that destruction of wealth and power rather than life would be the main conscious and unconscious motivation of the attacker.

Unless it can be proved that nuclear attacks would be launched only by implacable fanatics intent on wiping out entire populations (and intent on little or nothing else, ever) some level of civil defense high enough to make a real difference looks like a prudent investment. Even very high levels are not really provocative, since an American shelter cannot kill a single Russian or knock out a single factory, missile silo, railroad yard, or harbor.

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The Grant System

The system of individual project awards made on the basis of scientific merit after careful evaluation by panels of experts recruited from across the country has been a large factor in establishing the high quality of science in our larger centers and in the steadily rising standards in smaller, outlying institutions. The success of this system has been widely acknowledged (see the remarks of Monod in Report from Europe, *Science*, 19 Nov. 1965).

Don K. Price (21 Jan., p. 285) and D. S. Greenberg (*Harpers*, Jan. 1966) pinpoint this as the key issue in the current effort to substitute large institutional grants for individual project awards. The issue is put squarely by Price: "But as the government broadens the basis on which it gives support to universities and begins to make much broader grants for institutional or program support, the scientific ability of particular investigators becomes proportionally less important and more importance attaches to a vast range of subjects on which the specialized scientific knowledge of an advisory panel is much less decisive." He goes on, "It would be positively to the advantage of the universities, I believe, if their own members did not have so predominant an influence in making of grants to them, and if the government should rely a great deal more on a career government service of high quality." The practical development of this point would be the award of large bulk sums to individual institutions and the eventual elimination of direct support of talented individuals.

In my opinion the hazards and losses in assigning to institutions nearly total control of their research funds are much greater than those of the present system. We already have an example of the possibilities. The Sloan-Kettering Institute has been awarded a lump sum of $4.3 million dollars, 47 percent of its research budget, replacing individual support for 52 projects. This will, in the words of the New York *Times* (12 Jan.), "with very few restrictions enable the recipient institution to use the funds from the so-called 'single instrument' grant as it sees fit. For example, it could use money originally ear-marked for a slow moving program for the swift expansion of research on a 'breakthrough.' In effect, this method expresses support for an institution's total research program, a spokesman for the Public Health Service said in a telephone interview."

The basic problem seems to be a failure to recognize that nearly all important advances in knowledge come initially from individuals with good ideas and not from the planned exploitation of problems selected by career administrators. The very purpose of the scientific endeavor is lost in the concern for efficiency and quick returns and a politically satisfying distribution of funds. In general, scientists are working to obtain new knowledge of ultimate use to mankind. If this goal is important, then we should be giving our greatest support to the most competent and creative individuals. Who is better prepared to make the judgment of competence than other scientists? What criteria other than scientific merit should take precedence?

The study sections and advisory panels of the National Institutes of Health and the National Science Foundation provide scientists with a critical review by a broadly selected (and rotating) group of their peers who are not subject to the pressures of local politics and who have the opportunity and experience of comparing applications from all over the country. A grant application approved by an advisory panel in Washington is an important vote of confidence; disapproval should give the applicant serious cause for soul-searching. Certainly there are mistakes, but, in my judgment, far fewer than would be made by local review. Allocation of research funds within an institution is much more likely to perpetuate mediocrity and incompetence; recognition of new ideas or far-sighted proposals may be much more infrequent.

There is much merit in having panels of experts well informed on the advanced thinking of the scientific community as expressed in grant applications. In the long run, the good that is done by having these open lines of communication far outweighs any possible damage to the private enterprise of idea ownership. There is also, via this route, considerable dissemination of knowledge about investigators, young and old. There is great revenue in cross-fertilization. Moreover. the large numbers of working scientists coming to Washington to serve on study sections maintain a flow of information and personal contact with government officials that is necessary for mutual understanding and cooperation. . . .

The present project-award system may not lend itself too well to the development of new schools and departments. This problem could be handled by a separate system of institutional and departmental grants-in-aid. Similarly, funds for regular teaching could come from separate sources. For older and established institutions, the general research-support grant contributes to flexibility; it should not, however, be enlarged to replace project support to individuals.

Critical periodic evaluation of the individual on the basis of scientific merit by a distant, semi-anonymous panel of peers is a source of strength to institutions. The frequently expressed danger of loss of loyalty or control of grantees should hardly be a problem if the institution maintains control over the initiation of research applications and over hiring, firing, and the allocation of space.

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The Exclusive "Graduate" Course in Advanced-Degree Programs

One of the criteria used by accrediting committees when evaluating graduate programs at universities strikes me as being trivial but pernicious. It is the distinction between "graduate courses" and "senior-level courses carrying graduate credit." In my opinion, the only valid case for herding graduate students together and excluding the undergraduates is that graduate enrollments may be so large that it is inconvenient to enroll undergraduates in the same classes. Many accrediting committees gather data on the proportion of "graduate" courses in an advanced-degree program, implying that this proportion gives an indication of the quality of the program. Consequently, many institutions aspiring to higher levels of graduate work will, under pressure of this criterion, proliferate "graduate" courses for which prospective enrollment is prohibitively small. Recently I encountered a situation in which this criterion was carried to its extreme. A college was expanding its courses at the master's degree level and was hoping to offer doctoral programs in the not-too-distant future. In the interest of insuring "excellence" as it is judged by accrediting committees, the graduate council had adopted the following criteria: All the courses for the master's degree would be at the 500 and 600 level. The 500-level courses would be open to "qualified seniors" (not all seniors), and 20 percent of the credit for the master's degree could be earned at this level. The 600-level courses would be closed to all undergraduates, and 80 percent of the credit toward the master's degree would have to be earned in such courses. All the departments at this college are overburdened with the task of preparing 500- and 600-level courses in which enrollments during the foreseeable future will be of the order of 1 to 3 students per course.

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