

# APPENDIX F

## CRITERIA FOR THE SUPPORT OF RESEARCH BY THE NATIONAL SCIENCE FOUNDATION

*As Approved by the National Science Board  
at its Seventeenth Annual (112th) Meeting,  
May 18-19, 1967*

In order to make explicit the policies of the National Science Foundation concerning the support of research in educational institutions and in national centers, the National Science Board has adopted the following statement. It is intended as a clarification and reaffirmation of the general philosophy that has guided the Foundation since its establishment and which, the Board believes, properly implements the intent of the Act which created the National Science Foundation. The statement will serve as a guide to the staff and to the advisory groups which assist the Foundation in these endeavors. It is presented as a service to the scientific community and for the consideration of other bodies and administrators responsible for the support and conduct of scientific research.

The cultivation of science, the arts and the humanities has been accepted by the executive branch and by the Congress of the United States as an appropriate function of Government, in the conviction that such a course will lead to a more rich and meaningful life for our people. Concomitantly, the contribution of fundamental research to the development of the new technologies essential to the attainment of our national goals has become ever more evident, while the need for understanding the behavior of individual humans and their social groupings has never been more imperative.

In fostering the cultivation of the natural and social sciences, the Federal Government shares responsibility with individual citizens, private foundations, industry, local and State governments, as well as the universities. For most of the agencies through which the Government conducts and supports scientific research the cultivation of sciences, per se, is not a primary objective even though, in the pursuit of their specific missions, they find it necessary and appropriate to support fundamental investigations in academic institutions and elsewhere. As delineated in the National Science Foundation Act of 1950, however, the furthering of basic research is, itself, part of the specific mission of the National Science Foundation. Moreover, the Foundation is unique among all Federal agencies which support scientific research in that it must also be continually concerned with the nature and quality of education in all aspects of science and at all academic levels from grade through graduate school. Accordingly, the welfare and development of the institutions within which research and science education are conducted are also major considerations in the Foundation's programs and planning.

Basic research in universities is primarily motivated by curiosity concerning the nature of man and his environment. It is, in short, part of man's never ending quest for new knowledge and understanding; and participation in such research is an essential aspect of the training of young scientists. It insures continuity in the exploration of the frontiers of science and it gives assurance that competent scientists will be available to support the Nation's goals in education and in the development of science-related technology. Only infrequently can support of research

which is thus motivated be justified by certain anticipation of a defined application. But the history of science provides striking instances of the development of technology in which the essential contribution was knowledge which had been attained by such investigations. The successful damping of what would otherwise probably have been major oscillations in the national economy further testifies to the eminent practicality of fundamental studies. It is the judgment of history, therefore, that the national enterprise is best furthered by encouraging each field of the natural and social sciences to develop in accordance with its own intellectual needs and potentialities while encouraging each individual scientist engaged in fundamental research to select the subject matter of his investigation in accordance with the structure and developing opportunities of his own field.

The National Science Foundation has developed a variety of programs in support of research, each of which was designed to meet specific requirements. Among these may be noted:

- (1) A broad program of support of the research projects of individual scientists, most of whom are members of university faculties.
- (2) (a) National centers have been established to make possible research by university and other scientists in fields such as radio and optical astronomy and the atmospheric sciences where very large and expensive equipment is required.  
(b) Large ventures in which success is conditioned upon skillful management of logistical support and interdigitation of the activities of otherwise independent investigators, as in the Antarctic, are identified, funded and managed as coherent national programs.
- (3) To encourage development of additional scientific strength at academic centers throughout the Nation, so that the opportunities available to our people will be enhanced wherever they may live, the Foundation has begun to provide support for planned development of universities and colleges, matched to their potential as judged by qualified scientists and administrators. As these developments succeed, additional scientists qualified to advance the Nation's purposes in science and technology will emerge, thus engendering a requirement for additional support of academic research in the new centers of excellence.

There are two principal measures of the effectiveness of the Nation's effort in basic research:

- (1) The total undertaking must add significantly to the knowledge and understanding that is part of our cultural heritage. In the long run, this will also contribute to the development of new technology and to solution of the major problems of our society.

- (2) It must provide a setting in which students are stimulated and trained to carry on the great tradition of the scientific search and produce scientifically trained manpower in numbers adequate for the Nation's many requirements.

Since the support of basic research by other Federal agencies must be pursued within a framework consonant with their missions, it is the obligation of the National Science Foundation to manage its research programs in such a way as to permit the development of science along lines dictated by the internal needs of science itself. However, total Federal support for science, the sum of the programs of all agencies so engaged, should be so balanced as to assure the continuing development of science essential to our national purpose.

Before considering the criteria which should apply in selecting among research proposals for Federal support, it is useful to classify the types of institutions within which research is conducted, since somewhat different criteria appear to be appropriate among them. The categorization below encompasses virtually all research institutions, of which one major category is usually considered inappropriate for support by the National Science Foundation.

## **CLASSIFICATION OF INSTITUTIONS IN WHICH RESEARCH IS CONDUCTED**

**CATEGORY I: Academic Institutions.**

**CATEGORY II: National Centers and Fundamental Research Institutes.**

**CATEGORY III. Nonacademic Mission-oriented Institutions.**

**I. Academic Institutions** comprise institutions, or those parts thereof, in which research is intimately related to the process of undergraduate, graduate or postdoctoral education. (Postdoctoral education is the further training of young investigators who are on short-term appointments.) This category coincides approximately with the classification entitled "Educational Institutions Proper" used by the National Science Foundation in compilations of statistics. Separately organized research centers, even when operated by a university, should be considered to be in category III if they are primarily mission-oriented or in category II if they are primarily dedicated to pure science. In some cases, distinction between categories I and II will be difficult, but since the criteria for research support in institutions of categories I and II differ only slightly precise drawing of this line is not of major significance. Research in institutions of category II frequently includes a large component of "big science" and usually involves a higher ratio of support personnel to independent scientists than in institutions of category I.

**II. National Centers and Fundamental Research Institutes** are institutions whose objectives are largely defined in terms of fundamental

scientific research accomplishments rather than the development of new technology or other societally determined purpose. In this sense they are intermediate between institutions of category I and those of category III since their objectives are neither educational nor technological but scientific. Such institutions divide themselves into two types: (a) Private or public research institutes devoted largely to research; and (b) research institutes, such as the national centers supported by the National Science Foundation, in which education and/or service to academic user groups are primary or major secondary objectives. There is no sharp separation between these subcategories; research institutes have often tended later to develop a strong secondary commitment to advanced training and occasionally have evolved into universities. The National Science Foundation should deliberately give priority in its support to those research institutes or national centers with strong secondary commitments to education or to utilization of their facilities by academic users.

**III. Nonacademic Mission-oriented Institutions** are primarily concerned with the development of technology or contribution to some major problem of society rather than with education or the advancement of science, per se. This category includes most industrial laboratories, Government laboratories and mission-oriented Federal contract research centers (whether operated by industry or universities) as well as many nonprofit research institutes. The mission may be either quite specific or rather general, serving diverse technical needs of an agency. Some national centers include subdivisions which may be regarded as in category II while others, more properly, should be assigned to category III, with little interaction between them. In these instances, it will be useful to consider support of activities within these subdivisions as if they were independent institutions. In category III also may be included those nonprofit research institutes which engage in diverse research areas according to the needs of the clients, including the Government, who utilize their services.

To be sure, laboratories in category III frequently engage substantially in fundamental research which is indistinguishable in character from that in institutions of categories I and II. The present distinction arises from the fact that this research is conducted in a technological environment and is motivated, in part, by scientific necessities perceived within that environment. Decisions concerning the fraction of the total effort of such a laboratory which should be devoted to fundamental investigations are the responsibility of the management of the institution and will reflect the long-range responsibilities of the laboratory and the total funds available to it. The total allocation to an institution must be established by higher authority after considering the long-range importance of its mission and its success in accomplishing it. Although the quality of the fundamental research performed in a mission-oriented institution is an important factor in its achieving its other objectives, it cannot be the

primary justification for funding. Detailed criteria applicable to the support of research in institutions in this category are not presented, since they receive little support from the National Science Foundation.

## CRITERIA FOR RESEARCH SUPPORT

### Institutions of Category I

The financing of academic research should bear some rational relation to the magnitude of the national educational enterprise. Planning for support of research in colleges and universities should be consistent with other forms of support for related educational activities, both Federal and non-Federal, including fellowships, traineeships, construction of facilities, development grants, etc. *The total constellation of support should permit appropriate research experience for all qualified students and faculty.* This policy implies significant, original research experience for all graduate students capable of advancing to the Ph.D. level, as well as some research experience for highly talented undergraduates. Because graduate enrollment as a fraction of total college and university enrollment is growing, and because graduate training, including its research component, is intrinsically more expensive than is undergraduate instruction, the growth rate of support of research in institutions of category I may reasonably be expected to exceed that of total expenditures for higher education.

The particular strength of academic research should lie in its individualistic character and its relative freedom from constraints outside the intellectual structure of science itself. To be sure, not all academic research need necessarily be of this character, but it should be predominant; nor is it implied that such individualistic research should be confined to academic institutions. Nevertheless, the criteria for support of academic research, especially by the National Science Foundation, should stress the merit of individual research projects, whether these are selected by external committees of peers, internally within the academic institution, or by some other mechanism. This assessment of merit should include consideration of the following questions:

- (1) What is the promise of significant scientific results from the proposed project? What is the past record of performance of the investigators who will do the work and their potential for future accomplishment as estimated by colleagues or peers? Here, the term "significant" may refer either to intrinsic scientific interest or to potential application, or both, but it does imply some fundamentality and generalizability.
- (2) What is the potential scientific impact of the proposed work? How is the information sought likely to influence other workers in the same field, in related fields, or even distant fields?

- (3) To what extent does the proposed work open a new field, exploit novel techniques, or provide a critical test of current theory or understanding? What is the degree of novelty, originality, or uniqueness involved?
- (4) What is the educational value of the proposed research, as judged by the number and quality of students or other temporary colleagues involved, the record of past success of students of the principal investigator, and the general impact of the research on the academic environment in which it is to be performed? How is the work likely to influence science through the subsequent career patterns of the scientists trained under the proposed program?
- (5) What is the relevance of the proposed work to potential applications? To what degree might it contribute toward assessing future technological capabilities? This criterion is, of course, more relevant in the case of engineering research than in other programs of the National Science Foundation. But the question deserves consideration and might, on rare occasions, serve as a criterion for preferring a project which is not markedly superior in scientific merit to others near the cutoff line for support.

### **Institutions of Category II**

Largely because institutions of category II are generally funded by block-grant support, they may confront the National Science Foundation with three types of program choices:

- (1) The most important decision is the determination to create a new research institution.
- (2) More frequent are decisions to augment the facilities or the programs of national centers already in existence.
- (3) Occasionally there may arise necessity for a decision to phase out, or transfer elsewhere, programs already in being in such centers when it appears that they are no longer appropriate.

The questions listed below are applicable, in some measure, to each of these types of decision and should be regarded as a constellation of criteria whose relative weight and applicability must, inevitably, involve a considerable element of subjective judgement. Failure to meet some of the criteria would not necessarily imply a negative decision, but all of the questions listed are appropriate for discussion preliminary to formulation of program judgments.

- (1) Does the laboratory meet a real scientific need and an opportunity to attack important problems in a way, or on a scale, not otherwise feasible or promising? Is there a broad mission which is sufficiently specific to offer a continuing challenge to the laboratory with consequent assurance of high scientific productivity over an extended period? Have the requirements for continued evolution

of capabilities and facilities been given adequate consideration in preliminary planning?

- (2) Is there and will there continue to be a significant number of first-class scientists (as judged by their peers) who believe deeply in the proposed program and are willing to stake their personal scientific reputations on its success, including direct involvement in the program on both a full-time and a long-term basis?
- (3) Are there convincing arguments that the program objectives can better be achieved through the organization of a new program at a national center than through existing academic or other research institutions? To what degree would the new capability under consideration be unique on a national basis?
- (4) Will the center or its programs strengthen or detract from related work in the universities? Will the center provide new research opportunities for academic and other scientists? Is there assurance that user scientists will be accepted into the facility primarily on the basis of the scientific merit of their projects?
- (5) What contributions will the work of the laboratory make to the training of future scientists and/or technologists, including the training of future potential faculty members and industrial investigators as well as students generally? Will the laboratory foster transfer of new basic research techniques into technology and into other areas of science?
- (6) What impact is the work of the laboratory likely to have on other areas of science?
- (7) To what degree may tangible social benefits ultimately emerge from the work of the laboratory? The ultimate social benefits of fundamental research are extremely difficult to foresee; hence, significant fundamental research programs should not be rejected because of inability to apply this criterion in a meaningful manner. By the same token, proposals for major programs which argue their cause on the basis of intrinsically dubious forecasts of social benefits require the most careful evaluation.

Application of these criteria will constitute no major departure from current practice. It is hoped that their explicit statement may be of some service.