amplitudes and those calculated on the basis of a proposed structure: $R = 100\ (\Sigma||F_{obs}| - |F_{calc}||)/\Sigma|F_{obs}|$. For structures refined on the basis of visually estimated intensity data, R generally ranges between about 8 to 30 percent, depending on how thorough the refinement is and, of course, on the accuracy of the data. In more recent structure refinements based on diffractometer data, the values of R achieved are usually less than 10 percent and may be as low as 2 percent.

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Academic Research in Germany: A New Support Program

National interest, university welfare, and research needs are combined in one program.

Bernard R. Stein

An important shift in the thinking governing the support of academic research in the Federal Republic of Germany was revealed in a report issued in July 1967 by the *Wissenschaftsrat* (Science Council), a major governmental advisory group (*1*). The report, dealing with the planned expansion of the universities until 1970, recommended establishment of a *Sonderforschungsbereiche* (special research areas) program to support the formation of cooperative, multidisciplinary research efforts. Such efforts, although located within universities, would also provide for the involvement of individuals and groups outside the academic community. Three criteria would determine the selection of any special research area: intellectual or scientific merit, university considerations, and the national interest. The group or groups identified with each criterion would participate in the decisions.

In July 1967 the *Deutsche Forschungsgemeinschaft* (German Research Association), the principal national organization responsible for the support of academic research, agreed to advise the Science Council on the selection of special research areas proposals and manage the operations of the program. Details on proposal submission and selection procedures, implementation and financial arrangements, and the first list of approved research areas were revealed in a document issued by the Science Council in July 1968 (*2*). The list contains 141 areas divided among seven categories as follows: disciplines of the philosophical faculties, 8; regional area studies, 11; law, economics, and social sciences, 10; general and dental medicine, 35; mathematics and natural sciences, 37; veterinary medicine, 4; and engineering and architecture, 36. Among the 18 areas already funded at a total cost of slightly more than $1 million are the following: Southeast Asia research (Heidelberg), synoptic meteorology (Berlin), molecular basis of development (Freiburg), and medical statistics and documentation (Mainz) (*3*).

Proposal Submission and Selection Procedures

Under the research areas program a group of university researchers may submit a collective research proposal to the principal university decision-making body. In most cases this will probably be the senate or one of its authorized committees. Those proposals which are approved are then forwarded for comment to the appropriate state ministry of education (*Kultusministerium*), the agency which bears primary responsibility for the welfare of the university. In the Federal Republic there is no federal ministry of education, the education function having been assigned to the eleven Länder or states in the postwar settlement (*4*). The proposals are then submitted to the Science Council which routes them to the *Deutsche Forschungsgemeinschaft*, the German equivalent of the U.S. National Science Foundation, for review and evaluation according to guidelines established by the former. This evaluation, prepared with the help of the most competent scholars, carries great weight in the final decisions made by the Science Council. The Council may reject a favorable recommendation by the German Research Association, but may not, on its own, list any proposal for a special research area not previously approved by the Research Association or the appropriate state ministry of education.

Although the principal initiative for proposing a special area lies with the universities, the federal government, individual states, the Max Planck Society, and the Research Association may also recommend candidate proposals. Each must be submitted to the Science Council accompanied by a statement identifying goals and, if possible, specifying the university and the particular groups considered most appropriate to undertake the research. Following discussion by the Science Council, the proposal will be examined by the appropriate Association committee, and, if approved, the suggested university and respective state ministry of education are invited to present their views. If all parties agree that the proposal is in their interest, a formal application may be submitted and processed in accordance with the above procedure.

Only those special research areas appearing on the Science Council list may be considered for support from special federal and state funds. On the basis of research area priorities established by the Science Council with the aid of the Research Association, the universities are invited to submit requests for funds. Funding decisions are then made by a Research Association committee specifically constituted for this purpose.

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Rationale and Goals

The establishment of the special research areas program points up the urgent concern of the Science Council toward academic research. In its 1967 report the Council, a group similar to the U.S. National Science Board, gave its view of research as follows: "In the wake of continuously expanding specialization, modern research is increasingly characterized by cooperation and rising personnel and material costs. It is apparent that under these conditions the limitations placed upon opportunities and funds dictate the concentration of resources" (*1*, p. 126). The Council continued by pointing out the necessity of creating alliances between universities and other research organizations.

With the expansion of university responsibilities and activities the Science Council fears that the progressive fragmentation of research efforts may lead to a situation in which interdisciplinary research increasingly becomes the concern of organizations outside the university. To prevent this, it believes that conditions must be created which make possible the establishment of larger and more efficient research efforts. The Science Council recognizes that such action carries certain risks for the academic community, for "the establishment of special research areas introduces a division of labor among the universities forcing them and their individual faculties, respectively, to concentrate on specific areas. The consequences [of such actions] must, in turn, lead to a restructuring of faculties following the pattern of the research orientations chosen" (*1*, p. 127). Thus while commitment to a special area, such as oceanography, by a university, may carry with it the expansion of that particular area and neighboring disciplines, at the same time the university will most likely have to reduce expansion in other areas.

The Science Council also acknowledges the difficulty of reconciling the present nature of research with the desirability of maintaining a large and varied body of disciplines at each and every university. The expansion of knowledge and the demands for research resources make it increasingly doubtful that the existing range and depth of disciplinary offerings can be continued. The Science Council feels that great care must be taken to balance the demands of teaching with those of research if both students and research are not to suffer.

The Science Council states the aims of the special research areas program as follows: (i) concentration of resources; (ii) cooperation among researchers and various research directions; (iii) careful consideration of the areas selected for specialization; (iv) creation of research units of greater productivity; and (v) a strengthened financial commitment to research. Each of these aims may be said to reflect potential inadequacies and limitations.

In the view of the Science Council the diversity and magnitude of the goals set for the special research areas concept require that it be broad in scope. To accommodate these wide variations in objectives, the specific research projects have given way to project clusters with imprecise and often overlapping boundaries. To form rigid frameworks for each special research area has not appeared especially meaningful. Instead, flexibility among the areas is being encouraged.

Research Association Programs

The significance of the special research areas program may be more easily comprehended when viewed in the perspective of existing academic research support. Although German universities are state-supported institutions, a small but increasing proportion of their income derives from federal sources. The funds supplied by the states to the universities—in 1964 almost 70 percent of total receipts (*5*)—are expended chiefly for the expansion and operations of the university infrastructure. The expenditures include, among others, major construction, equipment, and personnel. Funds from the Research Association, however, have been largely directed to the support of research above and beyond the levels considered necessary to maintain minimally adequate operations.

Ever since its establishment in 1952 the German Research Association has been the principal agent in the support of academic and related institutional research. Its origin was the *Notgemeinschaft der Deutschen Wissenschaft* (Emergency Association for German Science), an organization established in 1949 to cope with the difficulties faced by the academic community following World War II. As a private, autonomous organization the Research Association membership includes all academic and related organizations and the Max Planck Society, a private research organization supporting some 50 research institutes. Its charge includes the support of all scholarly activities which are covered by the appellation *Wissenschaft* (higher learning), and the extension of advice to state and federal authorities. Despite its private character the Research Association receives the majority of its funds, supplied in equal amounts, from the federal and state authorities. In 1967 this amounted to about 93 percent of a total income of almost $45 million.

Research support by the Research Association encompasses a wide range of disciplines and areas extending from the humanities through the social and natural sciences to engineering, agriculture, and health. Most is carried out through two programs. One is known as the *Normalverfahren* (standard program) and permits every researcher, regardless of field and affiliation (university or otherwise) to submit research project proposals. In 1967, 4896 such applications were acted upon and resulted in 4372 grants (*6*). These accounted for almost 54 percent of all obligations. The second principal program is known as the *Schwerpunktverfahren* (priority area program) and is similar to the standard program except for the fact that funds are made available for research in areas specifically designated by the Research Association. In 1967, of the 58 separate priority areas being supported (10 in medicine and 31 in science and engineering), three were initiated as far back as 1957; during the past 2 years 18 priority areas have been terminated. Beginning in 1968 and extending through 1971, 21 new priority areas will be added. Among these are Oriental studies, data processing in linguistics, demography, empirical criminology, and receptor physiology. In 1967 the priority area program accounted for 29 percent of the Research Association's obligations.

In determining those areas to be incorporated under the priority area program the Association draws upon the advice of the scientific community, government, and industry. The selected areas often emphasize new and interdisciplinary research efforts. Although most priority areas are supported for at least 3 years, individual projects within an area are funded for specified lengths of time. In principle, priority area funds are directed to special situations for which the provision of seed money or transitional aid may create the institutional conditions leading to

permanent support. The decisions concerning the duration of support for a priority area depend on its internal development and such related matters as the establishment of national capability and manpower supplies.

The remainder of the Research Association monies is used to support young, postdoctoral researchers; provide equipment and facilities; help maintain libraries; and develop research groups. The latter accounted for less than 1 percent of the 1967 Research Association budget (never having exceeded 2 percent of any previous budget) and in absolute value was at its lowest level since 1963, the year following initiation of the program. The research group program is of special interest because it, like the recently adopted special research areas, was proposed by the Science Council (*7*). Established on the pattern of the research units created by the research councils in England, the German program apparently has met with certain difficulties (*8*). These research groups, unlike the English units, have no permanent institutional base. They are established with the understanding that the research will be supported by the Research Association for several years, after which time the host university may or may not incorporate the group into its own structure. Such ambiguity apparently has not attracted those researchers who are interested in pursuing academic careers.

To cope with the challenge and change deriving from and affecting the pursuit of research, the Science Council has explicitly subscribed to the need for flexibility in research support. Until recently such flexibility was almost a direct consequence of policy decisions affecting the priority area program. The creation of new priority areas would draw research proposals from the community served by the standard program, while termination of priority areas would add to the latter's pool of prospective proposers. However, changes in the support of research achieve a new significance when viewed in the light of an array of mechanisms which includes the special research areas program. For example, a project supported under a priority area may grow in stature—intellectually and other—to the extent that a larger, coherent interdisciplinary endeavor may be warranted. The result could conceivably be incorporation within the special research areas framework. Or a research area effort, after proper evaluation, might be continued either at a reduced level of activity or restricted in scope under another program, or both. For one of the research groups a transfer to special research area status may be a means of achieving academic permanency, the absence of which has been chiefly responsible for the program's limited success. Since all the programs will be reviewed on a continuous basis, the transfer of research efforts among them should allow for smooth transitions in their support without diminishing the necessity for meeting the highest intellectual standards.

University Structure and Research

Until about 20 years ago academic research in the Federal Republic was largely supported by the state governments to meet educational obligations. However, as knowledge produced by the universities has acquired a larger dimension, much academic research has been supported by the federal government and other organizations to satisfy a variety of social and economic needs. The development of this situation has, in turn, raised doubts concerning the adequacy of existing research support policies and programs.

Having assumed active roles as patrons and protectors of academic research, the state and federal governments and the universities also share in the responsibility for the results. Yet the universities and, to a lesser extent, government have in many instances exercised no decisive control over the formulation of research goals and all that these imply. The major research support programs of the Research Association have focused on research as a more or less isolated activity of principal importance to the researchers. To be sure, the priority area program has related research to long-range national needs by concentrating on areas which are expected to yield scientific and technical advances of particular importance to the nation. Yet in both the standard and priority area programs the project selection criteria place the decisions in the hands of peers who are members of the recipient community. The result has been a strengthening of research capability along the lines of the existing academic structure.

The many difficulties which beset German universities have increasingly revealed certain inadequacies in their structure and administration. Not the least of the causes for this has been the growing specialization of research and the resources which it requires. Thus, where previously a research project may have been pursued under the complete authority of a single professor with all necessary resources at his command, there is now an increasing reliance upon colleagues in the same or neighboring disciplines and upon the host university. It is the latter which provides the necessary and often expensive and sophisticated infrastructure in the form of information resources, a large variety of supporting personnel, and facilities. Yet reconciling these research characteristics with the broader responsibilities and the existing structure of the university has not been easy. The independence of senior staffs and their relationships with the ministries of education serve to perpetuate the allocation of resources according to tradition, status, and scholarly achievement with their attendant patterns of authority and reward structures (*9*, *10*).

The impact of research on all those connected with the university forces the latter to assume a major role as a collective authority in the decision-making processes concerning research choices and allocation of resources. This university role, previously considered unnecessary in what has been an almost random creation and diffusion of knowledge, is now confirmed in practice by the procedures of the special research areas program. The formal establishment of such a collective authority to deal with research may prove to be an important factor in restructuring the entire university.

A necessary component in the creation of an effective university authority is a redefinition of the faculty role. By participating in decisions dealing with the establishment of research efforts the faculty exercises an authority which extends beyond that of a particular discipline. Such participation offers satisfactions deriving from an active involvement in the administrative and policy affairs of the entire university without excluding the rewards inherent in the pursuit of scholarship. However, only if the faculty accepts and actively fulfills its expanded role can progress be expected in the restructuring process.

With the implementation of the special research areas program the existing interpretations of scholarly freedom—*Lehr-und-Lernfreiheit*—and academic autonomy may be expected to undergo even further change. These fundamental principles will be strengthened only insofar as they are pursued in a

manner consistent with the total obligations and objectives of the university. They may be expected to diminish if they exist merely as a privilege to pursue private intellectual interests without concern for wider needs. If the challenge to the existing academic structure was ever in doubt the following passage from the annual report of the Research Association of 1967 illustrates its seriousness: "The principal deliberative bodies of the DFG [German Research Association] expressed the opinion that the outlined aims [of the special research areas program] could be achieved more quickly and easily if support were increased considerably by means of a special fund to expand the priority area program. The WR [Science Council], however, feared that such a solution would not be acceptable to the authorities providing the funds" (*10*, p. 17). The conclusion of the Science Council underlines the necessity for a redistribution of authority to meet new demands and adjust to new conditions.

Academic Research Justified

Not only will the special research areas program improve the mobilization of critical quantities of resources and increase individual opportunity, but it will also contribute to a wider understanding and support of academic research. Until now the justification for the support of academic research by the Research Association has rested largely on the objectives of knowledge and manpower. Despite the fact that Association-funded research has an intellectual quality and societal significance at least equal to that supported by the states for education purposes or by the federal ministries for urgent missions, the arguments offered in behalf of such research have had little impact. Through the special research areas program, however, the inclusion of the university and larger national considerations in the selection and support of research adds significant strength to the justification of such activities.

Prior to the introduction of the program there was little if any opportunity for the university to influence the course of its development through the major Research Association programs. Any changes in existing levels of research were achieved by the individuals who secured support from the Research Association, ministry of education, or other organization. The opportunity now offered by the special research areas program to universities places the pursuit of research in a new perspective. This research will be subject to control by the university, rather than independent of it. The commitment of the university to support special areas research will be reflected in the argument that such research contributes not only to knowledge and manpower but also to a carefully considered strengthening of the educational institution within which it is pursued.

Although the university is considered the principal institutional pillar of the program, the state and federal governments provide still other and no less important kinds of institutional anchors. Participation by the ministry of education in the review of research proposals is important since only those approved may be recommended for adoption by the Science Council. Just as in the case of the universities, the state ministries of education are required to examine critically all candidate proposals and select those considered best capable of meeting state needs. The failure to make such choices places the authority for making them in the Research Association and Science Council. Thus, the endorsement of a particular research area by a state ministry of education, based as it is on the popular will transmitted through elected officials and expressed via their supporting staffs, cannot but help represent a measure of political support for the program.

The third link in the justification matrix forged by the special research areas program is the federal government. Its participation differs from that of the states in scope and complexity of responsibility. In the recent past federal support of academic research has been extended through the Ministry of Research via its general science promotion and nuclear and space research programs. Although the nuclear and space research programs provide the universities with considerable sums these are for rather specific purposes. The general science promotion program, however, is the major supplier of funds to the universities. In fiscal year 1969 its budget will be approximately $260 million of which more than 70 percent will be used for the construction and equipment of university plants. From this program the Research Association receives approximately 50 percent of its income (approximately 10 percent of the general science promotion program). Together both federal and state authorities play a major role in the promotion of the national interest through academic research, and the importance of their combined efforts may be gauged by the fact that federal and state funds account for more than 80 percent of all academic institution income.

However, of all the organizations supporting academic research, the Research Association is the principal national vehicle for the direct support of unsolicited research proposals. As an independent body, the Association determines its own policies and designs its own programs. Through its efforts to maintain high intellectual standards, the Research Association has fulfilled its principal obligations. Although subject to no external constraints specifying the disciplinary composition of programs, manpower, or related goals, the responsibility for interpreting the national interest has rested solely with the Research Association.

The special research areas program changes this situation in some considerable degree. It has created a new decision-making structure which permits more participation at the national level in the selection of research. With both the Science Council and the state ministries of education participating in this decision-making process, the national involvement exceeds mere concern with scholarly merit. Members of the Science Council are appointed by the state and federal governments and are charged with promoting the national interest. Their decisions on the choice of special research areas will reflect national assessments and thus provide the academic research community with political support by the federal government.

Research Association and Science Council

The implementation of the special research areas brings with it an important redefinition of the roles and responsibilities of the Research Association and the Science Council. Under the existing programs scientific merit has been the principal determinant in assessing proposed and continuing research efforts. As such, it was only proper and reasonable for peers to make the necessary judgments. The needed expertise was enlisted in the service of the Research Association, the acknowledged representative of the scholarly community. The special research areas program, however, changes this procedure by expanding the research selection criteria to include con-

siderations of university and national needs. This new situation requires the establishment of appropriate bodies to evaluate these particular needs. In the case of national interest considerations extending beyond questions of scholarly merit, the responsibility falls to the Science Council and the state ministries of education.

Until the creation of the special research areas program the principal Science Council activity had been the preparation of a number of comprehensive reports dealing, for the most part, with higher education and science for federal and state authorities. In addition, the Science Council is required to prepare an annual list of research priorities and recommendations on the use of appropriated government funds for scholarly, principally scientific, endeavors. Such activities, while of considerable significance—and there is almost unanimous agreement on the influence which the Science Council has had on the character and expansion of higher education—were advisory in nature and did not include making decisions regarding individual grants.

The Research Association, on the other hand, basically reflects the concerns and interests of academic research. Its leadership is neither popularly elected nor appointed by persons so elected; rather it is chosen by the elite of the scholarly community. As such it can hardly be considered as representative of the larger, and in some respects, opposing university and national interests. This is, of course, no fault of the Research Association but reflects upon the inappropriateness of its role as a public representative concerned with academic research supported by and affecting the nation. Although both the Research Association and Science Council exercise authority within the special research areas program on a national level, the concern of the former is primarily that of intellectual or scholarly merit; the latter oversees the political, social, and economic considerations with particular concern for higher education.

With the adoption of the special research areas program the societal concerns of the Science Council now appear equal to the scholarly considerations of the Research Association. In the past, the political decisions concerning academic research were made, for the most part, at levels far removed from the concerns of intellectual peer judgment. Once completed, the considerations on which those decisions were based were eliminated from the subsequent discussions of intellectual merit. The special research areas program, however, requires that the national interest be given a more explicit voice in the research selection process.

The exercise of a national interest judgment on individual candidate proposals combined with the responsibility to recommend to government authorities how research funds should be allocated gives the Science Council considerable leverage in determining the orientation of academic research. In no other Association research support program does the Council exercise such authority. How it will adjust its special interests in the research areas program to this responsibility remains to be seen.

For the Association the addition of the research areas program is a significant event. Beyond its contributions to research the program has helped define more clearly the nature of the Association's authority. Thus, while the Research Association cannot assume the political authority of the Science Council or that of the university, it has been encouraged to view the pursuit of research in a larger setting. Such issues as research effectiveness, concentration of resources, mobility of personnel, and nonacademic cooperative endeavors have been placed in the prespective of university and national welfare. The Research Association may have a considerable opportunity to expand its role as its concern for the collective responsibilities and obligations of the universities increases.

Summary

The special research areas program supports the formation of integrated, multidisciplinary research groups at academic institutions. It is an attempt to cope with the changing character of research: increased resources, a sophisticated infrastructure, and cooperative intellectual activity. In addition, the program recognizes the significance of research to the university and the nation. These considerations, in addition to those of scholarly merit, serve as criteria for the selection of special research areas proposals and signify a major change in policies dealing with the support of academic research.

By concentrating resources, improving individual opportunity, and encouraging extra-academic contact, the special research areas provide the conditions necessary to accomplish more effective research. A revitalized role for research will alter the emphasis now placed on a variety of disciplines. These changes may also cause the academic institutions eventually to become complementary components within the nation, so that one university might excell in the field of astronomy, another in oceanography, and so forth.

The special research areas program offers the university an opportunity to participate in the research selection and support processes and to influence its future development. The requirement that representatives of educational institutions review proposals serves to make the special research areas program a vehicle for a thorough restructuring of the university. A new relationship between academic research and the national interest has developed. Research emphasizing national goals is selected by federal and state governments, according to the terms of the special research areas program. These decisions imply a direct public commitment and degree of justification previously unknown. The program above all supports the view that academic research is becoming an increasingly complex scholarly and societal activity. By uniting the interests and needs of research, the university, and the nation, the Science Council of the Federal Republic of Germany has taken a step which promises progress with balance.

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