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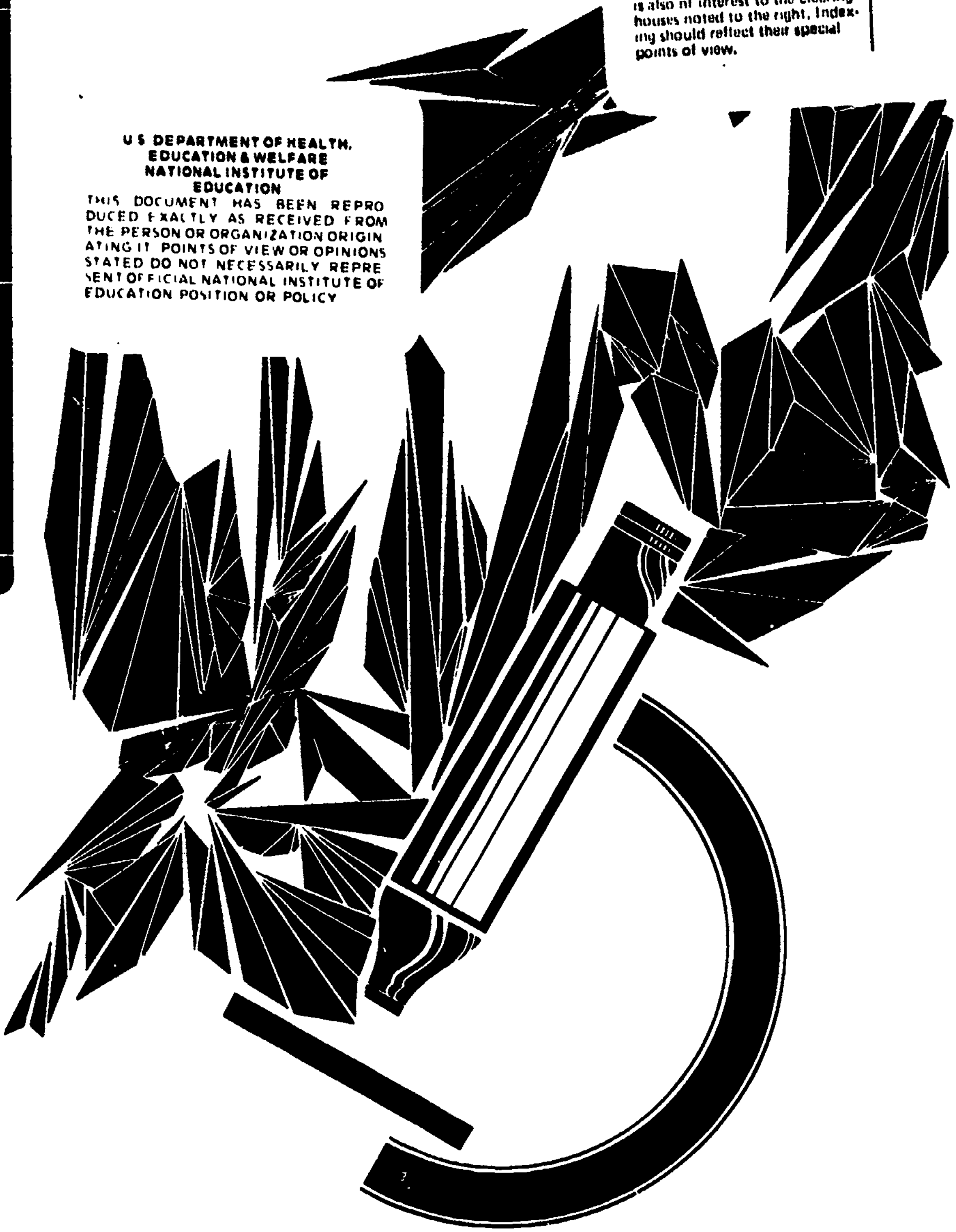
ABSTRACT

The 12 publicly supported universities and colleges of Michigan that, in cooperation with the National Science Foundation, sponsored and conducted this study were particularly interested in looking into the overlapping interests of the three public bodies most concerned with higher education--the local institutions themselves, the State of Michigan, and the federal government. The study is focused on a segment of higher education in which three levels of policymaking intersect in many important ways, mainly, the mechanisms and funding by which Federal agencies have been supporting a number of science activities on these twelve campuses over the period 1955-1966. The results presented in this report include quantitative facts as well as polls of the views of faculty, students, and administrators concerning all significant aspects of academic science--funding and funding mechanisms, institutional as well as federal, institutional management and development measures, faculty-administration relations, student training and enrollments, etc. Chapters cover the patterns of research support; some problems in financing science research; impact of funds on education; effects on administrative organization and practices; and major issues and policy problems. Statistical tables accompany the text. The supplement contains materials that deal with the methods and means by which the study was conducted and that provide additional information resulting from the study and suggestions for reading related studies. (Author/PG)

NSF-RA-G-69-002

Impact of Federal Support of Science

on the Publicly Supported Universities and Four-Year Colleges in Michigan



HE 006 155

Paul L. Dressel, Principal Investigator Donald R. Come, Associate Investigator

Interinstitutional Study Supported by National Science Foundation Contract No. NSF-C-506

Impact of Federal Support of Science
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March, 1969

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An Interinstitutional Study Supported by
National Science Foundation Contract No. NSF-C-506

With the assistance of

HERBERT E. COOLIDGE
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DONALD J. REICHARD

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Preface

This study, originally contemplated as a project of one-year duration, in actuality extended over two years. Interinstitutional cooperation, even when wholehearted, exacts its toll in time. Collection of the data, which seemed relatively simple, turned out to be time-consuming, tedious, and sometimes impossible. The analysis and summary of the data were necessarily delayed until all available data were in hand. The process of writing, obtaining reactions, and rewriting took, as usual, more time than anticipated. Surely, a sigh of relief from everyone concerned is in order.

The focus of the study, when launched, was on the impact of Federal and other extraneous sources of support of science research and science education in a state system of higher education. Several factors tended to shift the attention of the directors of the study from the original set of questions to broader issues. The first of these arose out of the gradual shift in the nature of Federal support over the past several years, and the marked differences among institutions in the amount and type of support. The second was developing awareness of problems arising out of the aspirations of institutions especially of some faculty members - to expand research and graduate education in ways hardly consonant with the limitations of state resources and plans. Third there were indications that Federal support uncoordinated with state support and plans could unwisely give encouragement to these aspirations. Fourth, the expansion of broad Federal support to both public and private institutions poses very serious and difficult problems in that some forms of Federal support would certainly lead to reduction in state support.

And so our study has turned to the implications of these factors for the future of Federal support. Though some of our institutional collaborators have expressed some doubts about the relation of our last chapter to the original enterprise, we remain firm in the conviction that a purely historical study would be entirely irrelevant to the anticipated developments.

Technically-oriented readers may be disturbed because the report omits many details, both concerning procedure and in the data drawn upon in the comments. The length of the report and the disinterest of many readers in such details led us to place much of this material in a Supplement, which is available in limited quantity to those with special interest in such detail.

Finally, we would like to emphasize our debt of gratitude to the several groups listed in the acknowledgment section. The liaison representatives, especially, gave many hours of time to the project. In each institution many additional hours were occupied in collection and organization of data by unidentified collaborators in the project. The total of dollars thereby expended in each institution is unknown, but certainly very sizable.

Two persons deserve special recognition. Dr. M. Frank Hersman, surely one of the most genial and helpful of all project monitors, gave many hours of time in phone calls, visits, and correspondence to the project. Dr. Lewis Pino, beyond his duties as the liaison representative, carried out many of the on-site interviews and was exceedingly helpful in comments on the manuscript.

For us as directors of the project, the experience has been stimulating and instructive. We hope others may find something of value in the report.

PAUL L. DRESSEL
DONALD R. COME

Acknowledgments

Institutions and Liaison Representatives

On this group fell most of the burden of reacting to and approving staff proposals, in meetings or by mail. The individuals had also the onerous task of coordinating local collection of data, of arranging the campus interviews, and of interpreting the project to colleagues.

Central Michigan University
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Coordinator of Institutional Research

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Dr. Donald Drummond, Dean
College of Arts and Sciences

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Michigan State University
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Dr. Paul L. Dressel
Assistant Provost and
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Michigan Technological University
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Dean of Graduate Studies

Northern Michigan University
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Dr. J. Patrick Farrell
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Oakland University
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Assistant to the Chancellor

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Dr. Hans H. Hennecke
Assistant to the President
until June 30, 1968
replaced by
Dr. Richard A. Mock
Director of Research

University of Michigan
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Mr. Jerry L. Kirks
Assistant Director
Office for Institutional Research

Western Michigan University
Kalamazoo, Michigan
Dr. George G. Mallinson, Dean
School of Graduate Studies

Steering Committee

Through occasional meetings and numerous phone calls this group gave guidance to the project on matters and at times when a meeting of the entire Liaison Representatives was not possible.

Dr. J. Russell Bright, *Director*
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Dr. M. Frank Hersman
Staff Associate
Office of Planning and Policy Studies
National Science Foundation
Washington, D.C.

Advisory Committee

The following persons were of great assistance to this study through personal interviews, or interviews arranged with their associates, and through written response to issues or questions sent to them. They are, however, in no sense responsible for the views presented here.

Walker L. Cisler, *Chairman*
Chairman of the Board
Detroit Edison Company
Detroit, Michigan

H. Glenn Bixby
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Detroit, Michigan

Brig. General Lester S. Bork, USA Ret.
Economic Club of Detroit
Detroit, Michigan

James Boyd
President, Copper Range, Inc.
New York, New York

Harold W. H. Burrows
President, Parke-Davis & Company
Detroit, Michigan
retired January, 1968
replaced by
Leon A. Sweet
Vice President
Research Development and Application

Thomas M. Butler
President for Engineering
Burroughs Corporation
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The Very Reverend Malcolm Carron, S.J.
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Vice President for Research
Ford Motor Company
Dearborn, Michigan

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Harold M. McClure, Jr.
President, McClure Oil Company
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Harold Taylor
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W. E. Upjohn Institute for Employment Research
Kalamazoo, Michigan

Calvin A. VanderWerf
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Holland, Michigan

Summary and Recommendations[1]

The twelve publicly supported universities and colleges of Michigan which, in cooperation with the National Science Foundation, sponsored and conducted this study were particularly interested in looking into the overlapping interests of the three public bodies most concerned with higher education the local institutions themselves, the State of Michigan, and the Federal Government. Business and industry were also represented through interviews and correspondence with an advisory group of Michigan leaders in those fields.

The study is appropriately focused on a segment of higher education in which the three levels of policy-making intersect in many important ways namely, the mechanisms and funding by which Federal agencies have been supporting a number of science activities on these twelve campuses over the period 1955 1965. The funds provided by the Federal government have increased greatly during this decade for most of these institutions, as for many others in the country, and the recipient institutions have experienced a variety of consequences as a result, some of which appear to touch critically the autonomy of these institutions and their traditional control over their own futures. Moreover, the threat of cutbacks and possible changes in the nature of this Federal support, which has recently become a painful reality, has given the study an added interest for the twelve institutions. Designed from the start as an aid to planners and policy-makers, the study has acquired by events and trends of the two years since its inception a relevance to immediate decisions of great urgency at all three levels of planning and policy making. In some respects, these events and trends diverted attention from some of the more specific questions originally raised to issues intrinsic to the problems and nature of coordination in a state system of higher education and

[1] Following limited distribution of this report, a number of discussions were engendered which raised some questions of clarification and led to more explicit recommendations for action. Rather than attempt to revise the report, this statement of Comment and Recommendations, which has been reviewed and generally approved by the Liaison Representatives and Steering Committee, has been added. As this statement developed, it became evident that, in many ways, it captured the significance of the study more concisely and effectively than the final chapter. Accordingly, it has been somewhat expanded to include sufficient introductory and explanatory material so that it presents a comprehensible brief statement of the study and its results.

the role of Federal support in such a system. Indeed, many of the original questions concerning support systems, mechanisms, and desirable changes are unanswerable until some of the underlying issues identified in the study are resolved.

The results presented in this report include quantitative facts as well as polls of the views of faculty, students, and administrators concerning all significant aspects of academic science funding and funding mechanisms, institutional as well as Federal, institutional management and development measures, faculty-administration relations, student training and enrollments, problems of state planning, etc. There is also a discussion of less quantifiable factors, such as balance and its opposite, imbalance, which play important roles in academic planning. In some ways and for a number of reasons the report falls short of its intended scope. In some cases, the data returns proved too erratic or limited for more than passing comment; in other cases, the data were too voluminous and complex to be conveniently summarized in tables. Exploration of alternative support policies was largely ignored because these policies can be rationally determined only after some decisions have been made about the roles of individual institutions in the total system of higher education.

The results of these surveys and discussions should be interpreted and evaluated in terms of the combined objectives of the three levels of planning and policy making. Twelve institutions in one state, however carefully chosen to represent all stages of development, cannot constitute an adequate sample for purposes of Federal agencies. However, for planning operations of the twelve institutions themselves, as well as for policy makers of the State of Michigan, the specific in-depth information on these institutions has already been useful. And indirectly, through the premise of Federalism, the planning purposes of Federal agencies will also be served.

A particularly important finding for policy makers at all three levels is the characterization of the twelve institutions as falling into three groups based on both the present state of development in their science departments and the views and aspirations of these departments for the future. To summarize in greatly over-simplified terms: institutions in Group A are now enjoying substantial Federal support of the traditional project kind; they would like this support to continue in much the same fashion, and they fear that changes might be inimical to their interests. They are not averse to expansion of institutional grants so long as these do not detract from the project system. Group B institutions are enjoying a more limited participation in project funds and are receiving a larger proportion of their Federal support in the area of science education. They are improving their capabilities in the national competition for research support, and they accordingly look with distrust on policy changes which might defeat this expectation. These institutions would welcome some broad institutional grants. Group C institutions, on the other hand, which are just setting out on their development, may have no present or immediate plans for graduate education and extensive research programs, and have thus far received little assistance from Federal agencies in either research or science education. They primarily need institutional grants for general program development. The Federal project system, for at least some of these emerging institutions, is significant primarily in their visions of the future. Because of the career aspirations of their expanding faculties, these institutions view the initiation of modest research programs as essential for faculty development, recruitment, and retention.

As this description of the three groups suggests, the graduate programs and their many important interactions with the undergraduate college, stand at the center of a number of planning issues for institutional authorities. Numerous analyses in the study suggest questions about the number of graduate schools that a state can afford, and underline the urgent need to explore the ways and means by which a state can define and maintain acceptable quality for all of its institutions without making them all into full-fledged universities.

Obviously, these questions will be extremely difficult to resolve, especially at the state level, for institutions strongly reject assigned roles which delimit their possibility of expansion into new levels and types of education. However, it may well be that half the battle is in the preliminary step of simply getting the need for state and regional planning recognized and accepted at the local institutional level where the most difficult adjustments will have to be made. If so, studies like this, in which administrators, faculty, and students examine their institution's resources and compare them with the goals, explicit or merely implicit, that these institutions are striving to reach, can constitute a long initial step towards the necessary realistic planning. Faculty members, whether participants in the study or readers of the published report, will be confronted with the cumulative and financially unrealistic implications of their desired graduate programs. State authorities, for their part, along with other representatives of the public who it may be hoped will be exposed to the report, will be made aware of the equally critical importance of providing faculty with adequate incentives and conditions for the development of high-quality undergraduate programs.

Finally, in the perspective of overall national policies for higher education, few would deny that at each of the three policy making levels institutional, state, and Federal steps must be taken to offset imbalances impending in the near future between the nation's projected academic scientific manpower with other science resources, on the one hand, and its projected capabilities and educational expectations on the other. These imbalances are especially found in important dimensions of the national science enterprise volume of support, composition of disciplines, and distribution of resources within the nation and within the states. Furthermore, the problems are of such a nature and magnitude as to require the creation of new institutional mechanisms and procedures for distributing the Federal funds for higher education, and this in turn can be accomplished effectively and efficiently only by a Federalist effort involving information, analyses, and perspectives at all three policy levels Federal, state, and institutional. The present study is at once a compilation of detailed information about specific institutions in a single state, and an instance of the kind of local exercise in state and national thinking which, under the premise of Federalism, appears indispensable to the formidable innovative tasks of updating the nation's scientific and academic enterprise. Similar studies in other states, or even in multi-state regions, with other and more structured styles of coordination or control may be necessary to develop and more clearly detail steps necessary to cope with issues raised in this report.

Recommendations

In undertaking this study, the twelve institutions were asked by the National Science Foundation to formulate recommendations on issues of academic science support facing administrators at the several policy levels. While the concept behind this request to obtain larger inputs to national policies from the institutional working level is certainly worth pursuing to its ultimate accomplishment, detailed recommendations about specific complex issues would be inappropriate to an initial effort of this kind. Instead, the following general observations are offered for the consideration of the policy makers.

Planning and Budgeting

Current governmental budgeting and support decisions often have the effect of frustrating institutional planning and of placing the institutions in a position of having to react to the vicissitudes of these external decisions. While highly structured mechanisms of support, particularly those of Federal agencies, may produce short-term advances, the academic institu ns are forced into strategies of opportunism. The effect is not only to frustrate academic planning, but, in the long run, to weaken the entire academic enterprise. Gradual and uncoordinated expansion of Federal support, often under political pressures, encourages unmerited and unreasonable institutional aspirations, results in duplication and ineffective use of resources, and very likely, in the long run, dilution of quality in the total national system of higher education. Cost sharing places an unreasonable burden on all institutions, but especially on the public universities largely dependent upon state appropriations and student fees. They have no undesignated funds for cost sharing and diversion of state appropriated funds from their traditional and intended uses to support research is unwise and subject to legislative reprisal.

Recommendation to the Federal Government

We recommend that the Federal agencies which provide support to institutions allocate a larger proportion of this support in the form of institutional grants. We endorse the general efforts in this direction reflected in the recent report by the National Science Board, "Toward a Public Policy for Graduate Education in the Sciences."[2] We also recommend that institutional funding levels be expanded to cover the needs of young investigators, and that it be granted for a period of at least three years in the future, as a step to encourage institutional planning efforts. And to alleviate institutional imbalance, we recommend that institutional funding be sufficiently generous and flexible to permit use in the arts and humanities as well as in the sciences. Especially in the case of state supported institutions it is essential that the institutional grant program be so administered as to encourage increasing support from other sources rather than be seized upon as a basis for decreasing it.

Regional Planning

In order to accomplish the improvements needed in the administration of academic resources at both the most operational institutional level and the central Federal level, mechanisms must be created to provide the

[2] Report of the National Science Board, January 1969.

needed opportunities for information exchange and policy development at the state level. The individual institutions must do their planning with an eye on each other and on the regional needs and resources, and the Federal government in its support of projects and programs in these institutions must likewise consider the regional effects of its actions. State compacts in the pattern of WICHE and SREB may be necessary to make regional planning effective. Initial Federal support for such agencies would encourage their formation, and continuing Federal support of regional enterprises would enhance their effectiveness.

Recommendation to the Federal Agencies

For the same reason of fostering the regional dimension of institutional planning, we recommend that the National Science Foundation, and all the other Federal supporters of academic programs, take appropriate measures to assure that their evaluation of proposals is effected with the fullest possible consideration of the existent regional plans, goals, and other considerations. When state and regional planning is not in evidence, individual institutional proposals with broad regional implications holding the possibility of needless duplication should be weighed carefully and perhaps even denied.

Graduate Programs

It is clear that neither the nation at large nor any one of the states has or will soon have the resources to provide graduate programs in all fields at all institutions of higher education which now aspire to them. Graduate study of quality cannot be conducted without an active program of research. Hence costs are high and institutional aspirations must be supported only when social needs and available resources justify expansion.

Recommendation to University Faculties and Administrators

In addition to the hard choices that must be made by state and local authorities in limiting and siting the number of graduate programs, we recommend that faculty members and administrators explore and take all possible steps to assist them in this indispensable goal. Administrators and professors, and their professional societies should seek ways to raise undergraduate teaching to a status as respectable as that of graduate teaching and research. Despite the denials of research-oriented faculty members, undergraduate education suffers from both lack of attention and from over-specialization in the research-oriented institution. The tendency to regard undergraduate teaching as a burden to be assumed by second-rate or non-tenured faculty must be corrected.

Recommendation for Further Studies

One or more studies similar to this one should be conducted in states or regions which have developed a more formal structure than has Michigan for central coordination and planning of higher education. Ideally, the studies should be conducted as cooperative efforts by one or more Federal agencies, representatives of state government, coordinating agencies, and the institutions themselves. Both public and private institutions should be included, since both are vital parts of the total higher education system and the traditional differences in their support are rapidly disappearing. Business and industrial interests and needs should also be more vitally involved than was possible in this study.

I. Introduction

The impact of Federal support of research and science education has been the subject of numerous studies and conferences and of innumerable articles and speeches. It is generally agreed that there has been an impact and that even more and more diversified support is required. The impact is almost obvious from the fact that government support of research and science education has expanded from practically nothing (excepting agriculture and service schools and academies) prior to 1945 to over two billion dollars in 1966 only slightly over twenty years later. Leland J. Haworth, Director of the National Science Foundation, has well summarized the development:

> Nowhere has the impact of the Federal commitment to science been greater than in the country's academic institutions. From essentially none before World War II (except in agriculture), Federal support for the conduct of research in the academic institutions proper (as distinguished from federally owned "contract research centers" operated by the universities) rose to approximately $1.26 billion in fiscal year 1966, almost two-thirds of the total research expenditures in those institutions; additional funds of the order of $0.11 billion were obligated for research laboratories and research facilities. Although the primary objective of most of this support has been to meet the informational needs of the agencies having specific missions in defense, health, space, atomic energy, etc. it has nevertheless had a profound impact in education, especially at the graduate level where the conduct of research is vital.
>
> In recent years significant, though smaller, support has also been given to higher education in its own name. Students have been assisted through fellowships and traineeships (as well as through opportunities for employment on research projects); growing support has been given to the classroom teaching function, especially by the National Science Foundation and, at a rapidly increasing rate, by the Office of Education. Still another type of program in several agencies provides special support to assist selected institutions to improve the quality of both research and classroom activities. In total about $2.2 billion was obligated by the Federal Government in fiscal year 1966 for support of research and science education in our universities and colleges.[1]

[1] *National Science Foundation Annual Report, 1967,* NSF-68-1. Washington, D.C.: U.S. Government Printing Office, 1968, pp x, xi.

A further comment by Haworth is relevant to the present study:

> An especially acute need, perhaps even more acute in its way than the total national need, is that of regions, states and localities that are endeavoring to develop high-quality academic institutions where such do not now exist. It is generally recognized that a first-class university or, to a more modest extent, a first-class college, has a highly salutory effect on the total life of the locality in which it finds itself. It influences in a positive way the educational systems, the culture, the intellectual life and, in more or less degree depending on the circumstances, the overall economy. Quite apart from the financial support they may receive, institutions endeavoring to better themselves and hence their communities have great difficulty in doing so when there is a shortage of high-quality individuals with whom to build their faculties. In the face of such a shortage they find it hard, if not impossible, to compete for such individuals with those institutions already recognized as having high quality.[1]

Origin of the Study

The national, regional, and state needs for education (especially for graduate education and research) and the relationship of various sources of support to these needs led to the current study. The study was planned to analyze the implications and consequences of the existing system of support of research and science education (a) to the academic institutions involved in the study, and (b) to Federal and nonFederal sources from which support for research and education is received. Recommendations for national policies in distribution of Federal funds and changes to optimize the contributions of Michigan's public institutions of higher education to the state and to the nation over the next ten years were expected as ultimate results.

Two broad Questions were posed:

1. What is the existing system by which scientific research and educational activities are undertaken and supported in Michigan's twelve publicly supported institutions of higher education and what alterations may or should be effected in this system over the next ten years?
2. What are the existing mechanisms, levels, and kinds of research support received from Federal and nonFederal sources and what changes would be desirable in this support base over the next ten years to support the research and educational opportunities and needs of the academic institutions and of their supporting agencies and clientele?

[1] *Ibid.*, p. xiii.

The Institutions Involved

The twelve public institutions involved in this study, their location, and their founding dates are:

Central Michigan University (Mount Pleasant), 1892
Eastern Michigan University (Ypsilanti), 1849
Ferris State College (Big Rapids), 1884
Grand Valley State College (Allendale), 1963
Michigan State University (East Lansing), 1855
Michigan Technological University (Houghton), 1885
Northern Michigan University (Marquette), 1899
Oakland University (Rochester), 1957 (Affiliated with Michigan State)
Saginaw Valley State College (University Center), 1963
University of Michigan (Ann Arbor), 1817
Wayne State University (Detroit), 1868
Western Michigan University (Kalamazoo), 1903

These institutions of higher education are a diversified group with varying degrees of specialization in the sciences and engineering, and with widely different resources, degree programs, and student enrollments. Each, under a pattern of autonomy provided for under the Michigan Constitution of 1963, may initiate new research and educational programs in the sciences and engineering at both the graduate and undergraduate levels.

The twelve institutions operate from a capital base of about $1,103 million. (Official 1966 67 financial reports of the institutions, June 30, 1967.) During the academic year, 1967 68, they received total state appropriations of $205 million, an increase of 123 percent over state appropriations received seven years earlier.[3] In the academic year, 1965 66, these institutions awarded 12,152 degrees at all levels in sciences and engineering.[4] They awarded 82.5 percent of all degrees awarded in public and private institutions in the State of Michigan, and 91.7 percent of all first professional and graduate degrees (9,675 of 10,542).[5]

The significance of these public institutions in the Michigan system of public and private higher education is likely to increase in the future as a consequence of large projected increases in enrollments. Total enrollments of 188,000 in 1967 are projected to increase to 229,000 by 1970,

[3] Michigan Council of State College Presidents (MCSCP), *Memoranda on Senate Appropriations Committee Action*, January 22, 1968 and February 28, 1968.
[4] Office of Education, *Earned Degrees Conferred 1965 66*, Washington, D.C., U.S. Government Printing Office, 1968, pp. 48 273.
[5] *Ibid.*, pp. 5 7

and to 298,000 by 1975. Enrollments will have increased by nearly 80 percent in the relatively short time of ten years, from 1965 to 1975.[5]

Michigan's institutions of higher education contribute substantially to the nation's scientific and technical enterprise as attested by the facts that in 1966 Michigan ranked sixth among the states in total Federal support and also sixth in Federal support of academic science. In 1965-66, Michigan institutions of higher education expended approximately $80 million for research and development, of which two-thirds was provided by the Federal Government. The remaining one-third was accounted for by institutional funds and by support received from industry, state, foundations, and other sources.

TABLE 1-1
TOTAL FEDERAL OBLIGATIONS AND ACADEMIC SCIENCE SUPPORT TO THE TWELVE INSTITUTIONS IN MICHIGAN INVOLVED IN NSF FUNDS IMPACT STUDY, 1963-65*
(THOUSANDS OF DOLLARS)

INSTITUTION	TOTAL SUPPORT				ACADEMIC SCIENCE SUPPORT†			
	1966	1965	1964	1963	1966	1965	1964	1963
CMU	1,221	343	173	234	126	165	161	234
EMU	2,502	1,433	322	139	1,270	193	192	138
FSC	777	19	8	0	609	0	8	0
GVSC	1,654	540	0	0	32	534	0	0
MTU	2,320	1,205	227	219	1,903	435	227	219
MSU	22,369	14,413	11,516	12,488	17,706	12,170	10,451	11,626
NMU	1,552	1,050	154	163	209	900	154	163
SVSC	772	952	0	0	0	0	0	0
U of M	66,265	58,806	45,862	45,524	61,489	51,025	44,827	44,465
WSU	11,948	9,422	7,122	8,068	8,171	7,529	6,484	7,660
WMU	3,078	1,732	619	467	1,350	536	346	358
Totals	114,458	89,915	66,003	67,302	92,865	73,487	62,940	64,863

*Figures taken from Table B-21, Total Federal Obligations and Academic Science Support to All Universities and Colleges, by State and Institution, 1963-66, p. 121 in *Federal Support to Universities and Colleges, Fiscal Years 1963-66*. National Science Foundation, NSF 67-14, July, 1967. (Note: Federal obligations for Oakland University are reported as funds obligated to Michigan State University.)

†"Academic science support" includes funds for "Research and development," "R and D plant," and "Other science activities"—primarily science education. When the terms research funds and research expenditures are used throughout this report, they include, unless otherwise stipulated, funds or expenditures for (1) basic and applied science and (2) development, or the systematic use of knowledge directed toward the design and production of useful prototypes, materials, devices, systems, methods, or processes. Funds for quality control and routine product testing are excluded.

Table 1-1 exhibits the total Federal *obligations* and the academic science support for twelve of the Michigan institutions involved in this study. State totals are included. This table reflects some of the changes taking place in Federal support over this period:

[5] *State Plan for Higher Education in Michigan (Provisional)* Lansing, Michigan: Michigan Department of Education, September 1968, (Table 1, p. II-19).

1. The number of institutions receiving support increased from 8 to 11. Nationally, the number increased from about 840 in 1963 to approximately 2,050 in 1966.
2. The non-academic science support increased from slightly under \$2.5 million to over \$21 million nearly a ninefold increase. Nationally, non-science support also increased ninefold, from \$85 million in 1963 to \$847 million in 1966.[7]
3. Total Federal support to the Michigan public institutions increased by 71 percent.
4. Institutions receiving the most extensive support are receiving a smaller percentage of the total. In 1963 the University of Michigan received two-thirds of the total amount made available to Michigan state-supported institutions. By 1966 the percentage decreased to 58. Nationally, the top 100 institutions in terms of Federal support accounted for 70.4 percent of total Federal obligations in 1966, compared to 85.4 percent for the same institutions in 1963.[8]

Table 1-2 shows the total and the academic science support for all Michigan colleges and universities. As this table suggests, graduate study and research activity are largely confined to the state universities and colleges. Of the 57 other Michigan institutions, 56 are undergraduate or community colleges. From 1963 to 1966 the total Federal support to state-supported institutions increased by 71 percent; the support to all of the Michigan colleges and universities increased by 88 percent; and the total Federal obligations to higher education increased by 116 percent. It appears from this data that Michigan has not held its own as Federal obligations have increased. This may be because graduate education and professional programs in engineering, science, and medicine are concentrated in a few of the state universities. The National Science Foundation report shows Michigan receiving 4.27 percent of the 1966 Federal obligations while granting 4.61 percent of the total, and 4.89 percent of the Ph.D. degrees in 1964 65. However, Michigan provided only 3.80 percent of the M.D. and D.D.S. degrees.

The research activities of the twelve colleges and universities have been heavily but not solely dependent upon Federal commitments. Table 1-3, based upon data presented in *Industrial Research*,[9] indicates the percentage of research funds derived from various sources in 1967.

National Science Foundation. *Federal Support to Universities and Colleges, Fiscal Years 1963 66*. NSF 67-14 Washington, D.C. U.S. Government Printing Office, 1967, p. vii.

[8] *Ibid*., p. 26.

[9] *Industrial Research*, 1968, 10(4), 72 73.

TABLE 1-2

TOTAL FEDERAL OBLIGATIONS AND ACADEMIC SCIENCE SUPPORT TO MICHIGAN COLLEGES AND UNIVERSITIES, 1963-66*

	TOTAL SUPPORT				ACADEMIC SCIENCE SUPPORT			
	1966	1965	1964	1963	1966	1965	1964	1963
State Supported Institutions (12)	114,458	89,915	66,003	67,302	92,865	73,487	62,940	64,863
Other Michigan Institutions (57)	14,331	6,627	1,258	1,054	5,051	1,877	1,033	886
State Total	128,789	96,542	67,261	68,356	97,916	75,364	63,973	65,749
National Total	3,017,509	2,288,986	1,605,906	1,396,705	2,171,050	1,797,702	1,509,547	1,312,201

*Figures taken from Table B-21. Total Federal Obligations and Academic Science Support to All Universities and Colleges, by State and Institution, 1963-66, pp. 121, 136 in *Federal Support to Universities and Colleges, Fiscal Years 1963-66.* National Science Foundation, NSF 67-14, July, 1967.

TABLE 1-3
PERCENT OF RESEARCH FUNDS FROM VARIOUS SOURCES FOR FIVE MICHIGAN STATE-SUPPORTED COLLEGES AND UNIVERSITIES, FISCAL YEAR 1967

INSTITUTION	FEDERAL	UNIVERSITY	INDUSTRY	FOUNDATIONS	STATE	ALUMNI & OTHERS
U of M	77	9	6	4	1	2
MSU	64	25	4	6	1	
WSU	71	7	6	11	1	4
MTU	40	34	15	2	9	
WMU	57	20	12	4	6	
Combined	72.5	13.6	5.9	5.3	1.1	1.6

Data for years prior to fiscal year 1967 exhibit much the same characteristics as those in Table 1-3 except that state support of research first appeared in significant amounts in fiscal year 1966. There are variations among institutions which attract attention. The Agricultural Experiment Station at Michigan State University markedly increases the direct university research support. At Michigan Technological University the relatively large support of research by industry and by the university through its own funds differs from the prevalent pattern.

The immediately preceding tables and data indicate the general character of the twelve institutions in this study, and document the extent of their past involvement in research and science education. Both the differences among the institutions and the changing patterns of Federal support are evident in these data.

Purposes and Projected Benefits

The benefits anticipated from this study were diverse in nature. It was hoped that each of the Michigan universities involved in the study would achieve some insights into the impact of research support on the institution's structure, its programs, goals and objectives. Also, it was hoped that these universities would gain a better understanding of research support throughout the state system and a clearer insight concerning the institution's own research role within this system. As a consequence, possible interrelationships of the institutions in the state system were expected to become more evident. The data collected in the study and the associated discussion were regarded as providing fundamental information which might be used as a basis for planning the future development of scientific research and education in Michigan's public institutions, both within individual institutions and for the system as a whole.

To further define the types of data required the two broad questions stated on page 2 were expanded into a number of more specific ones: Do common goals characterize the science research and education activities of Michigan's public colleges and universities, or do they differ significantly in identifiable respects? From these questions several categories of data and information were identified as evidence required to formulate answers. Thus the study attempts to describe the following:

1. *Quantitative aspects of support.* Amounts of support from Federal, state, and other nonFederal sources over the ten-year period, 1955–65. The amounts received from various sources would be related, insofar as possible, to institutional expenditures and to the number of students and faculty supported.
2. *Types of support.* Analyses of types of support from different sources (e.g., different departments and agencies of government, different types of private corporations and foundations) and of the flow of funds to different kinds of science activities.
3. *Mechanisms of support.* Relationship of amounts of support derived through various sources to the mechanisms by which the support is given. Qualitative significance of the various mechanisms of support, differential impact of the principal mechanisms of support on the institutions individually and collectively, including typical patterns of constraints, restrictions, or incentives associated with different mechanisms and different sources.
4. *Institutional management and development mechanisms.* Means used to originate research and development programs and the communication procedures with sources of support. Roles of the faculty and departmental and institutional administration in these processes. Relationship of type and mechanism of support to the disbursement and accounting procedures.
5. *Institutional impacts.* Relationship of support to the need for construction programs, procurement of equipment, recruitment of faculty, development of institutes, research centers, computer and data processing centers, and the development of interdisciplinary and cooperative enterprises both within and among institutions. Shifts in the historic functions and educational missions of the various institutions that have taken place in consequence of Federal and nonFederal support. Changes in emphasis which have occurred among the programs and curricula for which the different schools have been best known; changes in the mix of teaching and research programs; changes in the relative and absolute strength of certain scientific disciplines; changes in the emphasis given to special topics of research within the broader area of an academic discipline, changes in the emphasis given to public service.
6. *Faculty impacts.* Relationship of faculty to Federal and nonFederal sources of support. Institutional policies of recruitment and retention of faculty. The apportionment of time among research, teaching, and administrative work that has occurred as a consequence of the prevailing support structure.
7. *Faculty-administration relationships.* Qualitative judgments about the impact which the availability of Federal and nonFederal funds has on the relationship between administration and faculty.
8. *Student training and enrollments.* Determination of whether the availability of Federal support draws students into some programs in preference to others where support is not available. The directions Federal and nonFederal support have given to

graduate and undergraduate student training and research. The influence of support programs on curriculum development at the undergraduate level.

9. *Interinstitutional relationships*. Contribution of Federal and nonFederal support to the objectives of public higher education in the State of Michigan. The impact of Federal support programs on the staffing problems of smaller schools, in terms of training of future faculty and of competition for new faculty members. Specific programs involving interinstitutional cooperation or coordination developed in response to selective support programs.
10. *Policy implications*. Federal and nonFederal programs of support of research and education most likely to be perpetuated in the future by Michigan's public institutions of higher education. New policy developments likely to come into being in consequence of this.

In addition to the institutional benefits accruing from the collection and analysis of this data, other benefits were anticipated. State government officials should be able to see more clearly the role of research in state institutions and its relationship to the state's educational and economic development. Through assessment of the mechanisms, impacts, and consequences of various types of Federal and nonFederal research support, agencies of the Federal Government should gain insight into how Federal funds can best be distributed to promote the optimal development of higher education in the United States. The observed relationships between industrial research needs and higher education research potential may provide the basis for promoting increased industrial support of research and science education. Finally, the results of this study should be of benefit to other state public educational systems confronted with similar kinds of problems and issues.

Relation to Prior Studies

Of the many studies with broad, national approaches (many of which are listed in the bibliography in the supplement to this report), the study by Orlans most nearly approximates in its focus and questions the present study. In some respects the Orlans study, indeed, is a prototype for this one but, whereas Orlans was investigating the effects of *Federal* programs on a national sample of 36 colleges and universities, this study includes all state supported institutions of higher education in Michigan, and is concerned with impacts on individual institutions, as well as system-wide impacts and implications. Orlans' initial three questions were:

1. What have been the effects of Federal programs upon the quality of higher education, particularly at the undergraduate level?

2. To what extent can or should fuller use be made of institutions not heavily involved in present Federal programs?
3. What has been the experience of institutions with the administration of current Federal programs?

These questions are closely related to those raised in this study. Therefore, it is of interest to note here his answers to these three questions:

> 1. The direct effects of federal programs have been profound and beneficial in the sciences, noticeable but more imbalanced in the social sciences, and negligible in the humanities. Federal programs have *not* notably affected the relative proportion or quality of faculty or students going into the sciences, but *have* concentrated a large number of faculty and many of the best students at a few leading institutions. While improving the content of instruction by enlarging our knowledge in the sciences, their emphasis upon graduate research and education has depreciated the status of undergraduate teaching and reduced personal contact between senior faculty and lower classmen, especially at large universities. Nor has the quality of undergraduate science education been advanced by the deflection of the best graduate students from teaching assistantships to federal fellowships and research assistantships. The government (and vaster historical forces) has divided the liberal arts faculty into a contingent of relatively young scientists and social scientists with lighter teaching loads, higher income, substantial research support, and other perquisites, and another contingent of older humanists, with heavier teaching loads, lower incomes, and little research support.
> 2. The heavy concentration of federal research and development funds at a few major installations should be continued; but a greater effort is warranted to extend other programs of scientific research and education to more institutions below the d[illegible] level which do not now participate extensively in them. The desirability of dis[illegible] more broadly among doctoral level institutions funds now heavily concentrated at a few leading universities must be determined by the degree to which this advances the objectives of individual programs. High priority should be given to strengthening scientific research and education at leading state universities.
> 3. Government programs have developed along two administrative lines: the project system, in which funds are controlled by individual faculty for designated purposes; and various forms of aid for broader purposes, in which funds are controlled by alliances of faculty or by higher administrative officers. Both methods of support are needed: the project system is vital to the maintenance of high professional standards and the freedom of the individual investigator; broader forms of support are desirable to strengthen neglected scientific and educational areas. In both systems, it is important to emphasize criteria of quality and to resist pressures to distribute money on the basis of a mathematical formula.

The data collected by Orlans and the procedures described are also similar to this study in many respects. Trends in student and faculty quality, faculty-student contacts, teaching loads, "balance," faculty administration relationships, impacts on administration and record keeping

Harold Orlans, *The Effects of Federal Programs on Higher Education. A Study of 36 Universities and Colleges* Washington, D.C.: The Brookings Institution, 1962, pp. 293-294.

Ibid

functions these and others are common concerns. The conclusions of Orlans' report may be usefully compared with those of this study. The Carnegie Report summarized in the April, 1963 Special Issue of *The Educational Record* discusses many of the same issues.[12]

This study is also, in some sense, related to several previous studies that have examined the operations and interrelationships of Michigan's institutions of higher education. A state-wide survey of higher education in Michigan was made by John Dale Russell some years ago.[13] More recently, a citizens committee, appointed by the Governor, studied the problems of higher education (including science education) in the State of Michigan. The report of the Michigan Citizens Committee on Higher Education stressed the need for interinstitutional cooperation and planning in connection with graduate education in the sciences.[14] It urged the institutions (a) to develop a well-formulated statement of policy regarding the acceptance of Federal and nonFederal research support, and (b) to examine their research programs and directions in terms of the specific needs of Michigan, as well as those of the Federal government. It also stressed the need for a fresh examination of possible means for coordinating research and development activities carried on by Michigan's academic institutions, the Federal and state governments, and industry. The present study considers these and other issues raised by the Citizens Committee.

Another earlier study which provides some background for the current study is: *A Comparison of the Research Patterns of Michigan Universities with State and National Research and Industrial Trends*. Institute of Science and Technology, 1964. A 1960 study, *Science Programs in the State-Supported Institutions of Higher Education* in Michigan produced by the Science Study Committee for the Michigan Council of State College Presidents, is also indicative of concern with some of the issues here examined.

Organization of the Study

Following some informal exploratory discussions and correspondence with members of the National Science Foundation planning staff, the

[12] The Carnegie Report "Twenty-six Campuses and the Federal Government," *The Educational Record*. 1963, 44(2) (Special Issue), pp. 95 136.

[13] John Dale Russell. *Higher Education in Michigan The Final Report of the Survey of Higher Education in Michigan* Prepared for the Legislative Study Committee on Higher Education. Lansing, Michigan: The Committee, September 1958.

[14] Michigan Citizens Committee on Higher Education, Report of Study Committee II. *Graduate and Graduate-Professional Studies. Research and Public Services*. Lansing, Mich.: The Committee, March 1965.

National Science Foundation provided a small grant for an initial meeting in June, 1966 of representatives of the twelve institutions and several members of the staff of the National Science Foundation. The purposes of the study and the general nature of the data to be collected were discussed. Following that session, the project was discussed on each campus, and shortly thereafter approval and assurance of cooperation was forthcoming from all institutions. The contract for the conduct of the study was finally negotiated in January, 1967.

It was agreed that the study would be based on the Michigan State University campus, and would be carried out by a principal and an associate investigator located on that campus. In addition, each institution agreed to appoint a liaison representative to work with the principal and associate investigators in assembling necessary institutional data, to participate in formulating questionnaires, and in the conduct of necessary interviews.

A steering committee and an advisory committee were established to provide direction and consultation. The steering committee, composed of representatives from four of the institutions participating in the study and a representative of the State Department of Education, served in a capacity approximating that of an executive committee for the larger liaison group. The advisory body was composed of outstanding Michigan citizens representing industry, labor, and government. The names of the individuals serving on these respective groups are given in the preface. Dr. M. Frank Hersman, of the National Science Foundation, served most helpfully as the coordinating contact.

The contract was predicated upon the agreement of the cooperating institutions that they would bear approximately one-third of the costs of the study through contributions of the time of faculty, administrative personnel, and liaison personnel. The Office of Institutional Research of Michigan State University provided office space and the equipment. The two-thirds support provided by the National Science Foundation included a modest sum to provide for payment of unusual expenses incurred at the individual institutions participating in the study.

The details of procedure, data collection forms, and interview schedules were developed by the investigators, checked with the NSF liaison group, reviewed by the steering committee, and ultimately approved by the liaison representatives of the institutions. All of this was found to require considerable time and involved delays which materially slowed the progress of the study.

Institutions also found that completion of the several forms required more time than anticipated. Institutional records turned out to be less adequate and less convenient in relation to the precise data required than had been anticipated. Thus a project originally envisaged as an eight- to twelve-month project was stretched to two years.

One result of this was that the initial enthusiasm and interest on the part of the institutions were somewhat decreased by pressures of other events, especially certain ones which related to the character of the Michigan system of higher education and the autonomy of the individual institutions in that system. This did not make the institutions any less cooperative, but it did create concern as to whether the data being collected and the issues being investigated might be more sensitive than had originally been envisaged. The factors involved have been noted earlier in this chapter. Some shadows have also been cast upon the study by the fact that Federal support has not increased to the extent nor in the patterns anticipated. However, this latter development has been regarded as a temporary-one which does not decrease the significance of the study and which in some ways may enhance it because of increased potential for reconsideration of past policies and the development of new ones.

Organization of the Report

In this introductory chapter, the circumstances giving rise to this study have been briefly presented. Discussion of the research design, the data collection procedures, the nature of the data or evidence sought, the rationale for its inclusion, and a summary of the problems met and general nature of the responses was relegated to the Supplement of the original report to the National Science Foundation, since only those persons interested in technical details will find them of value. In Chapter 2, the pattern of research support is examined. Chapter 3 considers some of the problems in financing science research such as distribution policies, balance, and grants vs. contracts.

Chapter 4 considers the impact on the instructional staff and students, and Chapter 5 examines effects on administrative organization and practices. In each case, insofar as relevant, the various types of data are reviewed in reference to the particular area of impact on which the chapter focuses.

Chapter 6 brings together the various broad issues and policy problems identified in carrying out the study. Some of these transcend the specific issues originally raised and their consideration here results as much or more from the observations and developed convictions of the investigators as from the data collected and the views expressed in the institutions.

II. The Patterns of Research Support

The heightened research emphasis in universities is not due solely to increased Federal funds. Other sources, both public and private, also support research. Furthermore, research support, even if it included all capital facilities as well as operating costs, could not have been effective without the intellectual resources already existing in universities. Continued and increased support of research in the universities has produced the capacity for still greater research activity and results. Physical facilities have been erected, but even more important is the increase in personnel trained to plan, carry out, and administer research. Institutions supported because of their established capacity for research accomplishment, have further strengthened their research capacities.

The benefits of scientific research activity are broad enough to apply in some sense to the goals and aims of each institution in the Michigan state system. Providing scientific knowledge relevant to the attainment of major social or economic goals, contribution to the cultural heritage, improvement of the quality of instruction and learning all these are fundamental educational concerns. To some degree they are interrelated, but they are not valued equally by all scientists or pursued with equal emphasis by institutions. Most Michigan institutions are moving to increase research activity and emphasis relative to other historic functions or missions, but the nature and extent of research effort varies markedly.

The amounts and types of funding for scientific research are delimited by the institutional purposes and current extent of research activity, but benefits are not. A "big science" research project involving extensive facilities and many trained personnel, although mission directed, may offer derivative cultural and instructional benefits. Modest mission-oriented projects ("little science"), centering around an individual investigator, may have similar results. However, mission-oriented funds aimed at societal goals do not flow evenly to all institutions nor to all individuals within an institution. Facilities and the specific, individual talents are required for the conduct of such research.

Does adequate research funding reach those capable of making creative, scientific contributions and those engaged in the process of education as teachers or students? There is some opinion that the proportion of scientists capable of significant, creative contributions is very limited. Harvey Brooks estimates that no more than 5 percent of all basic scientific researchers have demonstrated such capacity.[1] Interviews of faculty in the Michigan institutions elicited similar expressions. Certainly the belief that highly creative scientific talent is commonplace and only needs funding to make it productive is not universally accepted. A more modest view is that there exist large numbers of competent investigators who by routine pursuit of questions lay the basis on which more creative and significant breakthroughs occur. Funds for this group have not been as readily available as some faculty members would like.

Since the goals of institutions and the capacities of individual institutions and scientists vary, some difficult decisions in the allocation of funds for science research have to be made. A fund allocating agency may have several interrelated and competing purposes. Educational institutions have purposes which may not exactly coincide with those of a funding agency. Institutions also have a role (both in formation of policy and in submission of proposals) in deciding the areas of science, the particular projects, and the particular individual researchers which shall be funded. Conflict arises between the freedom desired by fund recipients and the agency restrictions deemed necessary to insure the accomplishment of the purposes of the research. Finally, the importance of research funds in the overall growth and prestige of colleges and universities may foster institutional competition.

Some insight into the strength of the research orientation of the various Michigan institutions is acquired by analyzing faculty estimates of the percent of their professional effort given to research. Table 2-1 indicates considerable variation among the state institutions in the percent of a sample of science faculties who are actually spending, and who would prefer to spend, 31 percent or more of their effort in research activity. Only at the U of M and MSU did a majority of the faculty sampled both prefer and actually spend over 30 percent of their professional effort in research. At four other institutions, WSU, OU, WMU, and EMU, a majority preferred to, but did not actually, expend that proportion of effort. Notable, however, is the fact that the preference in each sample is for more research activity.

The Faculty Questionnaire, to which repeated reference is made throughout this report, was administered to a sample of Faculty in each of the twelve institutions included in the study in the areas of Engineering, Life Science, Physical Science, Social Science, and Psychology. For each

[1] Harvey Brooks, "Future Needs for the Support of Basic Research," in National Academy of Sciences, *Basic Research and National Goals* (March, 1965), p. 6.

TABLE 2-1
PERCENT OF A SAMPLE OF SCIENCE FACULTY ACTUALLY SPENDING AND PREFERRING TO SPEND 31-100 PERCENT OF PROFESSIONAL EFFORT IN RESEARCH

INSTITUTION	(N)*	PERCENT OF FACULTY	
		Actual	Preferred
MSU	97	59	86
U of M	96	52	76
WSU	43	35	74
OU	27	30	70
WMU	42	22	79
EMU	38	18	61
MTU	35	17	46
NMU	27	7	26
FSC	29	7	10
CMU	46	7	46
GVSC	39	3	21

*N total number of respondents to item

of the areas and for each academic rank from instructor to professor 10 percent of the faculty were sampled at U of M, MSU, and WSU; 20 percent at WMU and MTU; 40 percent at CMU, EMU, NMU, OU, and FSC; and 100 percent at GVSC and SVSC. Usable returns were received from 90 percent of the faculty sampled.

The faculty sampled also responded to the question of the relative importance of instruction, research, and publication to an individual's status in his academic department. Table 2-2 shows a striking percentage of faculty in most institutions responding that no one activity is more

TABLE 2-2
ACTIVITY CITED BY SCIENCE FACULTY SAMPLED AS THE STRONGEST CONTRIBUTOR TO STATUS

INSTITUTION	(N)*	PERCENT OF FACULTY IN EACH CATEGORY OF ACTIVITY				
		Instruction	Research	Publication	No One Activity	Don't Know
MSU	(95)	2	23	27	44	3
U of M	(93)	4	32	15	43	5
WSU	(43)	7	14	35	40	5
MTU	(34)	12	18	15	41	15
EMU	(37)	16	8	32	38	5
WMU	(41)	17	7	17	46	12
OU	(27)	19	15	19	44	4
CMU	(43)	28	0	21	40	12
NMU	(26)	38	11	8	38	4
GVSC	(38)	58	0	5	21	16
FSC	(29)	69	0	7	7	17

*N - total number of respondents to item important than any other. The number so responding combined with those responding "Don't know" comprised 40 50 percent of all faculty sampled in every institution except GVSC and FSC: in these two institutions most faculty respondents see high status as dependent on instructional activity. Clearly, where research and/or publication are very strong contributors to high status, instruction as a positive factor is very weak, and *vice versa*.

The relative strength of the research goals and aspirations in the Michigan public institutions of higher education can further be gauged by an analysis of the amount of time or effort expended in instruction. At U of M, MSU, WSU, and OU, the majority of the faculty sampled not only preferred to, but actually spent, half or less than half of their professional effort or time in instructional activities (classroom teaching and preparation, dissertation direction, service on student program committees, grading, counselling, and course development). At WMU, MTU, and EMU a majority of the faculty sampled *preferred to spend* half or less than half of their effort in instruction, but *actually were spending* over half. At CMU, NMU, FSC and GVSC the majority of the faculty sampled both preferred to, and actually did, spend over half of their efforts in instruction. Despite variations, the faculty in each institution except FSC (where the actual and preferred efforts in instruction coincided closely) preferred less time in instruction than was actually the case.

These faculty views emphasize the strong research orientation in the science areas at the U of M, MSU, and WSU. These views also reflect recognition within the institutions of considerable variation in the strength of their relative research orientations and levels of research activity. However, each institution tended to see itself as possessing certain strengths in research not shared with the others. In each of these three institutions interviewees strongly emphasized the interrelationship of research and instruction. Opinion at the U of M was that since World War II the mission of the University has indeed changed—if by change is meant a large growth in research activity. However, the shift in balance between research and instruction was felt to reflect an absolute growth in research and not a diminution in instruction as such. Faculty members and administrators of instructional units generally supported the view of the inseparability of instruction and research, especially in the area of graduate training and in the natural sciences.

Interviews at MSU and WSU suggest that the role of research in supporting instruction is even stronger at those two institutions than at the U of M and perhaps reflects a difference in the type of support sought and acquired. Comments on the educational equivalence of research and instructional funds were common from faculty and administrators of both MSU and WSU. Expansion in scope and strengthening in quality of the graduate programs through increased research funding and activity appeared as important goals of these two universities. Creativity in the undergraduate science program and preparation of undergraduate students for future research roles were seen as being stimulated by faculty research.

In strength of research orientation four institutions (MTU, OU, WMU, EMU) cluster somewhere beneath the three largest institutions. In these four institutions the close interrelationship between research programs and quality instruction was again underlined but the teaching function, and especially the paramount role of undergraduate training, was stressed. The desirability, or at least the feasibility, of full doctoral graduate programs in all areas of science was usually doubted. A more limited approach involving some research effort in practically all areas but a concentration of effort and a graduate program in a relatively few areas appeared to be the pattern constituting the most immediate goal. Moreover, groups of faculty dedicated almost entirely to undergraduate teaching and minimal research exist at these institutions. In three of the four institutions faculty orientation toward research and instruction is related to age and tenure with the older members being more oriented toward instruction. Current hiring practices favor development of a stronger overall research-graduate orientation.

At MTU graduate programs exist in some areas and there are four research centers or institutes associated with the University, but the major and continuing goal is that of undergraduate education. By 1975, however, the expectation is that graduate students will comprise about 8 percent of the total student body. This will involve considerable expansion in absolute numbers as the total student population grows. Also, continued and strengthened emphasis on meeting needs of the state and region not only through turning out technically trained graduates but also through the development of knowledge and its industrial applications leads to an expanding research function. The university as a whole is moving toward a stronger research orientation.

OU represents another type of institutional development toward a strengthened research orientation. Beginning as a small liberal arts oriented college, with a high percentage of its faculty from such colleges, OU after a period of three or four years has moved toward university status, including research and the development of programs of graduate instruction. The majority of both administrators and faculty interviewed insisted on the continued primacy of quality undergraduate education, followed in turn by the attainment of a program of quality graduate education. The opinion culled from both interviews and faculty questionnaire analysis is that research and the teaching function cannot be disentangled and that either an undergraduate or graduate program of quality without serious involvement of students and faculty in some research is inconceivable.

WMU and EMU represent still a third type of institutional development that of the movement of former teachers' colleges toward full university status. WMU is the only one of the former teachers' colleges offering the Ph.D. degree in the sciences. The orientation has become increasingly directed toward the research Ph.D., rather than toward teacher training. Recent staff acquisitions tend to be younger men who favor the growing research-graduate education emphasis, although instruction remains the dominant goal of the institution. Research project funding is still primarily sought as an aid in the education of students rather than the advancement of scientific knowledge as such or the fulfillment of the missions of agencies or industries. Science departments are in the van of the development within the University moving toward a full graduate program and strengthened research activity.

At EMU responses suggest that desire for involvement in research is somewhat less than at WMU. Graduate programs are less extensive and there is somewhat greater hesitancy among faculty in developing them. The close proximity of the U of M and WSU may afford a partial explanation. Nevertheless the considerable discrepancy between the research aims and ambitions of both faculty and administrators and the actual involvement suggests changing institutional goals and future lines of development. The rather high prestige accorded research and publication, the establishment of a university agency to assist in preparing research proposals, the existence of some important projects and strongly staffed departments—all are indicative of the emergence of new patterns.

At CMU and NMU there is a stronger emphasis on instruction and a lesser emphasis on research than at the other former teachers' colleges in Michigan, but fundamental changes are occurring at both institutions. Some master's degree programs stress training in the sciences rather than teacher training. Steps toward the development of research projects are found in some science areas. At NMU a special office to provide assistance in preparing proposals has been established. Hopes were expressed that research efforts would help meet the developmental needs of the upper peninsula region. And although there was skepticism about the early introduction of large-scale graduate and research programs, there was expressed a belief that the best and most exciting instructional programs were in areas which had received outside funds for equipment and research. At both CMU and NMU further steps toward a graduate study-research orientation may be expected, determined in extent and speed of implementation by a complicated interplay of available resources and the needs of students, faculty, state, regions, and the institutions themselves.

Relatively small proportions of the faculty sampled at FSC and GVSC were actually engaged or were interested in an active research program (to the extent of 31 percent or more of professional effort). The immediate goals of the institutions do not include any substantial attention to research. At FSC, the major continuing aims of the institution include both practical terminal programs and baccalaureate degree offerings. Although certain types of outside funds can be used to enhance these programs, the level of relevant research funding sought or received has been minimal. Funds for certain research services to industry, particularly in pharmacy, or for individual projects as part of the effort to maintain scholarly competence in the faculty are the major current needs.

GVSC, a relatively young institution, has a faculty and administration which has bent its effort to the successful establishment of a quality undergraduate program with a liberal arts inclination. As a new school staffed originally by faculty oriented to instruction, no major research activity centered on the campus has been launched. A few faculty members have been involved in projects based elsewhere. However, interest in and recognition of a significant role for research exists. There was a general expression that some research is necessary for personal, professional fulfillment and especially for service as an integral part of, or helpful adjunct to, the undergraduate instructional process in the sciences, but usually with the caution that research should not infringe upon instruction. Research funding and faculty time allowances which would support, not strain, the undergraduate program are considered essential. Some graduate instruction is now conducted by GVSC personnel in campus buildings under the auspices of, and with credit given by, the U of M. The institution as a whole appears to be delaying a decision about initiating graduate education with its research implications. However, that such a development is an expectation for the future is clear. The problem is, what is proper and necessary funding support to transitional or emerging institutions, and how is it to be provided?

SVSC, the youngest of all of the state institutions, is still engrossed in the problems of undergraduate curriculum development. But here, too, the expectation expressed in interviews is for the existence of a major institution in the future. With some populous communities nearby as a source of students, with demands for services as well as the offer of support from industry in the area, with the problems of urbanism and of the means for development of natural resources in the region being pressing ones the outlook is for a rather rapid growth for the institution and an expansion of programs leading in time to inclusion of graduate work and significant research.

The General Pattern of Support

Funds for Separately Budgeted Research General Distribution. Even more striking than the variations in the expressed and implied research goals are the variations among the institutions in funds expended for research. Table 2-3 includes all data available from each institution, indicating the total amount of funding for separately budgeted research from all sources. Included in this category of funding are all funds which are actually separately budgeted by the institution for R & D. Included are funds designated for research by Federal or nonFederal sponsors and the institution's own funds for which the institution has a choice in their disposition. These funds could be variously employed for research by individuals, groupings of individuals, or formalized institutes within the structure of the institution. The variations in funding among the institutions are immediately apparent. The institutions which in a consideration of current goals and aims appeared to be least oriented toward research NMU,CMU, FSC, GVSC, and SVSC are those with the least funding. The institutions whose faculty and administration expressed a somewhat stronger, immediate aim at conducting and developing graduate-research programs cluster in a middle group in funding. These include MTU, WMU, and OU. Added to this group could be EMU which did not currently have funding data available for the years included in this study but did report separately budgeted research expenditures in 1966-67 amounting to $184,000.

The variations in actual research expenditures among the other three institutions U of M, MSU, and WSU are so considerable that a fourfold classification of all institutions is suggested. The U of M, standing by itself, had expenditures in 1965-66 of over $47 million for research in the science areas included in the study. These expenditures were approximately two and one-quarter times the expenditures of all the other institutions combined and were over three times those of MSU. MSU, standing alone in a second category, had expenditures over three times those of WSU, and WSU, in turn, had expenditures over three times those of all of the other institutions combined.

TABLE 2-3

FUNDS EXPENDED FOR SEPARATELY BUDGETED RESEARCH IN THE SCIENCES BY INSTITUTION, YEAR, AND SOURCE OF FUNDS*
(IN THOUSANDS OF DOLLARS)

INSTITUTION	1957-58		1960-61		1963-64		1964-65		1965-66	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
U of M										
Federal Funds	14,575	78.2	21,095	78.1	31,846	84.2	36,067	83.5	38,502	81.1
Instit. Funds	1,158	6.2	2,267	8.4	2,629	6.9	2,971	6.9	3,206	6.8
NonFed. Funds	2,913	15.6	3,636	13.5	3,360	8.9	4,144	9.6	5,756	12.[illegible]
Total	18,646	100.0	26,998	100.0	37,805	100.0	43,182	100.0	47,464	100.0
MSU										
Federal Funds	1,415	27.9	2,579	39.0	5,963	58.3	6,680	56.6	8,597	61.2
Instit. Funds	2,895	57.0	3,258	49.3	3,266	31.9	4,029	34.2	4,248	30.3
NonFed. Funds	765	15.1	774	11.7	1,003	9.8	1,084	9.2	1,196	8.5
Total	5,075	100.0	6,611	100.0	10,232	100.0	11,793	100.0	14,041	100.0
WSU										
Federal Funds	....	...	....	...	3,611	83.0	3,469	79.6	3,240	80.7
Instit. Funds	....	...	....	...	50	1.1	129	3.0	36	.9
NonFed. Funds	....	...	....	...	690	15.9	760	17.4	738	18.4
Total	....	...	....	...	4,351	100.0	4,358	100.0	4,014	100.0
MTU										
Federal Funds	....	...	....	...	....	...	334	48.5	309	43.1
Instit. Funds	....	...	....	...	....	...	45	6.5	33	4.6
NonFed. Funds	....	...	....	...	....	...	310	45.0	375	52.3
Total	....	...	....	...	....	...	689	100.0	717	100.0
WMU										
Federal Funds	....	...	....	...	....	...	100	56.8	132	53.4
Instit. Funds	....	...	....	...	....	...	44	25.0	56	22.7
NonFed. Funds	....	...	....	...	....	...	32	18.2	59	23.9
Total	....	...	....	...	....	...	176	100.0	247	100.0

OU										
Federal Funds	. . . . .	. . . .	0	0.0	41	97.6	52	85.2	98	83.0
Instit. Funds	. . . . .	. . . .	0	0.0	0	0.0	0	0.0	0	0.0
NonFed. Funds	. . . . .	. . . .	1	100.0	1	2.4	9	14.8	20	17.0
Total	. . . . .	. . . .	1	100.0	42	100.0	61	100.0	118	100.0
NMU										
Federal Funds	. . . . .	. . . .	6	100.0	43	100.0	54	100.0	37	100.0
Instit. Funds	. . . . .	. . . .	0	0.0	0	0.0	0	0.0	0	0.0
NonFed. Funds	. . . . .	. . . .	0	0.0	0	0.0	0	0.0	0	0.0
Total	. . . . .	. . . .	6	100.0	43	100.0	54	[illegible]	37	100.0
CMU										
Federal Funds	. . . . .	. . . .	69	82.2	8	40.0	40	90.9	13	100.0
Instit. Funds	. . . . .	. . . .	0	0.0	0	0.0	0	0.0	0	0.0
NonFed. Funds	. . . . .	. . . .	15	17.8	12	60.0	4	9.1	0	0.0
Total	. . . . .	. . . .	84	100.0	20	100.0	44	100.0	13	100.0
FSC										
Federal Funds	. . . . .	. . . .	0	0.0	2	50.0	1	25.0	4	66.7
Instit. Funds	. . . . .	. . . .	0	0.0	0	0.0	0	0.0	0	0.0
NonFed. Funds	. . . . .	. . . .	7	100.0	2	50.0	3	75.0	2	33.3
Total	. . . . .	. . . .	7	100.0	4	100.0	4	100.0	6	100.0

*Where blanks appear either there were no such funds or the data were not available at this time

TABLE 2-4
COMPARISON OF GENERAL FUND EXPENDITURES FOR INSTRUCTION AND DEPARTMENTAL RESEARCH IN THE SCIENCES WITH EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH IN THE SCIENCES, BY SELECTED INSTITUTIONS AND YEAR*
(IN THOUSANDS OF DOLLARS)

INSTITUTION	1957 58	1960 61	1963 64	1964 65	1965 66
U of M					
G.F. Expend.	11,397	13,301	16,123	18,202	20,528
Sep. Budg. Res.	18,646	26,998(145)	37,805(203)	43,182(231)	47,464(255)
MSU					
G.F. Expend.	7,757	8,133	10,086	11,848	14,422
Sep. Budg. Res.	5,075	6,611(130)	10,232(202)	11,793(232)	14,041(277)
WSU					
G.F. Expend.	. . .	. . . . .	5,000	7,000	9,500
Sep. Budg. Res.	. . .	. . . . .	4,351	4,358(100)	4,014(92)
MTU					
G.F. Expend.	. . .	. . . . .	. . . . .	1,803	2,463
Sep. Budg. Res.	. . .	. . . . .	. . . . .	689	717(104)
OU					
G.F. Expend.	. . .	. . . . .	. . . . .	. . . . .	689
Sep. Budg. Res.	. . .	1	42	61(145)	118(280)
WMU					
G.F. Expend.	. . .	. . . . .	. . . . .	2,529	3,246
Sep. Budg. Res.	. . .	. . . . .	. . . . .	176	247(140)
CMU					
G.F. Expend. (salaries only)	. . .	487	679	816	1,053
Sep. Budg. Res.	. . .	84	20(24)	44(52)	13(15)
NMU					
G.F. Expend.	. . .	. . . . .	. . . . .	. . . . .	. . . . .
Sep. Budg. Res.	. . .	6	43(717)	54(900)	37(617)
FSC					
G.F. Expend.	. . .	. . . . .	. . . . .	. . . . .	. . . . .
Sep. Budg. Res.	. . .	7	4(57)	4(57)	6(86)

*Separately Budgeted Research Expenditures are expressed as a percentage of those for the base year in the parenthetical figures. The base year is the first year for which funds are entered, with the exception of Oakland for which 1963 64 is used

Table 2-4 gives an indication of the strength of research activity compared with other academic activities in science in institutions for which appropriate data were available. Throughout the period between 1957 and 1966, the U of M's separately budgeted research expenditures in science exceeded its Instruction and Departmental Research expenditures, and from 1960 on more than doubled them. As a part of Instruction and Departmental Research expenditures are all funds for R & D from the institution's own funds for which the institution has a choice in their disposition, but which are not actually separately budgeted for R & D. As MSU became more research oriented, its separately budgeted research expenditures pulled even with the Instruction and Departmental Research expenditures. At WSU from 1963-66, the separately budgeted research expenditures have varied around the point of being one-half of the Instructional and Departmental Research funds; the proportion has been about one-third at MTU, one-sixth at OU, with lesser proportions at WMU and CMU.

There was little change over the nine year period between 1957 and 1966, as the parenthetical percentages show, toward a lessening of differences in separately budgeted research expenditures among the colleges and universities. Absolute differences between the "haves" and the "have-nots" in research funds increased considerably. In general, those most successful in acquiring research funds and in building up staff and facilities for the successful conduct of research in the past have also been most successful in acquiring still more funds.

An analysis of the sources of funds for separately budgeted research in the Michigan state colleges and universities can be made on the basis of the categories of Federal Funds, Institution's Own Funds, and NonFederal Funds. Included under NonFederal Funds are grants and contracts for research from industry, foundations, voluntary health agencies, and funds designated for special research projects from state and local governments. The category of Institution's Own Funds includes those funds in the use of which the institution has a choice and which the instituition has actually budgeted separately for research and development. An important item included in Institution's Own Funds in Table 2-3 and elsewhere are the state legislative appropriations for the Agricultural Experiment Station at Michigan State University. Although these are not General Fund appropriations and might possibly be included under the category of NonFederal Funds from the state, the considerable degree of leeway afforded for their distribution among many specific projects was used as a basis for including these funds under the heading of Institution's Own Funds.

TABLE 2-5
FUNDS EXPENDED FOR SEPARATELY BUDGETED RESEARCH IN THE SCIENCES FOR ALL INSTITUTIONS BY SOURCE FOR YEARS 1964-65 AND 1965-66*
(IN THOUSANDS OF DOLLARS)

	1964-65		1965-66	
	Amount	%	Amount	%
Federal Funds	46,797	77.5	50,932	76.4
Institution's Funds	7,218	12.0	7,579	11.4
NonFederal Funds	6,346	10.5	8,146	12.2
Total	60,361	100.0	66,657	100.0

*Data were not available from EMU. GVSC and SVSC did not have data to enter

Relatively complete data were available on separately budgeted research expenditures by the institutions for 1964-65 and 1965-66. All institutions are included except EMU for which data were not available and GVSC and SVSC which did not have data to enter. Table 2-5 shows that within the state, about 77 percent of all funds came from the Federal governmental agencies, 12 percent from Institution's Own Funds, and 11 percent from other nonFederal sources. A more complete analysis of science research funding by source can be made by reference to Table 2-3. For the U of M, and most significantly for MSU, the proportion of funds from all Federal sources increased during the nine-year period. At MSU the proportion of funds from other nonFederal sources showed a significant decline though an absolute increase occurred. This trend in funding was accompanied at MSU by a precipitous decline in the *proportion* of separately budgeted research financed by the Institution's Own Funds which include state legislative appropriations for the Agricultural Experiment Station. Examination of Table 2-3 shows that for all institutions (with the possible exception of MTU with strong financing from nonFederal sources) the reliance in large schools and small ones alike has been mainly upon the Federal government. Campus interviews also elicited expectations for major future funding from the Federal government.

The distribution for 1964-65 and 1965-66 of all separately budgeted research funds for all institutions among the areas of science included in the study is indicated in Table 2-6. Expenditures for the Life Sciences combined (Agr., Bio., and Med.) account for 39 percent of the total against 49 percent for the Physical Sciences and Engineering. Expenditures for medical research exceeded those for engineering research, which in turn exceeded those in the Biological Sciences as such. Expenditures in Social Science and Psychology amount to only about 10-11 percent of the total of all science expenditures. However, because of cost differentials

TABLE 2-6
TOTAL EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH FOR ALL INSTITUTIONS BY AREA OF SCIENCE AND THE YEARS 1964 65 AND 1965 66*
(IN THOUSANDS OF DOLLARS)

AREA OF SCIENCE	1964 65		1965 66	
	Amount	%	Amount	%
Engineering	9,775	16.2	11,002	16.5
Physical Science	19,673	32.6	21,527	32.3
Life Science Agr.	4,150	6.9	5,199	7.8
Life Science Bio.	8,920	14.8	9,766	14.6
Life Science Med.	10,769	17.8	11,303	17.0
Social Science	4,403	7.3	5,374	8.1
Psychology	1,508	2.5	1,720	2.6
Other	1,163	1.9	766	1.1
Total	60,361	100.0	66,657	100.0

*Data were not available from FMC, and GVSC and SVSC did not have data to enter

for research in the various disciplines, variations in funding do not by themselves indicate whether the needs of the respective areas are adequately met. Data in Table 2-7 which provide some perspective over a nine year period between 1957 58 and 1965 66, show important increases in funding for Social Science and Psychology at the U of M and MSU, but do not indicate an appreciably greater proportion of all funds to these areas.

Variations in the fields of research emphasis on an institutional basis are indicated by Table 2-7. For the three largest institutions—U of M, MSU, and WSU—the balance of research emphasis within each institution is considerably different. The U of M shows a much greater emphasis than MSU or WSU on research in Engineering and Physical Science, both in absolute amounts of funds and in proportion of all separately budgeted research funds spent. Although the U of M had more strongly financed research programs in the Medical and Biological Sciences, WSU spent a much greater proportion of its total separately budgeted research funds on medical research. MSU spent a much greater proportion (36 percent in 1965-66) of its total separately budgeted research funds on biological science research than did U of M (11 percent). Of the three institutions WSU shows the strongest concentration of funds in any one field (50 percent in 1965-66 in Medical Science). MSU has retained much of its emphasis in research on the Agricultural and Biological Sciences with the former making up 36 percent of the total expenditures from separately budgeted research funds in 1965–66 and the latter 24 percent. The emphasis on agricultural research has lessened somewhat

TABLE 2-7

TOTAL EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH BY AREA OF SCIENCE, INSTITUTION, AND YEAR
(IN THOUSANDS OF DOLLARS)

INSTITUTION	1957-58 Amount	1957-58 %	1960-61 Amount	1960-61 %	1963-64 Amount	1963-64 %	1964-65 Amount	1964-65 %	1965-66 Amount	1965-66 %
U of M										
Engineering	3,824	20.5	5,537	20.5	7,757	20.5	8,391	19.4	9,462	20.0
Physical Science	7,010	37.6	10,146	37.6	15,006	39.7	16,687	38.6	18,233	38.4
Life Science Agr.	37	.2	61	.2	74	.2	122	.3	168	.4
Life Science Bio.	2,198	11.8	3,175	11.8	4,334	11.5	4,790	11.1	5,382	11.3
Life Science Med.	3,497	18.8	5,066	18.7	6,801	18.0	8,125	18.8	8,421	17.7
Social Science	1,309	7.0	1,896	7.0	2,372	6.3	3,350	7.8	4,232	8.9
Psychology	475	2.5	689	2.6	1,025	2.7	1,144	2.7	1,375	2.9
Other	296	1.6	428	1.6	436	1.1	573	1.3	191	.4
Total	18,646	100.0	26,998	100.0	37,805	100.0	43,182	100.0	47,464	100.0
MSU										
Engineering	256	5.0	437	6.6	737	7.1	903	7.7	987	7.0
Physical Science	284	5.6	662	10.1	1,805	17.7	1,882	15.9	1,983	14.1
Life Science Agr.	2,513	49.5	2,832	43.1	3,262	31.8	3,990	33.8	4,992	35.6
Life Science Bio.	1,236	24.4	1,448	22.0	2,638	25.8	3,062	26.0	3,353	23.9
Life Science Med.	22	.4	178	2.7	235	2.4	255	2.2	886	6.3
Social Science	540	10.7	702	10.7	776	7.5	906	7.7	1,057	7.5
Psychology	41	.8	151	2.3	168	1.7	205	1.7	214	1.5
Other	183	3.6	165	2.5	611	6.0	590	5.0	569	4.1
Total	5,075	100.0	6,575	100.0	10,232	100.0	11,793	100.0	14,041	100.0
WSU										
Engineering	....	...	....	...	89	2.1	132	3.0	188	4.7
Physical Science	....	...	....	...	673	15.4	706	16.2	830	20.7
Life Science Bio.	....	...	....	...	885	20.3	985	22.7	885	21.9
Life Science Med.	....	...	....	...	2,607	60.0	2,385	54.7	1,993	49.7
Social Science	....	...	....	...	17	.4	43	1.0	22	.5
Psychology	....	...	....	...	80	1.8	107	2.4	96	2.4
Total	....	...	....	...	4,351	100.0	4,358	100.0	4,014	100.0

MTU										
Engineering	...	...	...	...	...	...	335	48.6	323	45.0
Physical Science	...	...	...	...	...	...	280	40.5	316	44.1
Life Science Agr.	...	...	...	...	...	...	38	5.6	39	5.5
Life Science Bio.	...	...	...	...	...	...	36	5.3	39	5.4
Total	...	...	...	...	...	...	689	100.0	717	100.0
WMU										
Engineering	...	...	...	...	...	...	14	8.0	42	17.0
Physical Science	...	...	...	...	...		73	41.5	119	48.2
Life Science Bio.	...	...	...	...	...		5	2.8	14	5.7
Social Science	...	...	...	...	...	...	73	41.5	41	16.6
Psychology	...	...	...	...	...	...	11	6.2	25	10.1
Other	...	...	...	...	...	...			6	2.4
Total	...	...	...	...	...	...	176	100.0	247	100.0
OU										
Physical Science	...	...	1	100.0	6	14.3	18	29.6	29	24.6
Life Science Bio.	...	...			11	26.2	38	62.3	84	71.2
Social Science	...	...			15	35.7	4	6.5	3	2.5
Psychology	...	...			10	23.8	1	1.6	2	1.7
Total	...	...	1	100.0	42	100.0	61	100.0	118	100.0
NMU										
Physical Science	...	...			30	69.8	23	42.6	10	27.0
Life Science Bio.	...	...			13	30.2	4	7.4	9	24.3
Social Science	...	...	6	100.0			27	50.0	16	43.3
Psychology	...	...							2	5.4
Total	...	...	6	100.0	43	100.0	54	100.0	37	100.0
CMU										
Physical Science	...	...	49	58.3	7	35.0	4	9.1	7	53.8
Life Science Bio.	...	...	35	41.7	4	20.0				
Psychology	...	...			9	45.0	40	90.9	6	46.2
Total	...	...	84	100.0	20	100.0	44	100.0	13	100.0
FSC										
Life Science Med.	...	...	7	100.0	4	100.0	4	100.0	3	50.0
Social Science	...	...							3	50.0
Total	...	...	7	100.0	4	100.0	4	100.0	6	100.0

over time with the shift being from 50 percent of total expenditures in 1957 58 to 36 percent in 1965 66. The major increase at MSU came in the Physical Sciences with a shift from 6 percent of total expenditures to 14 percent over the nine year period.

MTU, as Table 2-7 indicates, has stressed research in Engineering and Physical Science. Similarly, FSC noted for its pharmacy curriculum has centered its separately budgeted research in Medical Science. OU has emphasized the Biological Sciences. At WMU, NMU, and CMU the Physical Sciences have received most support, but for quite different purposes than at U of M.

Funds for Separately Budgeted Research in Specific Fields

Engineering. Further insight into the pattern of research funding in the Michigan state colleges and universities can be gained by an analysis of the sources of support for separately budgeted research in the individual areas of science. Brief summary comments based on a mass of data collected are included here. In Engineering, the U of M consistently received from 1957 to 1966 a very high proportion (78 percent to 90 percent) of its funds from Federal agencies. In 1965-66, the Aerospace and Electrical Engineering departments combined received 67 percent of the total awards of $9,462,000 from all sources, Federal and nonFederal, for separately budgeted engineering research *for that year* at U of M. Nearly all of this came from two strongly mission-oriented agencies: Department of Defense ($3,007,000) and NASA ($3,170,000). Federal support to engineering research at MSU has not included large-scale, mission-oriented projects. Approximately half of its Federal awards in 1965-66 came from the National Science Foundation. The Federally-financed awards increased by over 500 percent between 1957 and 1966 but remained small in total compared to the U of M. At MTU, third in separately budgeted research expenditures in engineering, over 80 percent of its $223,000 in Federal awards in 1965-66 came from DOD and AEC to the fields of Mechanical Engineering and Chemical and Metallurgical Engineering. At WSU, Federal support of engineering research was relatively small between 1963–66, variable as a proportion of total expenditures and concentrated largely in Engineering Mechanics. Major grants were from the Public Health Service but with significant support from NSF in 1965–66.

The proportion of nonFederal funds, including both the category of Institution's Own Funds and of Other NonFederal Funds, which was spent on separately budgeted engineering research declined over a period of years from 1957 to 1966 at the U of M (22 percent to 11 percent) and at MSU (66 percent to 55 percent). In all of the universities combined which conducted separately budgeted engineering research in 1965 66, only 16 percent of the funds expended were nonFederal.

Physical Sciences. In 1964 65, $18,822,000 or 96 percent of the total Physical Sciences expenditures of $19,664,000 came from Federal sources. In 1965 66 the Federal percentage of total expenditures of $21,507,000 was 90 percent. OU, WSU, and especially MTU had relatively small proportions of their total separately budgeted expenditures in the Physical Sciences from Federal sources. Funds from industry or private foundations accounted for the variation. As in Engineering, the U of M dominated the expenditures, accounting for about 85 percent of all expenditures from all sources. In 1965 66 Physics at U of M expended 88 percent of all Federal funds for Physical Science at that institution and 75 percent of all funds for Physical Science at all institutions. DOD and AEC provided over 80 percent of the total funds spent by the U of M's Physics Department. At MSU, Physics also dominated, accounting for 65 percent to 75 percent of total Federal funds expended, but obtained 75 to 78 percent of these from NSF. At the state universities other than the U of M and MSU, the preponderance of support for separately budgeted research in the Physical Sciences has been provided by Federal funding and primarily for research in chemistry. The exception is MTU where nonFederal funds and state awards play an important role in earth science research. NIH and NSF have been the primary sources of Federal support.

Life Sciences, Medical. The proportion of total expenditures on separately budgeted medical research coming from Federal sources for all institutions combined was 76 percent in 1964-65 and 77 percent in 1965-66. NIH awards made up the great bulk of Federal expenditures at both the U of M and WSU where the medical research was concentrated. In 1965-66, 69 percent of the U of M's and 86 percent of WSU's medical research funds from Federal sources came from NIH. Private foundations and voluntary health organizations were important sources of funds for separately budgeted research in medicine. It is in this area of medical research that the nonprofit, private organizations provide the largest proportions of nonFederal support to university research. Their contributions are nevertheless small in comparison to Federal awards.

The separately budgeted research funds at MSU in Medical Science increased greatly percentage wise during the nine year period between 1957 and 1966, as the university moved toward the development of programs in human medicine. Accompanying this development was a very strong reliance on Federal funds, with the chief source of Federal funds shifting from the Department of Agriculture to the NIH and other Public Health Service agencies whose awards amounted to almost 90 percent of the total Federal expenditures in 1965 66. At FSC, separately budgeted research in Medical Science over the years was financed most heavily by Michigan-based industry, with a few NSF awards constituting the Federal source of funds.

Life Sciences. Agricultural. Separately budgeted research in Agricultural Science is centered at MSU, with some research (chiefly in forestry) being done at both the U of M and MTU. Throughout the nine year period between 1957 and 1966 the category of Institution's Own Funds (including state legislative appropriations to the Agricultural Experimental Station) was the most important source of funds for separately budgeted agricultural research at MSU. However, this category has tended to decrease relatively and in 1965 66 was, in fact, less than expenditures from Federal funds. The source of Federal funds also underwent change. In 1964 65, the Department of Agriculture contributed 48 percent of all Federal funds compared to 24 percent from AEC; in 1965-66, the proportions were 38 percent for the Department of Agriculture and 44 percent for AEC. In the case of the nonFederal support at MSU, the Institution's Own Funds constituted about 80 percent of the total, but with industry contributing over $400,000 yearly. Federal funds have provided an increasing proportion of total expenditures in Agricultural Research at the U of M, while at MTU nonFederal funds, mainly from the state, supplied the most important proportion.

Life Sciences, Biological. Most of the funds for separately budgeted research in the Biological Sciences in the Michigan state universities have been from Federal sources. In 1964 65 the proportion was 74 percent and in 1965-66, 73 percent. This is higher than for Agricultural Science, about the same as for Medical Science, and less than for Engineering or the Physical Sciences. All but 1 to 2 percent of the total expenditures, both Federal and nonFederal, were made by the U of M, MSU, and WSU -with the approximate proportions being 55 percent by the U of M, 35 percent by MSU, and 10 percent by WSU.

At the U of M, NIH provided over 70 percent of the Federal funds for separately budgeted research in Biological Science. The remainder of the Federally-supported expenditures came from several agencies, with major awards from NSF. Much the same Federal pattern of support prevailed at WSU. At MSU in 1965 66 the NIH supplied 45 percent and the Department of Agriculture 27 percent of the Federal funds for separately budgeted research in Biological Science. In each year important awards were received from NSF. Again, at MSU, the category of Institution's Own Funds, including legislative appropriations to the Agricultural Experiment Station, accounted for a high proportion (over 80 percent in 1964 65 and in 1965 66) of expenditures from all nonFederal sources.

MTU's research expenditures in Biological Sciences were largely, as in the Physical Sciences, based on nonFederal funds. The sources included voluntary health agencies, foundations, industry, and the Institution's Own Funds. OU had steadily increasing awards over the years from various Federal agencies for research in the Biological Sciences, while WMU relied upon lesser amounts from the Institution's Own Funds. Limited support in no consistent pattern came to NMU and CMU from Federal agencies, with NMU awards coming wholly from NSF.

Social Sciences. For the Social Sciences the proportion of Federal support is the lowest of all of the areas of science as categorized in this study. In 1964-65, it amounted to 47 percent of the total expenditures of $4,403,000 for separately budgeted research at all institutions combined. The figure was 44 percent in 1965-66.

At the U of M, Federal support came from numerous agencies. The usual pattern was for NIH support to account for one-fourth to one-third of expenditures of Federal funds, NSF for one-fifth to one-fourth, the Office of Education for one-fifth or less, and the remainder to be spread among several other agencies as sources. Less than 10 percent of the expenditures at the U of M were reported for the disciplines of Economics, Political Science, and Sociology. They fell within the general category of Other Social Science.

At MSU the Institution's Own Funds, including state appropriations to the Agricultural Experiment Station, were an important source of funds for social science research, especially Agricultural Economics, throughout the nine year period from 1957 to 1966. Although increasing absolutely, Experiment Station funds for separately budgeted social science research declined in importance relative to both Federal funds and funds from other nonFederal Sources. Private foundations provided about one-fourth of all nonFederal social science research funds by 1965-66 at

MSU. In 1957-58 about 75 percent of all Federal fund expenditures for research at MSU were awards from the Department of Agriculture and almost exclusively for Economics. In the latter part of the period prior to 1966, important awards from NIH, NSF, the Department of Labor, and the Office of Education had decreased the Department of Agriculture's proportion of Federal Funds to about 33 percent and provided for greater diversification in social science research. Separately budgeted research expenditures in Social Science for institutions other than the U of M and MSU have been small, amounting in 1964-65 to about 3 percent and in 1965-66 about 2 percent of the state institutions' totals.

Psychology. Separately budgeted research in Psychology at all of the state institutions combined has been very heavily funded by Federal money. About 90 percent of total expenditures in 1964-65 and 1965-66 were funded by Federal agencies. Thus Psychology ranks with Engineering and the Physical Sciences in its high proportion of Federal funding and is far above the proportion in the Social Sciences. Among Federal sources, NIH and NSF accounted for the greatest proportion of Federal funds for research in Psychology. In 1965-66, NIH awards constituted 54 percent of all Federal funds expended in psychological research at the U of M, 63 percent at MSU, and 72 percent at WSU. NSF funds in 1965-66 accounted for 8 percent of all Federal expenditures in psychological research at the U of M, 26 percent at MSU, and 19 percent at WSU. The relatively low proportion of NSF funds at the U of M was counterbalanced by Department of Defense awards there amounting to 18 percent of all Federal funds expended. NonFederal expenditures on separately budgeted research in Psychology at MSU and WSU were very low. At U of M, where the absolute amount of these nonFederal expenditures was more significant, about 60 percent of them came from the Institution's Own Funds between 1964-66.

About 98 percent of all funds expended between 1964-66 by the state institutions for separately budgeted research in Psychology were employed at U of M, MSU, and WSU. U of M's expenditures were about four times those of MSU and WSU combined. The pattern of sources at WMU, CMU, NMU, and OU showed an emphasis on Federal funding similar to that of U of M, MSU, and WSU. Moreover, the chief Federal agency of support was NIH, although OU had several grants from the Office of Education and NSF. WMU supplemented its Federal awards with the Institution's Own Funds, as it did in the Social Sciences, and CMU was the recipient of awards from voluntary health agencies.

Funds for Capital Facilities for Research Development

Another important type of expenditure for research is that for capital or the plant and facilities which are needed. Excluded from these capital expenditures is equipment purchased either from separately budgeted research funds or from state general fund appropriations for instruction and departmental research. Plant and facilities used for either research or graduate instruction are apt to be used for the other. Table 2-8 incorporates data which indicate for various state universities the major sources of capital funds for both of these activities during the decade, 1956-66. For all of the institutions combined for which data were available and applicable, state funds, the largest single source, comprised 46 percent of all funds expended. Federal funds (22 percent) and Institution's Own Funds (27 percent) accounted for most of the remainder. NonFederal funds from industry, foundations, voluntary organizations, and individuals, though important in absolute amount, made up only 5 percent of the total. However, institutional variations are notable. The most important single source at MSU, constituting 43 percent of total capital expenditures in science between 1956 and 1966, was the Institution's Own Funds. Contributing to this top ranking was the practice employed at MSU of using for capital development for graduate instruction and research some of the indirect cost reimbursements to the institution by outside sponsors of separately budgeted research. At CMU, the Institution's Own Funds were the only source of funds, while at OU other non-Federal funds were predominant. At WMU, Federal funds provided the largest proportion. Each source of funds had at least one institution for which it was most important.

Between 1956 and 1965 in Michigan, emphasis in capital development for research and graduate instruction was on the Life Sciences—including the Medical, Agricultural, and Biological Sciences. Almost three-fifths of all the expenditures, $29,917,000, were in the Life Sciences. For the Life Sciences at all reporting universities, Institution's Own Funds, including a very major expenditure at Michigan State, ranked first in support with $10,129,000; State Funds were a close second at $9,819,000 and Federal Funds third at $7,958,000.

Reimbursement of Indirect Costs to Institutions

Another major factor related to the pattern of research support are the indirect costs assumed by a university. Insofar as a university itself

TABLE 2-8

CAPITAL (PLANT AND FACILITIES) EXPENDITURES, 1956 66, FOR RESEARCH AND DEVELOPMENT AND GRADUATE INSTRUCTION BY INSTITUTION* AND SOURCE OF FUNDS (IN THOUSANDS OF DOLLARS)

INSTITUTION	FEDERAL FUNDS		STATE FUNDS		INSTITUTION'S OWN FUNDS		OTHER NON-FEDERAL FUNDS		TOTALS	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
U of M	4,959	19.6	15,355	60.8	2,665	10.5	2,301	9.1	25,280	100.0
MSU	6,204	25.1	7,627	30.9	10,631	43.0	238	1.0	24,700	100.0
MTU	. . .	. . .	196	92.0	. . . .	. . .	17	8.0	213	100.0
WMU	105	44.5	90	38.1	34	14.4	7	3.0	236	100.0
OU	. . . .	. . .	47	39.5	. . . .	. .	72	60.5	119	100.0
CMU	. . . .	. . .	. . . .	. . .	72	100.0	. . . .	. . .	72	100.0
Totals	11,268	22.3	23,315	46.1	13,402	26.5	2,635	5.2	50,620	100.0

*Data on Capital Expenditures not available from WSU, EMU, GVSC, and SVSC

Data for FSC not applicable to the area of Research and Development and Graduate Instruction assumes these indirect costs without reimbursement the university is supporting the research project from its own funds. These indirect costs include that part of the institution's expenditures for general administration, student services, libraries, and operation and maintenance of physical plant related to the project. Reimbursed indirect costs can accumulate to a very substantial amount for any given university. There has been some tendency to regard reimbursed indirect costs as funds to be used at the university's discretion. They have been used in various institutions for support of more research, for capital expenditures, or for major equipment such as computer facilities. Such funds may, of course, be returned to the general fund of the university and used to cover those costs which originally justified their payment.

Table 2-9 shows that in 1965-66 the U of M received $8,138,000 and MSU $1,212,000 in reimbursed indirect costs. Other institutions in the state had, of course, considerably lesser sums reimbursed. In 1965-66, OU had $20,000, CMU $6,000 and WMU expected practically full reimbursement for $39,000 of indirect costs. Table 2-9 also indicates the very considerable sums which U of M and MSU contributed to research activity in the form of unreimbursed indirect costs in support of research financed by sponsors outside the university. In 1965-66, this support amounted to $2,824,000 for U of M and $1,398,000 for MSU.

By noting the different percentages of unreimbursed indirect costs for U of M and MSU it is apparent that the commitment for an institution is proportionately heavier if awards come from certain sponsors rather than from others. Overall, in 1965-66, U of M's rate of reimbursement was 74 percent while MSU's was 46 percent. Clearly, for both institutions larger percentages of indirect costs went unreimbursed in the case of nonFederal as compared to Federal sponsors.

The Staffing of Research Activities

Teaching Faculty Employed Full Time. Reference was made earlier to differing percentages of the faculty in the institutions who were actively engaged in research to the extent of over 30 percent of professional effort. Table 2-1 of this chapter indicates percentages of the science faculty sampled who were so engaged as varying from 2.5 percent to over 50 percent. The question arises of how this faculty effort spent in research is financed. It has been suggested that without outside sponsorship, the direct cost of the faculty-researcher's salary comes from the General Fund appropriations for Instruction and Departmental Research. Esti-

TABLE 2-9

Reimbursement of Indirect Costs for Separately Budgeted Research, 1964-65 and 1965-66 for the University of Michigan and Michigan State University by Federal and NonFederal Sources (In Thousands of Dollars)

Institution	1964-65				1965-66			
	Total Indirect Costs	Reimbursed Indirect Costs	Unreimbursed Indirect Costs		Total Indirect Costs	Reimbursed Indirect Costs	Unreimbursed Indirect Costs	
			Amount	% of Total			Amount	% of Total
U of M								
Federal	8,665	6,433	2,232	25.7	9,013	7,160	1,853	20.6
NonFederal	1,765	1,050	715	40.5	1,949	978	971	49.8
Total	10,430	7,483	2,947	28.3	10,962	8,138	2,824	25.8
MSU								
Federal	1,844	713	1,131	61.3	2,247	1,126	1,121	49.9
NonFederal	304	N.A.	. . . . .	. . .	363	86	277	76.3
Total	2,148				2,610	1,212	1,398	53.6

mates of this cost are notably difficult. In this study institutions were asked to estimate the percent of General Fund expenditures for Instruction and Department Research which supported research. Several institutions found the task quite impossible. Some reported such research support as negligible. Of three institutions which made reasonably careful estimates, two reported about 13 to 15 percent and the third reported 5 percent. Because of the limited response and difficulties of estimation, no generalizations are possible. However, the institutions with high percentages of their faculty spending over 30 percent of their effort in research are not necessarily those which draw upon the highest proportion of their general funds to support their research effort, because these institutions are also likely to have considerable outside support for the direct costs of the research conducted.

Data collected in the study indicate that in those institutions with the strongest research orientation a relatively high proportion of the teaching faculty who are employed full time receive some of their regular salary, not considering compensation for summer employment, from a source other than the General Fund of their institution. Accordingly, in these institutions, as much as 10 percent or more of the total regular salary outlay for science faculty employed on a full time basis comes from other than the General Fund source. It does not follow that all of this supports research, but it is reasonable to assume that salaries paid from external funds support something other than instruction.

Professional Staff with Research Appointments. Distinct from the situation in which an individual who has a teaching appointment spends a portion of his time in research is that of a person who is specifically designated by a college or university as occupying a research position and who engages directly in research or development or the administration of it. If such a person holds at least a bachelor's degree, he is classified in the study as being in the category of Professional Staff with Research Appointment.

In institutions with a strong research orientation the Professional Staff with Research Appointment is sufficiently large as to play a vital role in the overall research performance. Data of such appointments was requested from all institutions, but some found it impossible to obtain. Brief comments on three institutions will suffice to suggest the patterns found. Fourteen to twenty professional research staff persons were employed at MTU between 1957 and 1966 and were paid solely out of state legislative appropriations. These individuals were participants in the centers and institutes in forestry, mineral, and wood research which received special legislative appropriations. Much of MSU's salary support of its professional research staff is similar in ultimate source to that of MTU's. For 1965 66 over half of the support other than the General Fund at MSU came from the Institution's Own Funds and largely from state legislative appropriation for the Agricultural Experiment Station. Among other nonFederal sources, industry contributed about $40,000 and private foundations $10,000 in salary support to professional researchers in 1965-66 at MSU. The greater part ($1,010,592) of all nonFederal funds ($1,414,340) for professional researchers' salaries in 1965-66 at MSU was employed in the area of the Life Sciences, including Agriculture, with about equal amounts of $180,000 given to both Engineering and the Social Sciences.

There was strong Federal support of $839,618 for professional research salaries, amounting to about 37 percent of all combined support for the purpose in 1965-66 at MSU. Somewhat over 70 percent of this Federal money came from the Department of Agriculture, over 15 percent from AEC and about 4-5 percent each from NSF and NIH. Again, about 85 percent of these funds went to the Life Sciences with important lesser amounts to the Social Sciences ($74,355) and Engineering ($36,772). Thus in salaries for professional researchers as well as in expenditures for facilities the Life Sciences at MSU were predominant.

The pattern of support for professional research salaries at WSU displays what are likely to be the most common lines for an institution with a growing research orientation. With no historic precedent for state legislative appropriations for an experiment station as at MSU, heavier emphasis is placed on Federal funds. WSU received 60 percent of its total funds for professional research salaries from Federal sources in 1965-66 as compared with MSU's 37 percent. Over 85 percent of the $555,000 in Federal funds came from NIH and were heavily concentrated in their use: $442,000 went to the Life Sciences, chiefly Medical, and $101,000 to the Physical Sciences. Almost 70 percent of the nonFederal funds at WSU came from the General Fund, and these, together with substantial grants from voluntary health agencies and private foundations flowed almost totally to the Life Sciences.

Graduate Research Assistants. The need for graduate assistants if substantial research is to be undertaken in the universities, as well as the need for research activity if graduate training is to be adequately carried on, were reiterated themes in interviews with faculty and administrators. Data were requested on numbers of graduate research assistants and sources of support. Graduate research assistants were defined as those engaged actively in research and were distinguished from graduate teaching assistants or fellows and from general duty graduate assistants who provide a variety of services to faculty and administrators. Teaching or general duty assistants may indeed help create a basis for faculty research activity by relieving the faculty of other duties, but the contribution is indirect. These roles will be discussed in detail in a subsequent chapter concerned with undergraduate and graduate education. Data were not forthcoming in all cases, but it is clear enough that as universities embark upon research programs they seek means to acquire graduate research assistants and that Federal funds predominate in the support of graduate research assistants. For example, of 428 graduate research assistants employed at MSU in 1965 66, 256 were paid from Federal Funds, 110 from the Institution's Own Funds, and 62 from Other NonFederal Funds.

Further example of the strength of Federal, as compared with non-Federal, support of graduate research assistants is indicated by analysis of the responses of Ph.D. candidates in science to the study's student questionnaire. One hundred and sixty of the candidates in the sampled population indicated they were holders of research assistantships. About two-thirds (102) of the 160 who held research assistantships were supported by Federal agencies. Of the 102, 24 were supported by DOD, 22 by NSF, 19 by NIH, 11 by AEC, 10 by NASA, and the rest from other agencies. Of the remaining 58, the universities' own funds supported 39, and other nonFederal sources the remainder.

Summary Remarks

At this point certain broad features of the pattern of research support may be recapitulated. In general, the picture is of twelve institutions of differing sizes, systems of financial support, and backgrounds of purpose and function, but which, with perhaps one or two exceptions, are moving or are planning to move towards increasing research activity and expanding graduate programs. At the present stage, the differences among the institutions insofar as the research-graduate student orientation is concerned are as striking as the similarities, and the possibilty in the future of anything approaching equality seems remote. It is, indeed, doubtful that the administrators and faculty of many of the institutions see any need in the state for other universities conducting research to the extent, and with the purposes of the U of M, or even that they see a need for more MSU's or WSU's. But they do believe that their research function should be expanded to contribute at an intensified level to the needs of the nation and state, to meet the requirements for adequate training of students, and to provide opportunities for professional fulfillment on the part of their faculties. These are commonly expressed goals although the goals are stated more strongly in some institutions than in others.

Specific statements as to what level of research activity is necessary for any given institution and what the ultimate role in research and student training an institution should ultimately fill within a state and regional system of institutions of higher education are very hard to come by. As one administrator suggested, his institution did not have goals of that kind. The current aim appears to be a movement toward expansion and development of programs, with some reasonably strong conception of those areas of science in the institution which should receive greatest encouragement by resources controlled by the institution itself.

The overall resources available to the institutions which are needed to carry on research vary tremendously, largely because there are great variations in funds available for separately budgeted research. Variation in these funds means that some institutions can afford more and better research equipment, and have access to funds to hire graduate research assistants and professional research appointees and to free time for faculty research by assuming part of regular as well as summer salaries.

The data presented in this chapter also show very considerable variation within individual institutions in the amount of research support going to the major areas of science and to the separate disciplines within the areas. Thus Aerospace and Electrical Engineering, the Medical Sciences, and Physics within the Physical Sciences are major areas and disciplines which are heavily supported at the U of M. At MSU, support to Agriculture and the Biological Sciences predominates with Physics being strongest within the Physical Sciences; at WSU the great weight is toward support in the Medical Sciences with support to Chemistry being the strongest within the Physical Sciences. The same unevenness in support prevails at the institutions which receive lesser amount of funds. The departments which are recipients of the greatest amount of funds can in most cases be easily identified both from financial data and from interview data.

As far as the sources of funds for separately budgeted research are concerned, Federal funds predominate. This was generally the case in large and small institutions alike. Furthermore, the available data show increasing Federal proportions out of the total support during the period between 1957 and 1966. Also, the most strongly supported research areas in the institutions generally had the highest proportion of Federal support. A common pattern was for a heavily supported discipline to receive the great bulk of its support from one or two Federal agencies. In one sense, and perhaps indicative of the major direction, Federal funds contributed to a concentration of research effort among the fields of science within institutions. In another sense, however, as new areas of research began to be supported in a major way within institutions, Federal support contributed to this expansion and introduced a degree of diversity. Although, for example, funds for separately budgeted Physical Science research (largely from Federal sources) were $16,858,000 more than funds for separately budgeted psychological research (largely from Federal sources) in 1965-66 at the U of M, as compared with a $3,535,000 difference in 1957 58, the absolute increase in funds for Psychology from $475,000 to $1,375,000 in that period created a financial base for a research program of increased significance. The role of Federal funds in bringing research diversity at MSU has been considerable.

Federal funding of capital facilities--plant and equipment—for research and graduate instruction was highly significant between 1957 and 1966 and amounted to over 20 percent of the total in those institutions providing data. Nevertheless, state legislative appropriations, which amounted to almost half of the total, were the prime source. State appropriations into the general funds of the institutions, along with the other sources of those funds, also helped to cover substantial indirect costs of research which were not reimbursed by outside sponsors. The differing policies of sponsors on reimbursement create problems in the administration of research grants by the universities and colleges and call for continued moves toward greater uniformity. Still another state contribution to research in the institutions is the difficult to calculate, but nevertheless substantial, sum paid out in faculty salaries to cover the time spent in research which is not paid from separately budgeted research funds.

Direct financing (other than support through taxes) of research by business and industry in the universities is relatively small. The 1967 figures, cited in Chapter 1, indicate a proportion from business and industry of about 5 percent for all fields of science combined. Engineering is most strongly supported. Somewhat less in overall proportion are the contributions made by private foundations and voluntary organizations. Strongest percentages of research support from these sources are in the Medical and Biological Sciences. In some institutions private foundations help supply funds for Social Science research which is rather meagerly supported by Federal agencies in comparison with Federal support provided other areas of science.

With all of the fields of science taken together, the phenomenon of Federal support of science research in Michigan's state institutions of higher education is outstanding. Without it the structure which has been built up would collapse. And the prospect for future support as seen by faculty and administrators is also largely Federal. This is true whether the institution is now highly funded or is just getting a foothold in sponsored research.

III. Some Problems in Financing Science Research

The pattern of support discussed in the preceding chapter generates a number of problems including: the spread of funds among the institutions; effects of funding on the balance among the scientific disciplines within the institutions; opportunity for the young investigator to obtain funds within the system; and the desirability of various types of awards grants, contracts, applied, and basic.

The Spread of Research Fund Awards Among Institutions

As shown in the previous chapter, there is a striking degree of concentration of separately budgeted research funds among a few of the state colleges and universities of Michigan. Furthermore, the data available for the period between 1957-66 indicated that absolute differences in funding among the institutions were tending to increase.

However, as the data in Chapter 2 show, the response of all faculty samples reflects a desire for more research activity and less instruction. Ten of the state institutions are designated as universities and, although differing in purposes and goals, have aspirations to fulfill the university status. There exists the conviction in each institution that more research support is needed but there are variations in intensity of the conviction. A few faculty and administrators at institutions most heavily funded suggested that funding may have reached a saturation point, but most continue to see expanded financial support as desirable to strengthen weaker areas and open new research activities. In certain institutions at the other extreme, doubts are readily expressed that the institution and its departments possess the facilities, faculty training and interest, or time to engage in much research activity. In a third group of institutions, the general tenor of opinion is that the institution is fully ready for major expansion in research activity, but lacks adequate funding to do so. Many persons in these institutions view their problem as that of breaking into an established funding pattern in which success appears to be self-generating for the institutions already receiving large-scale funds. Even these latter institutions, however, recognize relevant research for which they would like adequate funding.

The concentration of research awards has apparently resulted from the fact that much of the research done in major research universities is derivative from awards competitively acquired. The research (whether basic, applied, or developmental) derives from the purposes pursued by a Federal or nonFederal agency or organization. The purpose may be, on the one hand, as general as seeking an unspecified advance in the state of the knowledge of a science, or, on the other hand, the development of a prototype mechanism with specific and limited function. Within these limits of purpose, derived from agency missions, the universities and their staffs may develop their research interests. Only breadth and diversity of purpose of the numerous agencies, Federal and nonFederal, can keep such a system from narrowly channeling or stifling research creativity. As has been noted, these awards are competed for, and the main, ostensible basis of award to an institution has been how well it may be calculated to accomplish the agency's purpose in comparison to the ability of another institution to do so. Necessary missions pursued by the most able and efficient means is the ideal. In practice this has meant in a state system of universities, as the data in the previous chapter indicated, large amounts of funding by a few agencies, to a few institutions, in selected areas of science research.

It is not likely that the funding of the science research carried on by institutions which currently have lesser build-ups in facilities, professional staffs, and experienced faculty will be derived from the major research missions of major agencies, at least in the near future. Institutions not currently recipients of substantial awards for mission oriented research which aspire to advance their research-graduate student programs and to maintain a faculty of high caliber in the sciences, must search for funds from sources—Federal, state, or private—which recognize the worth of research for the promotion of the total educational venture. The only alternative, satisfactory to essentially none of the institutions in the long run, is to define and carry out a program in such manner as to preclude research.

Rates of Application and Awards for Research Grants and Contracts. The spread of research awards can be analyzed in more detail by considering the number of applications for research grants and contracts and the success achieved from applications made. Table 3-1 indicates the number of applications made per faculty member between 1962 and 1967 by the science faculty sampled for the study's faculty questionnaire. For applica-

TABLE 3-1
NUMBER OF APPLICATIONS FOR RESEARCH GRANTS AND CONTRACTS MADE TO FOUR TYPES OF SPONSORS BY A SAMPLE OF FACULTY FROM ELEVEN INSTITUTIONS, 1962 67*
(Institutions listed in order of number of applications per faculty member made to Federal agencies)

INSTITUTION	FEDERAL GOVERNMENT		PRIVATE FOUNDATIONS		PRIVATE CORPORATIONS		STATE AND LOCAL GOVERNMENTS		
	N	N per Faculty Member	N	N per Faculty Member	N	N per Faculty Member	N	N per Faculty Member	Total N per Faculty Member
U of M	382	3.98	43	.45	69	.72	15	.16	5.31
WSU	141	3.28	70	1.63	31	.72	13	.30	5.93
MSU	292	3.01	44	.45	66	.68	36	.37	4.51
MTU	91	2.60	14	.40	14	.40	11	.31	3.71
WMU	87	2.07	21	.50	5	.12	12	.29	2.98
OU	46	1.70	8	.30	2	.07	4	.15	2.22
CMU	65	1.41	13	.28	7	.15	7	.15	1.99
EMU	51	1.34	23	.61	8	.21	1	.03	2.19
NMU	37	1.32	4	.14	0	.00	1	.04	1.50
FSC	34	1.17	3	.10	12	.41	3	.10	1.78
GVSC	46	1.15	18	.45	2	.05	9	.22	1.87
Totals	1272		261		216		112		1861
Percent of Total Applications	68.35		14.02		11.61		6.02		

*Sample based on the science faculty responding to Faculty Questionnaire.

tions to all four types of sponsors, but particularly Federal, the data show high numbers of applications per person in those institutions which have a strong research orientation. If the applications for educational, rather than research activities, were completely eliminated in the totals for the number of applications, the differences among the institutions in research aspirations would be further emphasized. Without exception, the faculty made more applications to Federal agencies than to all other sources combined, reenforcing the point that faculty see the greatest possibilities in and have the greatest expectations of support from the Federal agencies. Obviously the possibility for research support in some institutions was limited by the number of applications for support.

Table 3-2 indicates the success in receiving awards. Institutional differences in rate of success are somewhat less than the differences in rates of application. It is difficult to discern a consistent pattern which corresponds to the differences in the overall research orientation of the institu-

TABLE 3-2
NUMBER OF AWARDS TO A SAMPLE OF SCIENCE FACULTY AND PERCENT OF AWARDS OUT OF TOTAL APPLICATIONS FOR RESEARCH FUNDS FROM FOUR TYPES OF SPONSORS, 1962-67
(Institutions listed in order of percent of success of applications to Federal sponsors)

INSTITUTION	FEDERAL GOVERNMENT		PRIVATE FOUNDATIONS		PRIVATE CORPORATIONS		STATE AND LOCAL GOVERNMENTS	
	N	Awards as % of Applications	N	Awards as % of Applications	N	Awards as % of Applications	N	Awards as % of Applications
U of M	306	80.1	26	60.5	51	73.9	7	46.7
WSU	97	68.8	60	85.7	24	77.4	10	76.9
NMU	23	62.2	0	0.0	0	0.0	0	0.0
MSU	180	61.6	29	65.9	64	97.0	17	47.2
MTU	51	61.5	7	50.0	6	42.9	6	54.5
EMU	26	51.0	10	43.5	8	100.0	1	100.0
OU	23	50.0	5	62.5	2	100.0	4	100.0
GVSC	23	50.0	11	61.1	2	100.0	5	55.5
WMU	36	41.4	14	66.7	3	60.0	8	66.7
CMU	21	32.3	5	38.5	3	42.9	0	0.0
FSC	9	26.5	0	0.0	5	41.7	0	0.0
Totals	800		167		168		58	
% of Awards	67.1		14.0		14.1		4.9	
Awards as % of all applications		62.8		64.0		77.8		51.8

tions. Eight out of eleven institutions had at least a 50 percent rate of success with applications to Federal agencies. However, a faculty member from EMU, OU, GVSC, or WMU might consider his 40-50 percent chance of success with a Federal agency application to be substantially less than the 60-70 percent range of success for faculty members at WSU, NMU, MSU, or MTU. The U of M sample of faculty members not only had the highest per capita rate of application for Federal grants and contracts but also a significantly higher rate of actual awards.

A higher rate of application and a higher rate of success in obtaining those awards which are not already pre-empted by the past success of established researchers would seem necessary for research expansion for the colleges and universities less well established in research activity. The current distribution of grant and contract awards is not accomplishing the more limited research goals of these institutions.

Reasons Cited for Success in Applications for Federal Research Grants and Contracts. The faculties at the various institutions indicated in responses to the Faculty Questionnaire, and also through the interviews on the campuses, differences in knowledge about programs of support by sponsors of research. There was a strong correspondence, particularly in the case of Federal programs, between the level of information about programs and the strength of the research orientation of the institutions. Lack of information may, in part, account for differences in numbers of application. A relatively high percentage of faculty in all of the institutions consider themselves well informed about Federal research programs as compared to those of other sponsors. No doubt the variations in asserted level of information about sponsors are related to the opportunity level of support by the differing sponsoring groups.

Those faculty members sampled in the Faculty Questionnaire were asked to weigh the following factors in relation to success in gaining funds:

1. Relevance of a research proposal to the mission or needs of an agency, corporation, or foundation.
2. Personal reputation of an investigator.
3. Reputation of a college or university in a given field or area of science.
4. Existing facilities in the institution for research in the area of a proposed study.
5. Skill of an investigator in formulating a proposal.
6. Assistance of administrative officers of a college or university in formulating or presenting a proposal.

Only the responses of faculty with experience in applying for funds from Federal agencies were analyzed, because very small numbers indicated experience or offered judgments on applications to state and local governmental agencies, private profit-making corporations, or private foundations. The faculty members responding were asked to rank the factors considered *very* important, to omit those not considered very important, and to add others to the list which they thought to be very important. Table 3-3 exhibits only the percentages of faculty rating a factor as first or second. Between 42 percent and 80 percent of the faculty in each institution entered in the table ranked the personal reputation of the investigator as first or second in rank of importance with the median percentage figure being 57 percent. In each of these institutions over 75 percent of the faculty gave this factor a very important rating. About equal proportions of the responding faculty held relevance of a research proposal to an agency's mission and the skill of an investigator in formulating a proposal to be very important, although differentiation can be noted among the first and second rankings. Among the six factors listed, assistance by administrative officers in formulating or presenting research proposals was given the least support. Nevertheless, considerable proportions (from 24 to 71 percent) of the faculty in each institution entered in Table 3-3 consider administrative assistance to be very important. Faculty interviewees also remarked on the importance of such assistance.

TABLE 3-3
FACTORS AFFECTING SUCCESS OF APPLICATION FOR RESEARCH FUNDS TO FEDERAL AGENCIES AS SEEN BY 245 FACULTY MEMBERS WHO HAVE MADE APPLICATIONS

FACTORS AFFECTING SUCCESS	PERCENT OF FACULTY RANKING FACTOR AS FIRST OR SECOND IN IMPORTANCE					
	UM (84)*	MSU (73)*	WSU (30)*	WMU (21)*	MTU (21)*	EMU (16)*
Personal reputation of investigator	67	58	80	57	42	50
Relevance of proposal to agency's mission	59	60	43	43	66	43
Skill of investigator in formulating a proposal	28	37	26	28	38	62
Reputation of college or university	15	17	23	38	28	12
Facilities of institution for research	7	6	10	19	23	18
Assistance of administrative officers	1	4	0	0	0	6

*Number responding. Institutions with less than 15 responders were omitted.

There was, also, a rather strong recognition among faculty in all institutions that a high level of research funding and activity within a given institution both results from and tends to attract talented men with high reputation. In response to a question on the Faculty Questionnaire, 69 percent of the respondents expressed a belief that there is a *strong* tendency for the most able faculty to be attracted to those institutions and departments which are most heavily supported in research. Little variation can be noted between the responses of faculty in large and small institutions or in institutions with strong or weaker research orientations.

Although lack of research activity and funds has made recruiting difficult, some success was being achieved by those institutions presently receiving restricted amounts of research funds in hiring young persons with general promise and interest and competence in research. Less success has been met in recruiting established investigators to form the mature nucleus of a growing department. A generation gap has thus been created in which the older faculty of long tenure and of higher rank have somewhat less research interest and capacity than the younger members of the science departments. In this situation the young research oriented faculty members may find the generally poor reputation of the department a major hurdle in seeking research funding. The addition of one or two established researchers can markedly alter that reputation.

The reputation of the institution and the facilities of the institution for research were judged by the respondents to the Faculty Questionnaire to be about equal in importance. Opinion in the interviews reflected a not uncommonly held feeling in developing institutions that the actual capacity of institutions did not justify the great differences in research funding among institutions. This opinion was expressed in a variety of ways—directly in some cases or in others by suggesting that proposal review panels tend to go along with the familiar channels of funding; that it is hard for an investigator at a former teachers' college to receive support for a research project to be conducted by an individual; that little money goes to institutions with only undergraduate programs; and that granting agencies do not recognize the problem of getting a program off the ground in a developing institution.

Internal Problems in Encouraging Research

Most faculty and administrators at the institutions which receive minor proportions of the total of research funds in the state are less concerned with reasons for unfavorable consideration of applications than with the restraints upon research performance found within their own institutional settings. Facilities—space and equipment—are seen as inadequate in some instances. These deficiencies equally hinder the initiation of new programs and the expansion of programs already well under way. Space and equipment shortages exist among departments both at institutions with strong research programs and those without such programs.

In those institutions with eager, competent, young faculty members not currently being funded in research certain other difficulties which block research activity are constantly recurring themes in the interview data.

Lack of time for research is a recurring complaint in institutions still strongly oriented toward instruction with heavy teaching loads for faculty. Reduced loads and the start or expansion of a sabbatical program are seen as crucial. Employment opportunities fc ımmer teaching in those institutions to which secondary teachers typically return for advanced work also divert attention and effort from research. Institutions seeking to initiate strong research programs emphasized the paucity of funds for support of graduate students who as fellows, scholars, or graduate assistants might be expected to provide some assistance in research. At some institutions, funds are even inadequate to hire undergraduates to help with laboratory set-up and clean-up. Faculty members in a number of institutions felt that it was not unreasonable for sponsoring agencies to expect some stronger institutional commitment in providing a certain minimum base for continuing research activity before the other agencies would commit large sums in research project awards. How, within the limits of funds from student fees and legislative appropriations and in the face of the pressure of heavy enrollments, an institution can improve the image of its overall research capacity, whatever the individual competence of some of its faculty, was a major concern.

Strategy for Development of Research Funding. A commonly held view of faculty and administrators alike is that their respective institutions should and can do better in receiving research awards from sponsors. They believe that "The funds are there, especially in Federal agencies, and the failure to get them has in considerable degree been our own fault."

One basic approach to the development of a research base is to set institutional priorities among the various academic departments or areas of science and to provide selective encouragement of hand picked scientific areas. When stated by administrators as a definite policy, they emphasize that encouragement results from unequal distribution of new funds rather than from cutting one area back to build up another.

Encouragement of selected areas of science begins in the hiring process. Inevitably most of the new research oriented faculty will be younger scholars. In the process of expanding staff to meet new enrollments the age make-up and general orientation of a department can undergo rapid change. The relative lack of senior professors experienced in framing and conducting projects creates a problem, but luring established researchers from major research oriented institutions is seldom successful and some administrators believe it is not worth the cost and possible disruptive effects.

The next step in the research development strategy requires lightened teaching loads and funds for some equipment. Use of institutional funds for graduate assistants facilitates load reduction and also brings some graduate students. Departments selected for development have noticeably fewer complaints about teaching loads and the paucity of space and equipment. In one instance at least, the advantage of selected departments extended to the library as well, with about one-half of the total library budget for purchases of supporting materials for academic departments being temporarily directed toward the needs of three science departments.

TABLE 3-4
FACULTY OPINION ON EFFECTIVENESS OF RELATIVELY SMALL RESEARCH GRANTS FROM AN INSTITUTION'S OWN FUNDS IN DRAWING LARGER SUPPORT FROM OUTSIDE SOURCES
(No responses and faculty who have not received a research award or participated in an award-supported project eliminated, N = 323)

INSTITUTION	(N)	PERCENT OF FACULTY RESPONDING TO DIFFERENT LEVELS OF EFFECTIVENESS				
		Often	Occasionally	Seldom	Very Seldom	No Opinion
U of M	83	32.5	37.4	9.6	2.4	18.1
MSU	73	19.2	31.5	13.7	12.3	23.3
WSU	34	17.6	35.3	11.8	20.6	14.7
WMU	23	8.7	69.6	. . .	4.3	17.4
MTU	20	40.0	40.0	5.0	. . .	15.0
CMU	14	7.1	. . .	7.1	42.9	42.9
EMU	20	10.0	45.0	. . .	5.0	40.0
NMU	12	15.4	15.4	7.7	. . .	61.5
OU	20	20.0	40.0	15.0	5.0	20.0
FSC	9	11.0	22.0	. . .	11.0	56.0
GVSC	15	6.7	6.7	13.3	6.7	66.7

Once a few selected departments have established a base of excellence in staff, and have some time and facilities needed for research, these departments are then expected, with some measure of administrative assistance, to obtain funds for sponsored research. Many schools have what are commonly called "seed grants" from the institution's own funds, one ostensible purpose of which is to establish a research project which a sponsor can be asked to support on a larger scale. The grants are normally awarded by a faculty-administrator committee and vary from a few hundred dollars to $1500–$2000 or more. As Table 3-4 shows, faculty views as to the efficacy of these small grants are mixed. On the whole, the faculties see these seed grants as a positive factor indicative of institutional commitment but not often a determining factor in attracting outside funds.

Whatever a developing university may do out of its own resources to encourage research, the ultimate step as expressed by one administrator is that "Good people will have to generate their own new money, and they will have to do this despite the difficulties of competing with able faculty whose institutions are further along the way in program development." Another administrator asserted that in his university the accepted view is that "funds can be found if there is vigorous, intelligent, and persistent effort." The individual faculty member who does not find funds is a disappointment. The burden thereby imposed on the individual faculty member is considerable and may not be one which even talented men of science will want to assume.

Alternative Systems for Financing Science Research and Education. The problems associated with project support and its failure to meet the needs of many of the institutions naturally leads to discussion of alternative methods for making awards. Most commonly mentioned are institutional or block grants under which funds are conveyed to institutions or major academic areas within institutions, with only the most general restrictions as to their use. A limited use of such broad grants by NIH and NSF in the past has gained the approbation of recipients.

The institutional grant approach generates some vehement opposition and strong reservations as well as some strong support. The following attitudes were suggested by the interview data:

1. The institutions and, within institutions, the departments, which had the strongest research orientations were somewhat less favorable to expansion of institutional awards than institutions and departments with weaker orientations.
2. Most, though not all, of the administrators with such rank as president, vice-president for instruction or research, or dean were favorable toward expanded institutional awards. A very few were opposed and some expressed reservations.
3. Only a minority of the departmental chairmen and other faculty interviewed indicated much enthusiasm for expanded institutional awards.
4. Nearly two-thirds of the departmental chairmen and other faculty interviewed had serious reservations about expanded institutional awards. Many of these faculty, however, saw some advantages, and the pattern of cited advantages coincided with those noted by top administrators.

The top administrators at those institutions most successful in obtaining research funds stressed the values stemming from the competitive system of obtaining awards from a number of different, mission-oriented sources. Opposition was generally expressed to a system which, without critical scholarly review of proposals, might pour funds into weak departments. Some administrators feared the pressures which might play upon them under an expanded institutional grant system, although they recognized the possible benefits of large, institutional grants. These benefits included: acquiring laboratory space and equipment, supplements to project awards, flexibility in covering different kinds of expenses from one year to the next, security for the continuance of the core of a program even though the major project grants should accrue to special areas of the program, and redressing imbalances among programs. The uses of broad grants visualized by top administrators in the most research-oriented institutions were largely for sustaining or supporting existing programs or for filling in gaps.

In the institutions with less well-developed research programs, most of the top administrators and a minority of the faculty more strongly supported the use of broad grants. One administrator avowed that his institution could pursue its objectives with broad form grants alone. These administrators saw institutional grants as most useful in initiating research programs, in gearing up some particular departments for research activity, in helping to fund sabbaticals for research activity, in purchasing equipment vitally needed, and in providing money to pay for graduate research assistants. The responsibility for distributing funds among these competing purposes weighed lighter on minds of most of these administrators than advantages. Support by the departmental chairmen and the science faculties was somewhat less enthusiastic. Some felt that such funds would help their departments in development of ongoing research; others, in departments admittedly weak in research activity saw the means to get programs started. In some small institutions with weak departmental structure, broad institutional grants were viewed quite favorably.

Most faculty members regardless of their institutional affiliation, expressed at least some reservations about broad grants, especially if these would entail a cut-back or a freezing of project awards. The most strongly stated objections were directed toward the probable distribution processes by which institutional grants would be divided up by local administrators and/or faculty committees. Whatever the system used it would be the "genesis of trouble and red tape," would cause "serious, internal trouble," create "fears of partiality" and "departmental backstabbing," and generally be "too political with the institution." These objections came from both young and old faculty members and from institutions whether presently strongly or weakly involved in research. A large proportion of the faculty who objected to institutional grants saw considerable merit in broad departmental grants. The need and usefulness of broad grants to their programs was recognized but the desire to avoid internal wrangling within their institutions was strong. The difficulties of establishing a national formula for distributing broad grants to individual science departments were only partially envisaged. An automatic distribution on some formula basis would destroy the strategy of concentrating resources to insure some high quality areas in an institution. A competitive system of broad grants to departments would raise questions of criteria of excellence. One administrator remarked that current programs of broad grants for departmental development do not show an understanding of needs of "emerging institutions." Another concern of some faculty and of numerous administrators was that broad support grants from the Federal Government might well lead to a corresponding decrease in state legislative appropriations.

There is some support for broad form grants but disagreement exists about specific types and mechanisms for distribution. If such funds could be provided to sustain or to create better balance in present programs, to create a stronger potential for research in some institutions, and to provide starter funds for the new or young investigator without encroaching on project grant funds, some faculty members and most administrators would support the broad form grant.

Faculty Views on the Relative Position of the State Institutions in Research Activity. The desired end of an ideal support system from the point of view of the faculty in the institutions now receiving limited outside funds is for much less concentration in funding and research activity than is now current. When asked (Table 3-5) whether it would be in the best interest of higher education in Michigan for there to be six or fewer major university centers of scientific research in the state, only at the U of M, MSU, WSU, and WMU did a majority of the faculty sampled respond affirmatively. These institutions are ones whose faculty might readily assume that they would be among the six institutions.

There was limited support in the faculty response (less than 30 percent) for the position that in each state institution a common set or core of research areas in science should be strongly funded, but a majority supported the view that each institution should receive strong financial support for at least one, or a few, specialized areas of science research. A surprising proportion of faculty members expressed the view that the

TABLE 3-5
WOULD 6, OR FEWER, MAJOR UNIVERSITY CENTERS IN THE STATE, CONDUCTING THE GREATER PART OF SCIENTIFIC RESEARCH, BE IN THE BEST INTEREST OF HIGHER EDUCATION IN MICHIGAN?
(No responses eliminated, N = 507)

INSTITUTION	(N)	FACULTY RESPONSES BY PERCENTAGE		
		Yes	No	No Opinion
U of M	94	60.6	12.8	26.6
MSU	95	65.3	14.7	20.0
WSU	43	62.8	14.0	23.3
WMU	42	54.8	33.3	11.9
MTU	34	38.2	38.2	23.5
CMU	45	46.7	37.8	15.6
EMU	37	24.3	56.8	18.9
NMU	26	19.2	73.1	7.7
OU	26	42.3	42.3	15.4
FSC	28	46.4	53.6	. . .
GVSC	37	35.1	45.9	18.9

state government should assume major responsibility in providing funds required to support within each institution either a fundamental group of research areas or at least a few specialized areas, although in most institutions somewhat more faculty felt that such funds should come by Federal grant or contract. (Table 3-6). This plea for a larger state responsibility coincided with a view expressed by some faculty in interviews that the universities should seek to convince state officials of the inseparable relationship between instruction and research and to demonstrate the need for continuous, assured state funding of a certain level of research. However, most faculty members recognized that the state gives little direct support to research projects and they expect little change in the future. They believe that the quest for research funds, whatever the patterns of occasional retrenchment by Federal agencies, must still be directed largely toward the Federal government.

Feasibility of Inter-Institutional Participation on Sponsored Research Projects. The present concentration of research awards, facilities and personnel at a few of the state institutions has raised the question of inter-institutional cooperation in research. About 10 percent of the faculty sample for the Faculty Questionnaire had actually had some such experience. Over a third of the faculty at all but one institution agreed that inter-institutional participation in specific, sponsored research projects is feasible. Less substantial proportions of the faculty in the various institu-

TABLE 3-6
FACULTY OPINION ON THE SOURCE TO ASSUME MAJOR RESPONSIBILITY IN PROVIDING INCREASES IN SCIENCE RESEARCH FUNDS TO SUPPORT A CORE OF RESEARCH AREA OR ONE OR A FEW SPECIALIZED AREAS OF RESEARCH IN EACH STATE INSTITUTION
(No opinions and no responses eliminated, N = 327)

INSTITUTION	(N)	PERCENTAGE DISTRIBUTION OF FACULTY RESPONSES AMONG SOURCES			
		Federal Grants and Contracts	State Government General Fund Appropriation	Private Corporation Grants and Contracts	Private Foundations Grants and Contracts
U of M	54	55.5	35.2	7.5	1.8
MSU	58	44.8	50.0	. . .	5.2
WSU	33	39.4	57.6	. . .	3.0
WMU	27	44.4	51.8	. . .	3.7
MTU	22	31.8	54.5	9.1	4.5
CMU	26	46.1	42.3	3.8	7.7
EMU	27	48.1	48.1	. . .	3.7
NMU	14	57.1	21.4	7.1	14.3
OU	21	61.9	33.3	4.7	. . .
FSC	20	45.0	35.0	15.0	5.0
GVSC	25	44.0	40.0	4.0	12.0

TABLE 3-7
FACULTY OPINION ON WHETHER SOURCES OF FUNDS FOR SCIENTIFIC RESEARCH SHOULD PURPOSEFULLY PURSUE A POLICY OF PROMOTING INTER-INSTITUTIONAL PARTICIPATION IN SPONSORED RESEARCH
(Eliminate no responses, N = 499)

INSTITUTION	(N)	PERCENT OF FACULTY RESPONSES		
		Yes	No	No Opinion
U of M	93	11.8	55.9	32.3
MSU	95	20.0	46.3	33.7
WSU	41	29.3	56.1	14.6
WMU	41	31.7	39.8	29.3
MTU	33	36.4	36.4	27.3
CMU	43	53.5	14.0	32.6
EMU	37	45.9	37.8	16.2
NMU	26	26.9	46.2	26.9
OU	26	34.6	42.3	23.1
FSC	27	44.4	37.0	18.5
GVSC	37	37.8	32.4	29.7

tions favored having the sources of funds purposefully pursue a policy of promoting inter-institutional participation as they distributed funds for sponsored research. (Table 3-7).

Approximately a third of the faculty interviewed also indicated a willingness to explore inter-institutional cooperation and felt that present means of travel and communication provide greater possibilities than are presently being exploited. Proposals ranged from improved means of inter-institutional use of computers and library facilities to more complicated plans of faculty interchange. However, faculty with doubts or decidedly negative views toward inter-institutional research collaboration predominated. Problems of time and distance, of administrative procedures, and of cooperation between faculty from different universities with different images were cited. The prevailing view was that facilities and projects must be developed at each institution.

Support of the Young Investigator

If there is a lack of support for the young investigator, it might appear in serious discrepancies between actual research involvement and preferences. The discrepancy should be much greater in the lower ranks than for associate or full professors. Using the test of active research participation as 30 percent or more of professional effort in research activity, comparisons among the faculty sampled for the Faculty Questionnaire show little differentiation by rank in actual activity on this basis. In every institution, those at any given rank, taken as a group, expressed a desire to devote an equal or greater amount of time to research than currently was the case. Again, there was little variability on a rank basis in the proportions of faculty who would *prefer* to spend 30 percent of their professional effort in research. This similarity of responses from faculty of different ranks does not demonstrate major generational differences in desire to perform research.

Faculty members sampled for the Faculty Questionnaire were asked to choose among instruction, research, or publication as the activity contributing more to an individual's status than any other one activity. The tendency in most of the institutions was for junior faculty to feel less pressure for research activity based upon status considerations than did faculty in higher ranks, although assistant professors at MSU and WSU attached greater significance to research as a contributor to status than did their higher ranking colleagues in these institutions.

The number of applications for sponsored research made per person by instructors and assistant professors during the immediately previous five-year period was smaller than the number made by associate and full professors; probably some instructors and assistant professors had not been faculty members for a full five years and would have had less time in which to make application. At MSU, NMU, and FSC assistant and associate professor applications were about the same per capita; at WMU applications by assistant professors were more numerous than those made by full professors; at CMU assistant professors were more active in application than either associate or full professors. But generally speaking, although instructors and assistant professors maintained, in about the same proportion as faculty of higher rank, that they were carrying significant research loads (spending more than 30 percent of their professional effort in research), they were not applying as often for funds from outside sources.

More crucial to the problem of the young investigator is the lower percentage of awards out of total applications. In the case of Federal agencies to which the great bulk of all applications were made, full professors met with success in 73 percent of their application efforts, associates in 58 percent, and assistant professors only in 51 percent. This lower rate of success limited still further the participation of assistant professors in research funded by outside sponsors. Important institutional variations can be noted in Table 3-8 which suggest that the problem of the young

TABLE 3-8
PER CAPITA RESEARCH AWARDS BY FEDERAL AGENCIES TO TEACHING FACULTY AND PERCENT OF AWARDS OUT OF TOTAL APPLICATIONS, BY ACADEMIC RANK (1962-67)

INSTITUTION	FULL PROFESSORS		ASSOCIATE PROFESSORS		INSTRUCTORS AND ASSISTANT PROFESSORS	
	Per Capita Awards	% of Awards from Application	Per Capita Awards	% of Awards from Application	Per Capita Awards	% of Awards from Application
U of M	3.40	85.4	3.21	71.5	2.53	81.1
MSU	2.60	72.7	1.52	58.6	1.17	44.3
WSU	3.28	75.6	1.50	55.8	1.56	70.0
MTU	2.07	70.7	1.82	55.6	.70	50.0
WMU	.60	42.9	1.20	39.1	.71	44.4
CMU	.08	6.2	.20	33.3	.75	41.9
EMU	1.00	78.6	.85	50.0	.29	26.7
NMU	2.29	100.0	0.00	00.0	.39	36.8
OU	1.33	47.1	1.30	68.4	.18	22.2
FSC	.50	18.7	.17	28.6	.36	36.4
GVSC	1.00	35.7	.33	75.0	.52	65.0

investigator is less serious in the institutions which already have strong research programs.

Yet the preponderance of opinion in the interviews, at institutions both large and small, is that getting adequate funds to encourage and help start able young investigators is a particularly difficult problem. Without a policy of some special consideration for beginning researchers within a system of project grants or through an expansion of broad form grants, the strategy of many institutions is simply to insist that their young faculties exert greater effort in seeking awards.

Balance Among and Within Scientific Disciplines

The issue of balance among scientific disciplines within an institution and within separate areas of study of each discipline has been a subject of much discussion by college and university administrators and faculty. Clearly by balance is not meant equal levels of activity and accomplishment in each discipline or area. Rather, balance implies that the institution has established a hierarchy of academic activities, with different emphasis on different disciplines, meshing into a pattern of overall activity and accomplishment which attains the goals of the university as a functioning part of the total society. Imbalance would exist only when the goals of the institution, and thus the goals and needs of the society, are somehow distorted by the extraordinary expansion or the extraordinary contraction of given scientific disciplines or areas. Expansion or contraction of a program would not in itself create distortion or imbalance. In fact, as society's needs and institutions' goals shift, an accompanying shift in emphasis among disciplines and areas of science is necessary to retain balance between programs and goals pursued. Imbalance sets in when factors either internal or external to the college or university bring changes in programs, in goal attainment, or ultimately in redefinition of goals in ways which are deemed inappropriate by administrators and faculty.

It is generally agreed that outside funds for research, particularly Federal funds, have contributed to great changes in emphasis in college and university programs, and thus, in the long run, in the institutional goals. Depending upon their conceptions of the proper aims and goals for these institutions in the research-graduate program area, observers of the changes conclude that they have led either to imbalances and distortions of functions and goals or to the establishment of a new balance among programs—with the new aims, goals, and programs of the institutions now being more realistic within the framework of state, regional, and national needs.

Unevenness of available funding and actual expenditures of funds has caused uneasiness among some administrators and faculty in the large institutions. And in the smaller, but still sizable institutions, which are seeking to emerge as universities with strong graduate-research programs, the strategy of concentrating internal resources in building up a base for research in only a few selected, scientific areas to which it is hoped outside funds might be more readily attracted, raises questions of the criteria of choice of the selected areas and of the advisability of restricting the chance for immediate development of other areas by such choices. However, justification of the unevenness of the funding which supports some scientific disciplines much more strongly than others within a given institution is made by administrators on numerous grounds. It is pointed out that the degree-gaining graduates of the science areas which are most strongly funded are apparently in as heavy, or heavier, demand by the society as are those in other areas. This training of needed scientific personnel within a research framework is regarded as a major goal for universities. Furthermore, it is noted that the funding needs of disciplines vary and that in some areas major research activity can be carried on with relatively minimal funds. Dollar awards and expenditures act as less then perfect guides to show relative emphasis among programs, and the variations in funding would on these grounds be no exact indication of imbalances. It is also suggested that disciplines vary in their ability to make effective use of research funds. In general, when the question of imbalance, resulting from funding patterns, among the broad scientific discipline areas of science within a given institution is raised, administrators and faculty seem to believe that what appears as imbalance is traceable to variations in emphasis based on necessities for fulfillment of aims and goals and on efforts to make actual expenditures coincide with the monetary requirements and scientific readiness of the different disciplines.

Despite these explanations, the existence of significant imbalances is recognized. Many faculty members and administrators are in basic agreement with the blunt statement of one top administrator that, "Research support by the Federal government, without support of higher education in general, tends to distort higher education." The institution's own general funds are often strained by the necessity of assuming cost-sharing obligations for sponsored research projects in the disciplines heavily funded from the outside, or in the case of some smaller institutions by the practice of directing the institutions' funds into a few specially designated disciplines to create a research base capable of attracting Federal funds. This is why some university people reiterate the need for a considerably expanded program of Federally financed institutional grants.

Impact of Sponsored Research Funds on the Balance of Research Conducted Within Scientific Disciplines. Faculty members queried as to whether funds for sponsored research create imbalance or distortion in the types of research which are carried on *within* their particular scientific discipline, respond much as do administrators in regard to imbalance stimulated by outside funds among the various disciplines. There is a recognition of the directing force which outside funding exerts upon research activity, a feeling on the part of some that it tends to create certain distortion or imbalance, but that the problem, though significant, is not serious. The preponderant view among those who expressed an opinion was that research funds "Give necessary financial backing to previously conceived programs." With the exception of two institutions relatively weak in research orientation, at least two-thirds of the faculty sampled in each institution responded in that fashion. In the three institutions strongest in research, the percentages of response were 91 percent at WSU, 88 percent at the U of M, and 74 percent at MSU. Relatively few of the faculty (0 to 22 percent) at the various institutions felt that research funds from outside their institution gave research programs within their discipline "a focus which was not previously contemplated." MSU, where 16 percent of the respondents felt that outside funding tended to give research a focus not previously contemplated, provided the strongest response of this kind among the faculty at the three largest institutions.

The greater proportion of the faculty sampled indicated that they developed their own research interests and conceived their own research programs, but they also recognized that the availability of funds played a significant role in whether or not new research programs would ever be initiated. In all but one institution, about two-thirds or more of the faculty said that the role of such funds in initiating new projects was that of either a dominating or a significant influence. (Table 3-9).

As numerous interviews brought out, faculty members pursue their professional interests within the framework of the missions pursued by funding agencies. Given the existence of multiple sources of funding, most faculty who responded appear to be reasonably successful at finding some sponsor who sees adequate connection between what the individual wants to do and the sponsor's mission. In the process of making the fit, some research interests of the faculty get squeezed out and this is of sufficiently frequent occurrence as to be recognized as a problem.

TABLE 3-9
IN THE DETERMINATION AT YOUR INSTITUTION OF THE NEW RESEARCH PROJECTS WHICH WILL BE INITIATED IN YOUR DISCIPLINE, WHAT DO YOU CONCEIVE TO BE THE ROLE PLAYED BY THE AVAILABILITY OF FUNDS IN THE BUDGETS OF SPONSORS FOR CERTAIN TYPES OF RESEARCH?
(No responses eliminated, N = 327)

INSTITUTION	(N)	PERCENTAGE OF FACULTY RESPONSES: Dominating Influence	Significant Influence	Some Influence	Little or No Influence	No Judgment
U of M	85	27.1	47.1	12.9	4.7	8.2
MSU	74	23.0	47.3	14.9	4.0	10.8
WSU	34	23.5	55.9	8.8	3.0	8.8
WMU	23	17.4	73.9	4.3	4.3	. . .
MTU	20	45.0	40.0	5.0	5.0	5.0
CMU	15	40.0	13.3	6.7	6.7	33.3
EMU	20	35.0	30.0	10.0	. . .	25.0
NMU	12	7.7	61.5	7.7	. . .	23.1
OU	20	15.0	50.0	30.0	5.0	. . .
FSC	9	44.5	22.2	. . .	. . .	33.3
GVSC	15	53.3	20.0	6.7	. . .	20.0

Methods of Conveyance of Research Awards. In the faculty interviews the response to a query on the ideal type of research fund award was that it should provide the greatest possible freedom of the investigator to pursue a fundamental research problem of his choice. Though often a preference for grant awards was indicated, interviews with administrators of numerous research awards indicated that, increasingly, the terms of grants and contracts make little difference in the actual conduct of research.

Of 261 faculty members sampled in the Faculty Questionnaire who had had experience in conducting research under a sponsored award, 45 percent declared that important differences exist in doing research under grants and contracts. Of this 45 percent, about 90 percent considered contracts to be more restrictive than grants. Thus a substantial minority of the 261 held to the historic idea of distinction between the two. However, only about one-third of this minority felt the restrictions to be serious. Those who noted restrictions found them to be most evident in the formulation of the study and to a lesser extent in its conduct.

Faculty researchers, for the most part, appear to have adjusted to the degree of "basic" research which is possible within mission-oriented programs of agencies. At best, the basic-applied dichotomy rests upon tenuous definitions. Some researchers, especially those in Engineering, consider it to be their major function to tackle fundamental scientific issues which loom as obstacles in the application of known information to the solution of rather practical problems. Many faculty also believe that a higher proportion of project grants in the near future will be problem-solving oriented for society's welfare. This possible development is not viewed with total unconcern, but it is still recognized that very fundamental and important research can be conducted within that framework. In the selection of the projects which they seek to have funded and in their approach to them, most faculty apparently continue to look for opportunities to make use of and extend the basic knowledge of their disciplines.

IV. Impact of Funds on Science Education

Implicit in the preceding discussion of research funding has been the close interrelationship between research and both undergraduate and graduate education in the sciences. In this chapter attention will be given more directly to science education programs. Enrollment changes in scientific curricula and especially the relative development of undergraduate and graduate programs will be examined. The relationship of these developments to sponsored research funding will be considered. Growth in facilities plant and equipment, and the sources of funding of these facilities will be noted. Data available on numbers of teaching faculty and the rank make-up of the faculty will be considered. Faculty and student views will be compared on the impact of research activity on the quality of graduate and undergraduate education. The variant impacts of different types or methods of financial support upon the progress and educational goal attainment of graduate students are matters of interest. Finally, the methods of funding, the organization, and the results of special educational projects in the science areas, particularly the institutes conducted by the colleges and universities for secondary and elementary teachers, will be examined.

Student Enrollments in Scientific Curricula. Enrollments in scientific curricula in the Michigan public colleges and universities show important increases between 1957 and 1966, the years covering data collection in this study. For the four institutions (U of M, MSU, WSU, and MTU) which have had over the period from 1957 to 1966 the heaviest enrollments in science among the state institutions (undergraduate data were not available for WMU), overall increases in enrollment of combined graduate and undergraduate majors in science varied from 30 percent to 60 percent during that nine year period.

OU and GVSC, being newer institutions and having student bodies for only four years or less prior to 1966, showed large percentage gains in science undergraduate majors, with increases of between 50 percent and 100 percent each year. FSC, an older institution with stability in its science program, showed an increase of 13 percent in its science majors.

However, it was in the rapidly changing former teachers' colleges, that the greatest percentage increases in science enrollment can be noted. EMU's undergraduate science majors increased by 320 percent to a total of 1,246 between 1957 and 1966; at CMU, with graduate students being 5 percent or less of the total in each year, overall numbers of science majors increased by 368 percent between 1957 and 1966 to a total of 1,707 in 1966.

A somewhat changing pattern of enrollment can be observed among the major areas of science dealt with in the study—Engineering, Physical Science, Life Science, Social Science, and Psychology. In those institutions which had in 1957 the largest enrollments of science majors, the science areas with the strongest enrollments of majors in 1957 generally also had the strongest enrollments in 1966. However, areas which originally had the lower enrollments increased at a more rapid rate. At MSU, for example, majors in the Life Sciences, as a percentage of overall science major enrollment declined from 36 percent to 34 percent; Engineering majors declined from 30 percent to 19 percent of the total. The proportion of Physical Science majors increased from 18 percent to 22 percent, and of Psychology majors from 5 percent to 7 percent.

Similar tendencies can be observed at WSU. The proportion of Engineering majors declined from 49 percent in 1958 to 42 percent in 1966 and Life Science majors, another strong area at WSU, from 21 percent to 17 percent. On the other hand, the proportion in Physcial Science increased from 15 percent to 17 percent, in Social Science from 11 percent to 15 percent, and in Psychology from 5 percent to 8 percent. For three years from 1963 to 1966, the U of M showed slight declines in the proportions of science majors in Engineering, Life Science, and in Physical Science and increases in the percentage of majors in Social Science from 11 percent to 16 percent and in Psychology from 7 percent to 9 percent. At MTU between 1957 and 1966 majors in Engineering decreased from 89 percent to 75 percent while Physical Science increased from 5 percent to 14 percent and Life Science from 6 percent to 11 percent.

In the newer institutions, and in those universities which earlier concentrated on teacher preparation, the general pattern is for programs developed after 1957 to have the greatest number of student majors and to center primarily in Physical Science and secondly in Social Science. CMU in 1966 had 662 Physical Science undergraduate majors and EMU had 448 compared with 543 enrolled at the U of M, 1,633 at MSU, and 429 at WSU. In Social Science, CMU in 1966 had 308 undergraduate majors and EMU had 497 compared with 736 enrolled at the U of M, 2,170 at MSU and 252 at WSU.

During the period covered by the study there was an absolute increase in numbers of graduate student majors in science curricula at the institutions in which the strongest graduate programs were established, but the proportion of graduate students in science relative to total majors in science increased relatively little. At MSU, the graduate proportion between 1957 and 1966 changed from 17 percent to 22 percent; at WSU between 1958 and 1966, from 30 percent to 34 percent; at the U of M for the three years 1963 to 1966 there was a slight decrease from 49 percent to 48 percent. In 1966, 58 percent of the majors in Physical Science at the U of M were graduate students, as were 50 percent at WSU and 27 percent at MSU. Some 55 percent of the majors in Life Science at the U of M were graduate students, as were 46 percent at WSU and 25 percent at MSU. The graduate Engineering programs were also strong at the U of M and WSU. At the U of M some 44 percent, and at WSU some 23 percent of the majors enrolled in Engineering were graduate students. The 1,232 graduate student majors in Engineering at the U of M and the 475 at WSU constituted in 1966 the highest number of graduate student majors in any of the scientific areas in these institutions.

At MTU and CMU, other institutions for which data on both undergraduate and graduate student majors are available, graduate majors were 4 to 5 percent of the total. At MTU the greater numbers of graduate student majors were in Engineering, but the largest proportion of graduate students was in Physical Science. At CMU, graduate majors in the Life Sciences were greatest in number with somewhat fewer numbers in Physical Science and Social Science. Of the former colleges of education WMU had the strongest graduate student major enrollment in the sciences with the areas of major concentration being Psychology, Physical Science, and Social Science in that order.

Data on credit hours produced in the major areas of science provide a somewhat different perspective on the relative strength of instructional programs than data on the number of student majors. While Engineering, for example, at the U of M in 1966 had 39 percent of all science majors enrolled, only 17 percent of all credit hours in science were produced in Engineering. At WSU 42 percent of the science majors were enrolled in Engineering compared with 6 percent of credit hours produced. At MSU comparable figures were 19 percent and 6 percent and at MTU, 75 percent and 34 percent. Obviously students in Engineering take many courses in other science areas. A contrasting picture is found in Physical Science and Social Science. In each of these areas at the largest institutions the proportions of credit hours out of total credit hours taught in science were substantially higher than the proportion of majors in these areas out of all majors in science. At the U of M in 1966 only 18 percent of all science majors were in Physical Science but 32 percent of credit hours were produced in that area; at MSU comparable figures were 18 percent and 30 percent and at WSU, 17 percent and 32 percent. At the U of M in 1966, 16 percent of all science majors were in Social Science, but 18 percent of the credit hours were produced in that area; comparable figures at MSU were 22 percent and 31 percent and at WSU, 15 percent and 38 percent.

At the largest institutions the proportion of credit hours earned by graduate students of all credit hours earned in science was much less than the proportion of graduate student majors of all science majors. This was most apparent in Physical Science and least so in Engineering. At the U of M in 1966, 58 percent of the science majors in Physical Science were graduate students but they earned only 17 percent of all of the credit hours in that area; comparable figures at MSU were 27 percent and 7 percent, and at WSU, 50 percent and 13 percent. The proportions of graduate majors and proportions of graduate credits earned in science are less disparate in the other institutions offering graduate work. This difference probably results from the general tendency of master's level programs and *new* doctoral programs to rely more heavily on courses and credits than is true in established doctoral programs.

Relationship of Enrollments to Funding of Separately Budgeted Research. Little relationship exists between enrollments in science in the Michigan colleges and universities and the funds available for sponsored research. Several institutions with minimal research funds are training large proportions of degree-seeking students in science programs, particularly in Physical Science and Social Science. Most of these are undergraduates but it is clear that many of them are not in contact with faculty members who are active in research.

Among institutions with a significant level of research funding and a faculty active in research, expenditures for separately budgeted research have little relationship to the number of student majors enrolled. At the U of M in 1965-66, expenditures for separately budgeted research in the areas of science covered by the study amounted to over $44,000,000 and there were 7,230 student majors in the areas of science; figures for comparable categories at MSU were $14,000,000 in expenditures and 12,522 students; at WSU there were expenditures somewhat over $4,000,000 with 4,937 students. There are really no good reasons to expect that separately budgeted research expenditures would be directly related to enrollment, but there is a reasonable contention that quality instructional programs require some funding for research. Our data show only that neither relative enrollments among disciplines in a given year nor such trends as increasing enrollments in Physical Science and Social Science appear to be closely related to differing amounts of funds for research in the areas of science.

Despite the assertion that graduate programs in science are dependent upon adequate research programs which must receive some funding from outside the institution, there is, within the state colleges and universities in Michigan, only a rough relationship between graduate enrollments and the actual amount of research funding. The relationship is closer than for undergraduate or total enrollments, but the most that can be said is that institutions with large numbers of graduate majors in science receive the strongest support for sponsored research, and that those science areas within an institution which have the largest graduate enrollments usually have substantial outside research support. At WSU in 1965-66, separately budgeted funds for research in Engineering amounted to $188,000 with 475 graduate student majors enrolled; at the U of M the research funds amounted to $9,462,000 with 1,232 graduate student majors enrolled. For graduate students, perhaps even more than for undergraduates in science, the expenditure figure for research required for adequate training of a student would depend upon the particular field of science and the specific level and type of training provided.

Within each of the universities with strong research programs, the relationship between the amount of funds for separately budgeted research and the number of graduate student majors enrolled varied greatly among the major areas of science. The $9,462,000 in research funds associated with 1,232 graduate students in Engineering at the U of M can be compared with the $18,233,000 in research funds in Physical Science and 749 graduate student majors—the largest group of graduate majors in any general area of science at the U of M in 1965-66 except Engineering. Data from both WSU and MSU could be cited to illustrate the same point. There is no meaningful relationship between gross amounts of research funds and enrollments either within or among institutions.

The lack of relationship is not really surprising. The costs of conducting significant research vary among specific disciplines and fields of science so that depending upon the specific area of training of a graduate student, differing amounts of expenditures would be required to fund research necessary for his education. Secondly, much of the sponsored research is directed to fulfillment of the mission of a sponsoring agency rather than to enhancement of the educational process. Thirdly, it is possible that some graduate programs are launched without outside fundi., for research. The alternatives in such a case are either to use the limited internal funds of the institution to support the research or to have the quality of the graduate program suffer. Certainly in the opinion of faculty and administrators a strong graduate science program requires strong support for research.

Sources of Capital Expenditures for Science Research and Education. One evidence that science education programs derive benefits from separately budgeted research can be found in the equipment purchases made under the terms of the research awards. Table 4-1 indicates for 1965-66 the major sources of funds in four institutions for the purchase of equipment, apart from the equipment included in the capital expenditure for new buildings. In each institution an important part (ranging from 16 percent to 82 percent) of its science equipment added during the year 1965 66 was financed from funds for separately budgeted research. In each institution a great proportion (ranging from 58 percent to 97 percent) of these funds for equipment came from Federal agencies. Direct grants of funds for equipment purchases added to the Federal contribution. For most institutions these direct grants were relatively minor in the overall pattern of funding, although for OU in 1965 66 they accounted for 36 percent of the special equipment purchases.

Without the funds for equipment purchase coming from separately budgeted research awards or special equipment grants, heavier reliance would have to be placed on Instruction and Departmental Research allocations. The data indicate that a high proportion of equipment purchased in some institutions is dependent upon this source. Additional data available for the year 1965 66 for CMU, EMU, NMU, and FSC show that practically 100 percent of science equipment purchases in these institutions, apart from original equipment in new buildings, was financed from Instruction and Departmental Research funds. An important point to emphasize is that after research projects have been completed, most of the equipment remains at an institution. Not only during the actual term of the research project, but also subsequent to it, this equipment can be used in the educational program.

State legislative appropriations for capital expenditures (new plant and original equipment) for science in the Michigan state colleges and universities are also heavily supplemented by funds from other sources. These funds make important contributions to equipment acquisitions which are employed both in research and in graduate student and undergraduate training. (Table 4-2). Among the institutions providing data, the range of funding from other than state legislative funds varied from 2

TABLE 4-1
EQUIPMENT EXPENDITURES IN SELECTED INSTITUTIONS FOR SCIENCE RESEARCH AND EDUCATION BY SOURCE, 1965 66
(In Thousands of Dollars)

SOURCE	U OF M		MSU		WMU		MTU		OU	
	Totals	% of Source	Totals	% of Source	Totals	% of Source	Totals	% of Source	Totals	% of Source
Funds from Separately Budgeted R&D										
Federal	1,884	89.6	1,127	80.0	50	87.7	21	58.3	29	96.7
Institution's Own Funds	97	4.6	216	15.3	3	5.3				
Other Non-Federal	122	5.8	66	4.7	4	7.0	15	41.7	1	3.3
Total	2,103	100.0	1,409	100.0	57	100.0	36	100.0	30	100.0
% of All Sources	81.8		69.8		16.1		22.6		27.5	
Funds from Institution's Instruction and Dept. Research Fund	466	100.0	576	100.0	283	100.0	123	100.0	39	100.0
% of All Sources	18.1		28.5		79.9		77.4		35.8	
Funds from Federal Science Education Grants	2	100.0	35	100.0	14	100.0	...	...	40	100.0
% of All Sources	.1		1.7		4.0		...	...	36.7	
TOTALS	2,571		2,020		354		159		109	

TABLE 4-2

Capital (Plant and Equipment) Expenditures for R&D and Graduate Instruction and for Undergraduate Instruction by Institution* and Source of Funds, 1956-66
(In Thousands of Dollars)

Institution	Federal Funds Amount	Federal Funds %	State Legislative Appropriations Amount	State Legislative Appropriations %	Institution's Own Funds Amount	Institution's Own Funds %	Other Non-Federal Funds Amount	Other Non-Federal Funds %
U of M								
R&D and Grad. Instruc.	4,959		15,355		2,665		2,301	
Undergrad. Instruction	549		9,798		5,303		427	
Total	5,508	13.3	25,153	60.8	7,968	19.3	2,728	6.6
MSU								
R&D and Grad. Instruc.	6,204		7,627		10,631		238	
Undergrad. Instruction	992		6,210		1,198			
Total	7,196	21.7	13,837	41.8	11,829	35.7	238	.7
MTU								
R&D and Grad. Instruc.	....		196		...		17	
Undergrad. Instruction	....		4,487		....		291	
Total	....	...	4,683	93.8	....	...	308	6.2
WMU								
R&D and Grad. Instruc.	105		90		34		7	
Undergrad. Instruction	679		2,637		189		....	
Total	784	20.9	2,727	72.9	223	6.0	7	.2
CMU								
R&D and Grad. Instruc.	....	...	....		72		....	
Undergrad. Instruction	....	...	3,600		....		....	
Total	....	...	3,600	98.0	72	2.0	....	..
OU								
R&D and Grad. Instruc.	....	...	47		....		72	
Undergrad. Instruction	....	...	909		....		114	
Total	....	...	956	83.7	....	...	186	16.3
FSC								
R&D and Grad. Instruc.	....	...	....		....		....	
Undergrad. Instruction	....	...	1,478		243		....	
Total	....	...	1,478	85.9	243	14.1	....	...

*Data on Capital Expenditures not currently available from other institutions.
WMU's data covered only the period 1964-66.

TABLE 4-3
TENDENCY FOR THE MOST ABLE UNDERGRADUATE STUDENTS TO BE ATTRACTED TO INSTITUTIONS AND DEPARTMENTS MOST HEAVILY SUPPORTED IN RESEARCH
(No opinions and no responses eliminated, N - 467)

INSTITUTION	(N)	FACULTY RESPONSES BY PERCENT					
		Strong + Tendency	Some + Tendency	No + or Tendency	Some Tendency	Strong Tendency	Rank by Combined + Tendencies
U of M	85	30.6	43.5	25.9	. .	. .	5
MSU	90	17.8	41.1	35.5	4.4	1 1	11
WSU	39	20.5	41.0	38.5	. .	. .	10
WMU	40	25.0	52.5	20.0	2.5	. .	4
MTU	33	15.7	57.6	15.2	12.1	. .	6
CMU	38	36.8	28.3	18.4	10.5	. .	9
EMU	34	44.1	38.2	14.7	. .	2.9	3
NMU	20	25.0	60.0	15.0	. .	. .	2
OU	27	25.9	44.4	29.6	. .	. .	7
FSC	28	35.7	57.1	7.1	. .	. .	1
GVSC	33	15.1	52.5	21.2	. .	. .	8

percent to 58 percent of all expenditures on new plant and original equipment in science areas. The tendency was for the institutions of larger size with the strongest research orientations to have the largest proportion of expenditures being funded by monies not appropriated by the state legislature. Thus between 1956 and 1966 some 58 percent of such expenditures at MSU came from non-legislative sources; the corresponding figure for the U of M was 39 percent and for WMU between 1964 and 1966, 27 percent.

...

Research Programs and the Quality of Graduate and Undergraduate Education

Faculty Opinion on the Educational Results of Research Programs. Over 90 percent of faculty members sampled for the Faculty Questionnaire believed that institutions and departments which are heavily supported in research in the sciences tend to attract the most able faculty. Most of the faculty also believed that there is a *strong tendency* for the most able graduate students to be attracted to those institutions and departments which are most heavily supported in research. To a lesser degree the faculty felt that the most able undergraduates were also drawn toward educational groupings supported heavily in research. (Table 4-3). However, most of these faculty members did not observe a strong influence in the case of undergraduates, and it may be significant that a large minority (26-41 percent) of the faculty in the three largest and most research oriented institutions maintained that strong research support had no tendency to attract the most able undergraduates in science or else performed as a negative force.

At least 60 percent of the faculty in six institutions, including those with the strongest research orientation, maintained that without research funds in a field of science the development of a graduate program of high quality is impossible. Almost all of the faculty in every institution held either to this position or that such funds are helpful, though not necessary, in carrying on a high quality graduate program. (Table 4-4). This response to the Faculty Questionnaire corresponded closely to the opinions previously noted as having been put forth in faculty and administrator interviews.

The preponderant opinion in each institution (ranging from 45 percent to 80 percent of the faculty sampled) was that research funds to faculty were helpful, but not necessary, for the existence of a high quality undergraduate program. (Table 4-5). Notable is the fact that at each of the

TABLE 4-4
RELATIONSHIP BETWEEN A FACULTY MEMBER'S SCIENCE AREA RECEIVING RESEARCH FUNDS AND THE DEVELOPMENT OF A HIGH QUALITY GRADUATE PROGRAM IN THAT AREA
(No opinions and no responses eliminated, N = 49[illegible])

INSTITUTION	(N)	FACULTY RESPONSES BY PERCENT: Impossible Without Funds	Helps But Not Necessary	No Important Relationship
U of M	92	60.9	37.0	2.2
MSU	96	69.8	25.0	5.2
WSU	41	73.2	26.8	. .
WMU	41	73.2	26.8	. .
MTU	33	60.6	36.4	3.0
CMU	44	31.8	54.5	11.4
EMU	38	50.0	44.7	2.6
NMU	23	43.5	52.2	4.3
OU	27	74.1	25.9	. .
FSC	22	36.4	59.1	4.5
GVSC	36	47.2	44.4	5.2

three largest and most research oriented institutions approximately 30 percent of the faculty sampled either saw no important or fundamental relationship between obtaining research funds and an undergraduate program of high quality or felt that such funds with their associated activity would actually hinder undergraduate program development.

The differing relationship between research and the graduate and

TABLE 4-5
RELATIONSHIP BETWEEN A FACULTY MEMBER'S SCIENCE AREA RECEIVING RESEARCH FUNDS AND THE DEVELOPMENT OF A HIGH QUALITY UNDERGRADUATE PROGRAM IN THAT AREA
(No opinions and no responses eliminated, N = 485)

INSTITUTION	(N)	FACULTY RESPONSES BY PERCENT: Impossible Without Funds	Helps But Not Necessary	No Important Relationship	Hinders Development
U of M	85	7.1	63.5	23.5	5.9
MSU	89	4.5	60.7	27.0	7.9
WSU	40	10.0	60.0	27.5	2.5
WMU	41	9.8	58.5	26.8	4.9
MTU	33	9.1	63.6	24.2	3.0
CMU	44	13.6	45.4	29.5	11.4
EMU	38	13.2	57.9	26.3	2.6
NMU	25	. . .	80.0	16.0	4.0
OU	27	18.5	70.4	11.1	. . .
FSC	26	7.7	53.8	34.6	3.8
GVSC	37	10.8	54.1	27.0	8.1

undergraduate programs was also apparent when faculty were asked whether research grants and contracts had an impact upon the content or upon the means of instruction employed. In the three largest institutions, 74 percent to 87 percent of the faculty sampled recognized an impact of sponsored research funds on graduate instruction in their departments while 44 percent to 51 percent noted an impact on undergraduate instruction. The incidence of recognition of impact was somewhat less in institutions with a lesser research emphasis, and the pattern of stronger recognition of impact on graduate than undergraduate programs shifts, as one would expect, when the responses of faculty from institutions emphasizing undergraduate programs are examined. (Table 4-6).

Those faculty who indicated that they felt that sponsored research had an impact upon the instructional program of their department were, in each institution, almost unanimous in believing that such research activity contributed to improvements of the graduate program. Over half of the faculty in the majority of the institutions replied that research "greatly bettered" the graduate instructional program and most of the rest of the faculty in all institutions maintained that the program was "somewhat bettered." In open-ended responses, the benefits for graduate instruction stemming from research funding were indicated to be additions to and improvement of the curricula, the ability to obtain more and better faculty, and the ability to make significant equipment additions.

With the exception of one institution, lesser proportions of the faculty in each institution said that the funds "greatly bettered" undergraduate instruction than said so in the case of graduate instruction. In the three largest universities between 51 percent and 61 percent said that sponsored research "greatly bettered" graduate instruction while only 27 percent to 39 percent said that it resulted in "greatly bettered" undergraduate instruction. In some institutions significant, though minor, proportions of the faculty maintained that sponsored research "somewhat worsened" undergraduate instructional programs. Nevertheless, the bulk of the opinion on the relationship between sponsored research and undergraduate training centered on the "somewhat bettered" response with the next strongest choice being "greatly bettered." The specific type of betterment indicated most often in open-end responses was that research strengthened the undergraduate curriculum and subject-matter offerings of the departments.

Student Opinion on the Impact of Research on the Quality of Instruction by Professors. Faculty opinion was heavily weighted toward the view that research funding and activity improved the instructional program in

TABLE 4-6

In Your Department Do Sponsored Research Grants and Contracts Have an Impact Upon the Content of the Instructional Program or Upon the Means and Methods of Instruction Employed?
(No responses and responses of no graduate program were eliminated: N = 510 for Undergraduate Education; N = 368 for Graduate Education)

INSTITUTION	(G)	(UG)	PERCENT OF FACULTY RESPONSES: YES — Impact on Graduate Program	YES — Impact on Undergrad Program	NO — Impact on Graduate Program	NO — Impact on Undergrad Program	DON'T KNOW — Impact on Graduate Program	DON'T KNOW — Impact on Undergrad Program
U of M	94	94	77.7	43.6	13.8	31.9	8.5	27.7
MSU	87	96	87.4	51.0	8.0	30.2	5.7	18.7
WSU	39	42	74.4	47.6	20.5	45.2	5.1	7.1
MTU	32	34	65.6	47.1	18.7	32.3	15.6	20.6
WMU	40	41	42.5	34.1	35.0	53.7	22.5	12.2
CMU	40	45	22.5	17.8	37.5	46.7	40.0	35.6
EMU	36	38	36.1	44.7	50.0	42.1	13.9	13.2
NMU	. .	28	. . .	39.3	. . .	42.9	. . .	17.9
OU	. .	27	. . .	48.1	. . .	29.6	. . .	22.2
FSC	. .	29	. . .	10.3	. . .	69.0	. . .	20.7
GVSC	. .	36	. . .	13.9	. . .	50.0	. . .	36.1

Institutions with fewer than 15 responses were not included the sciences, particularly for graduate students. A sample of both graduate student majors and undergraduate senior majors in science at the U of M, MSU, WSU, MTU, and WMU indicated a generally favorable view of the impact of research activity on instruction but a considerable proportion of students expressed reservations on some specific issues. Overall, the responses of the graduate students and undergraduates were remarkably similar. On most matters, the undergraduate judgments were slightly less favorable toward the impact of research on instruction. However it seems that by the time majors in science become seniors, their views on the relationship of research and instruction approximate those of graduate students. Student views represent their insight into the relationship and do not necessarily capture the actual effect of research on instruction. For example, when students respond to the question about effect of research on classroom preparation, the response not only includes a judgment on the level of classroom preparation but also a judgment of the force of one among several causes about which they may

TABLE 4-7
STUDENT OPINION ON THE IMPACT OF RESEARCH ON TEACHING BY PROFESSORS

PROPOSITION CONCERNING IMPACT	PERCENT OF STUDENT RESPONSES		
	Agree	Uncertain	Disagree
Research keeps a professor abreast of his field			
Graduate responses N = 1,203	91.1	4.8	4.1
Undergraduate responses N = 494	89.8	5.1	5.1
Research leaves a professor too little time for classroom preparation			
Graduate responses N = 1,207	35.8	22.9	41.3
Undergraduate responses N = 499	33.1	29.3	37.7
Research results in the introduction of highly relevant material into the course			
Graduate responses N = 1,206	50.3	23.2	26.5
Undergraduate responses N = 478	47.8	25.8	26.4
Research results in the introduction of course material which assumes a higher level of sophistication than most students have			
Graduate responses N = 1,205	28.4	19.8	51.9
Undergraduate responses N = 495	30.9	23.4	45.7
Research makes a professor unavailable regarding matters pertaining to the course			
Graduate responses N = 1,206	30.0	19.8	50.2
Undergraduate responses N = 496	29.6	22.8	47.6
Research stimulates a professor's desire to teach			
Graduate responses N = 1,203	16.7	36.0	47.3
Undergraduate responses N = 496	18.1	38.7	43.1

have little accurate information. Nevertheless, the judgment which students make is important when seeking to describe the research impact on the instructional process in science. Approximately 90 percent of the graduate students and undergraduates agreed that research activity plays an important role in keeping a professor abreast of the developments in his field. (Table 4-7). But they disagreed (45 percent of the respondents) or doubted (35 percent of the respondents) that research stimulates a professor's desire to teach. The students generally agreed that research enriched the subject matter content of courses. Some 50 percent of the graduate students (with undergraduates responding quite similarly) felt that research results in the introduction of highly relevant material into the course, while 27 percent disagreed. Some 52 percent of the graduate students denied that the material introduced assumed a higher level of sophistication than most students have, while 28 percent thought that such was the case. Somewhat less favorable were student views on the impact of research on the availability of professors for matters pertaining to course work: 50 percent of the graduate students did not think that research interfered, but 30 percent did. Even less favorable was student opinion concerning the relationship between research and time left for classroom preparation. Only 41 percent of the graduate students saw no conflict but 36 percent did. It can be concluded that satisfaction with the level of preparation by professors for classroom activity was not high and that many students see research activity as a cause of inadequate preparation.

In general, those students who, on the basis of various indicators, had a greater research orientation than other students tended consistently to indicate a favorable connection between research activity and good teaching. Thus a greater proportion of students holding research assistantships saw research by professors positively supporting instruction than did students with other kinds of aid. Students pursuing the Ph.D. degree saw a more positive connection than did students pursuing the less research-oriented masters degree. Students at the more heavily research-oriented universities were more positive than those at the less research-oriented ones. Similarly a higher proportion of students receiving aid from Federal agencies than of those receiving aid from the universities or other non-Federal sources saw a positive connection between research by professors and a good instructional situation. Of course more students receive research assistantships from Federal than from all other sources combined, and Federal awards go to high proportions of students at heavily research oriented institutions and to a considerably greater proportion of Ph.D. than masters degree candidates. The point that research oriented students supported by Federal funds see a more favorable connection between research and teaching activity than other students should not be overstressed, because, though consistent, the variations are often quite small.

Methods of Student Financial Support and Their Impact on Science Education

One of the major contributions to science education in the American colleges and universities today is the system of monetary awards to students, particularly graduate students, which enables them to continue their studies and at the same time provides services in a variety of ways to the institutions. In an effort to understand the impact of this award system upon the science educational process, numerous questions related to awards and their use were asked in the Student Questionnaire.

Distribution and Sources of Awards. Students were asked what kind of non-loan financial assistance they were receiving and from what source it came. All but 12 percent of the Ph.D. candidates at the five institutions indicated that they were recipients of funds under a General Duty Assistantship, a Teaching Assistantship or Fellowship, a Research Assistantship, a Fellowship or Scholarship for which performance of duties was not required, a Traineeship, or some other form of non-loan award. All but 33 percent of the candidates for masters degrees said they were recipients of such awards. Among the universities, about 9 percent of the candidates for the Ph.D. at MTU had no award, about 11 percent at both the U of M and MSU, about 19 percent at WSU, and 27 percent at WMU. In the case of masters candidates, 25 percent at the U of M had no awards, 31 percent at MTU, 34 percent at MSU, 41 percent at WMU and 45 percent at WSU.

Considerably different proportions of graduate students received the different types of financial assistance. Among the 88 percent of the Ph.D. candidates who received some kind of assistance, the highest proportion (28 percent) held Research Assistantships; they were followed by 21 percent with Fellowships, and 21 percent with Traineeships, 20 percent with Teaching Assistantships or Fellowships; and finally by 3 percent with Scholarships, 2 percent with General Duty Assistantships, and 5 percent with other non-loan support. The pattern of awards for masters candidates was quite different. Some 18 percent designated "Other" as their type of assistance. Among the identifiable types, some 27 percent of all masters candidates receiving some kind of non-loan aid had Teaching Assistantships, followed by 18 percent with Fellowships and 15 percent with Traineeships. Research Assistantships, which held top numerical ranking among doctoral candidates came in a poor fourth among identifiable types among masters candidates with 10 percent of the candidates holding such awards. Still smaller proportions of masters students held Scholarships (7 percent) and General Duty Assistantships (5 percent).

The role played in the sciences by various funding sources can be gauged to some extent by noting the proportions of students receiving specific types of assistance from the different funding sources. (Table 4-8). Among the Ph.D. candidates, Federal sources funded high proportions of students holding Traineeships (88 percent), Research Assistantships (64 percent), and Fellowships (56 percent). The role of Federal awards in supporting students engaging in research activity and training carried over with only slightly less emphasis to masters candidates as well. On the other hand, 94 percent of the Ph.D. candidates holding Teaching Assistantships or Teaching Fellowships, 67 percent of those holding General Duty assistantships, and 36 percent of those holding Scholarships received their funds from university sources. This tendency for teaching and general duty activities to be supported by the universities themselves carried also over to the masters candidates. Funding of graduate students by Other nonFederal sources, though not predominant for any given type of assistance, was important in the provision of Fellowships and Scholarships.

A high proportion of the graduate students indicated the importance of the financial assistance they were receiving in enabling them to continue their education. Some 67 percent of the Ph.D. candidates and 54 percent of the masters candidates said that without aid they could not have continued their studies. Uncertainty was reflected by the responses of approximately 21 percent of all respondents, while about 13 percent of the doctoral and 24 percent of the masters candidates said that they could have attended the university without financial aid. Among Federally aided students a somewhat smaller proportion (13 percent) indicated ability to continue studies without financial assistance than did university aided students (17 percent).

Role of the Graduate Teaching Assistant or Fellow in Science Education. In an era of expanding enrollments in science accompanied by increased pressures upon faculty for research or public service, a major tendency has been for an increased proportion of classroom instruction to be taken over by graduate students who are given the title of lecturer,

TABLE 4-8

Type of Assistance Received by a Sample of Graduate Students During 1967 68 at U of M, MSU, WSU, MTU, and WMU by Degree Being Pursued and Source of Assistance

Source of Assistance	Type of Assistance: Ph.D. Candidates															
	Gen'l Duty Assistant		Teaching Assistant		Research Assistant		Fellowship		Scholarship		Traineeship		Other		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Federal	3	25.0	6	5.3	102	63.7	68	56.2	4	28.6	105	87.5	15	48.4	303	53.1
University	8	66.7	106	93.8	39	24.4	20	16.5	5	35.7	10	8.3	9	29.0	197	34.5
Other non-Federal	1	8.3	1	.9	19	11.9	33	27.2	5	35.7	5	4.2	7	22.6	71	12.4
Total	12	100.0	113	100.0	160	100.0	121	100.0	14	100.0	120	100.0	31	100.0	571	100.0

Source of Assistance	Type of Assistance: Masters Candidates															
	Gen'l Duty Assistant		Teaching Assistant		Research Assistant		Fellowship		Scholarship		Traineeship		Other		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Federal	1	5.3	4	3.7	19	48.7	35	48.6	5	19.2	46	76.7	31	43.1	141	35.5
University	17	89.5	102	93.6	14	35.9	19	26.4	12	46.2	7	11.6	5	6.9	176	44.3
Other non-Federal	1	5.2	3	2.7	6	15.4	18	25.0	9	34.6	7	11.6	36	50.0	80	20.2
Total	19	100.0	109	100.0	39	100.0	72	100.0	26	100.0	60	100.0	72	100.0	397	100.0

assistant instructor, teaching assistant, or teaching fellow. The institution simultaneously buys instruction and supports graduate students. The graduate student not only receives needed financial assistance but has an experience useful to his future professional role.

The degree to which other than regular faculty in the ranks from instructor through professor have assumed a part of the instructional load in the sciences is indicated by Table 4-9. The data, especially that for the three largest institutions, suggests that factors other than the growth of research activity have contributed to the increase in the proportion of faculty beneath the regular ranks. Heavy concentrations of graduate teaching assistants or fellows and others of similar :us are in areas

TABLE 4-9
LECTURERS, ASSISTANT INSTRUCTORS, AND GRADUATE TEACHING ASSISTANTS OR FELLOWS AS PERCENT OF FTE FACULTY, 1965-66, BY FIELD OF SCIENCE AND INSTITUTION

INSTITUTION	PERCENT OF FTE FACULTY				
	Engineering	Physical Science	Life Science	Social Science	Psychology
U of M	16.1	37.3	20.1	30.9	48.2
MSU	26.6	49.1	24.5	27.3	34.9
WSU	3.3	44.6	18.5	28.9	32.3
MTU	11.9	19.7	13.5	0.0	0.0
WMU	No breakdown of faculty by rank				
OU	20.02	11.6	0.0	7.4	0.0
CMU	. . .	0.0	0.0	0.0	14.3
EMU	. . .	6.8	36.0	18.0	0.0
NMU	. . .	2.8	33.3	0.0	. . .
FSC	. . .	0.0	0.0	0.0	0.0
GVSC	. . .	0.0	0.0	0.0	0.0

(Physical Science and Social Science) which have had heavy enrollments of non-major students. In areas heavily supported by outside research funds, graduate research assistant positions would compete for able graduate students with graduate teaching assistant positions.

Certainly the data in Table 4-9 also indicate that the use of graduate students to handle increased enrollments and to afford support for students is becoming common even where strong research support from outside funds is not yet present.

The increased use of graduate students as teachers is sometimes viewed as endangering the quality of teaching. However, some 67 percent of the undergraduate senior majors and 77 percent of the graduate students sampled with the Student Questionnaire found their learning experiences under graduate student teachers very satisfactory or generally satisfactory. Even when graduate students were asked to evaluate the educational experience of being taught in graduate courses by other graduate students, 71 percent of those who had had such an experience rated it as very satisfactory or generally satisfactory.

Time Demands Upon Graduate Assistants and Stretch-Out of Graduate Study. The duties performed by graduate teaching assistants or fellows or by graduate research assistants require expenditure of considerable amounts of time and can readily extend the period necessary for completion of the degree they are pursuing. At all institutions, work loads were heavier for doctoral than for masters candidates. Hours worked per week were generally heaviest for research assistants, next heaviest for teaching assistants or fellows, and least heavy for general duty assistants. The most extreme variations were represented by doctoral students with research assistantships, 54 percent of whom reported working over 20 hours per week, and by masters candidates holding general duty assistantships who noted a median workload of 9.5 hours per week. Students supported by Federal agencies, with a high proportion of doctoral candidates and research assistants among them, worked more than 20 hours a week on the average; students supported by the universities, on the other hand, worked an average of 14 hours a week.

Graduate students recognized that holding any kind of assistantship requiring performance of duties would stretch out the period of time necessary for completion of a degree. The median time estimate made by all graduate students for fellowship holders to complete the doctorate was 3.72 years following the baccalaureate. Acceptance of any kind of assistantship, general duty, research, or teaching, was viewed as lengthening the period of study by almost a full year beyond that needed by a fellowship holder. The research assistantship was generally held as being more advantageous than general duty or teaching assistantships. The tendency to estimate a slightly faster progress toward a degree for research assistants (despite reportedly higher work loads) may be related to the practice of relating the research duties of graduate research assistants to the production of a doctoral dissertation.

Professional Training of Graduate Research Assistants and Graduate Teaching Assistants or Fellows. In interviews faculty and administrators stressed that the program of activity for graduate assistants was intended to provide important professional training. Such training is also an expectation of students. When asked to indicate the most significant benefit that one could gain from holding the type of assistantship or teaching fellowship which he deems most desirable, 34 percent of the students said that the chief benefit was the opportunity to become more proficient in the subject matter of a field of science, 20 percent emphasized the opportunity to gain teaching experience, another 20 percent mentioned the opportunity to learn research techniques and only 26 percent said that the chief benefit was the income. The strong emphasis on various aspects of professional training is apparent.

The graduate assistants sampled expressed a reasonably high level of satisfaction with the faculty efforts to further their professional training as they fulfilled the duties of their assistantships. In terms of their general treatment, 53 percent of the graduate assistants felt that the university professional staff regarded and respected them as interns, while 7 percent of the students reported that most senior staff accepted them as valued peers. Some 22 percent of the graduate assistants, however, felt that they were regarded as just another graduate student, while about 18 percent felt that the faculty viewed them negatively as hired hands or clerical staff. The source of assistance (Federal or university) apparently had little to do with how the graduate student felt he was viewed by the faculty. Masters candidates attributed to the faculty a somewhat more negative view of themselves than did doctoral candidates. In general, most of the graduate assistants felt that the faculty who supervised their assistantship duties regarded them with sufficient respect, did not supervise them too rigidly, and in fact could properly exercise somewhat great supervision.

The majority (over 70 percent) of the graduate research and teaching assistants indicated that their work assignments furthered their professional development. However, 46 percent of the graduate assistants regarded their assignments routine all or most of the time. Graduate assistants supported from Federal funds responded significantly more often (to the extent of 15 to 20 percentage points) than did those receiving assistance from the universities that their duties were not routine, that the duties made reasonable use of their abilities, and that the duties were important as part of their professional training. These favorable attitudes can probably be explained by the high proportion of graduate research assistantships among the total of assistantships financed by the Federal government.

About 83 percent of the graduate assistants said that their duties were either very much or at least somewhat related to their intended future employment. Again the response of the Federally supported graduate assistants was more positive (90 percent) than that of those supported by university sources (77 percent).

Prestige Rating, Professional Training Contribution, and Student Preferences of Types of Assistance to Graduate Students. Some 63 percent of the graduate student respondents to the Student Questionnaire assigned the highest prestige ranking to non-duty Fellowships. The non-duty Scholarship was selected by 13 percent of the students; 11 percent chose the Teaching Assistantship as most prestigeful, 10 percent chose the Research Assistantship, 3 percent chose the Traineeship, and none chose the General Duty Assistantship.

Judgments as to which method or type of assistance would contribute most to professional development were quite different. The highest proportion of graduate students (36 percent) indicated that Research Assistantships would make the top contribution. Next, 26 percent of the graduate students chose Teaching Assistantships, 21 percent chose Fellowships, 10 percent chose Traineeships, 5 percent chose Scholarships, and 2 percent chose General Duty Assistantships.

When prestige, contribution to professional development, and time required for completion of degree are combined with other factors considered by the students to be significant, non-duty Fellowships were indicated by 43 percent of the graduate students sampled as being the type of assistance they would most prefer. Next, 19 percent assigned top preference to Research Assistantships, 16 percent to Teaching Assistantships, 12 percent to Scholarships, 9 percent, to Traineeships, and 1 percent to General Duty Assistantships.

Impacts of Science Institutes for Non-College Teachers

The science institutes for secondary and elementary teachers conducted by many of the Michigan public universities constitute programs of major importance in science education. Financed primarily by the National Science Foundation, these programs have exemplified in some of the institutions, which do not have strongly developed research undertakings, the science projects sponsored by outside funding agencies. Each of the three largest state universities has carried on these projects, as has MTU. The science institute has been even more important in the total program of science training in the former teachers' colleges.

Summary

This chapter has ranged widely over many aspects of science education and the impact of Federal support. The following statements summarize the results:

1. There is little relationship between science enrollments and external funds for research either within or among institutions.
2. Plant, equipment, and student subsidies from Federal sources have been major contributions to science education as well as to research.
3. Faculty and students generally agree that research has contributed to the improvement of instructional programs, especially at the graduate level, but significant minorities express some concern about research distracting attention from instruction.
4. Science institutes have apparently had beneficial impacts on the universities as well as on the elementary and secondary schools. In some cases these programs have become the nucleus of a developing graduate program.

V. Effects on Administrative Organization and Practices

Our interviews with administrators and faculty brought out a number of factors which complicate the attempt to determine in these institutions the effects which non-general fund monies in support of research and science education have had on administrative organization and practices. These factors are embraced in several developments which parallel and interact with the effects of these funds.

1. The increase in amounts and types of support have been gradual developments over a period of years. With changes in personnel being relatively common over this period of time, there are few individuals who have viewed the full extent of impact on administrative organization and practices. The picture has been one of gradual adjustment and accommodation from year to year rather than precipitous change.
2. During the same span of years institutions have been growing in size and often changing their character in that process. Thus it is not always clear whether certain changes in organization or practices are responses to new funding sources or to the changing size and nature of an institution. In fact, these three developments are closely and perhaps inseparately interrelated.
3. Some changes in organization, decentralization of administration, faculty involvement, and financial management are perhaps as much a result of changing patterns of relationships and trends in higher education generally as of any particular form of support or system of higher education.

A few further words about each of these points, more specifically in relation to the Michigan situation, will make these complicating factors somewhat more apparent. The Michigan state-supported institutions can be divided into three rough subgroups in relationship to non-general fund support. The first group, composed of three universities (U of M, MSU, and WSU) may be characterized as having had major support for a decade or more, with organizations and practices that reflect this. Each of the universities has found it necessary to develop offices to coordinate development of proposals and to facilitate the conduct of the resulting grants and contracts. Expansion in accounting, auditing, and purchasing personnel has followed. Research coordination and development, in these institutions, has become an area of administration related to but identifiably separate from previously existing administrative patterns.

At WSU a contracts office was first established in 1951. In the 17 years since that date, Federal and nonFederal grants and contracts have increased over thirty-fold and a more elaborate organization has come into being. At the U of M approximately 150 persons are involved in coordination of research grants and contracts. MSU has had to make similar adjustments by introducing an office of research contracts and a vice-president for research development. Some changes in administrative functions of other units within universities are surely involved in inserting these offices into an existing administrative structure, but the changes are not to be simply described. It is obvious that a faculty member seeking to develop a project for Federal support in 1951 and a faculty member doing so today operates in very different contexts and under different procedures, as well as with offices and personnel outside of the usual academic hierarchy. The faculty member of 1968 and most of the administrators accept the existing pattern as useful and perhaps inevitable without much reflection about its origins. The individual project system of support is the prime mover in bringing about this pattern.

Another group of institutions in Michigan (EMU, WMU, MTU, and OU) have had a major change in character in the past decade. From relatively small institutions with limited purposes, they have grown rapidly, have expanded their range of programs, have achieved increased autonomy, and have moved to new levels of education by introducing master's and/or doctoral degrees. These institutions were relatively little involved in earlier Federal programs which were based upon the purchase of research from the institutions. They have moved into the pattern of Federal support more recently, when that support itself has markedly increased in amount and in range of programs. Although, in a certain sense, these institutions have had to adapt to a much more complicated situation in a shorter period of time than those institutions which were earlier involved, the fact that much of their support has been for science education rather than for research projects has posed a somewhat different administrative problem than that faced by the first group of universities. Moreover, these institutions have been simultaneously involved with the necessity of administrative and management modification generated by alteration in institutional character. Undoubtedly, the availability of Federal support encouraged and accelerated institutional changes, particularly with regard to movements into graduate and research programs, but it is difficult to separate these effects from many other factors.

In the residual group of institutions, the funds and the number of programs or projects involved would seem to indicate relatively little impact. Nevertheless, the administrators and many of the faculty in these institutions are becoming aware of the possibility of Federal support and are seeking ways to take fullest advantage of the developing possibilities. Pressing immediate needs for facilities, equipment, and staff for expanding undergraduate programs by no means eliminate aspirations for some research and for appropriate types of graduate education. Indeed, administrators report that, unless such prospects are indicated, it is difficult to hire any able young faculty members.[1] This is not a negligible impact!

There is one other element in the situation which is difficult to weigh objectively. Colleges and universities need money; in some cases, they need it very badly indeed, simply to maintain quality in rapidly expanding programs. Moreover, the availability of funds and the accompanying indication of types of programs or proposals which might receive support generate needs. In every institution there are individuals who seek recognition by starting new programs, whether or not these innovations are important to or even appropriate in the institution. Individuals and departments cherish the opportunity to deal directly with agencies and individuals in Washington, thereby, on one hand, achieving some recognition through travel, administrative involvement, and scholarship, while at the same time, achieving some degree of independence from the internal budget and administrative red tape which, at best, seems always to be regarded as restrictive and irksome. Administrators are hesitant about interfering with or vetoing individual and departmental proposals which involve specialized interests and competencies and may bring institutional recognition and additional funds.

Perhaps, in part because of this understandable concern for funds, some hesitancy about discussion of problems and of untoward impacts of Federal Government support was noted. In group interviews where some individuals were forthrightly critical, there were obvious attempts to soften these remarks by other individuals (sometimes, but not always, administrators) who were obviously concerned about possible untoward effects. One presumes that there exists some fear that the reporting of

[1] Our interviews preceded the current freezing of Federal expenditures. Informal comments from some of the same persons indicate that applicants presently are rather less demanding.

negative reactions might somehow interfere with further support, negate its expansion, or, at the very least, appear ungracious. Thus irritation at refusals of proposals was presented as an explanation of some rather critical comments from certain faculty members.

Because of this apparent hesitancy of expressing forthrightly qualms about or criticism of Federal programs of support, a considerable portion of this chapter will be devoted to following up and discussing comments and remarks which often are virtually asides or were incidental to some pre- or post-interview informal conversation. It is difficult to maintain appropriate balance in dealing with such comments. On the whole, approbation for the support received was predominant. The effects of this support are apparent, and are readily documented by the projects, by the equipment, and by the facilities which are available on the several campuses. These are discussed elsewhere in this report, and thus we may be excused for concentrating here on some of the less obvious and perhaps less desirable results.

It should be said, too, that the seeming unwillingness to talk about effects on organization, management, emphasis, etc. in an institution are not solely a result of unwillingness to criticize. There is also involved (and the immediate reaction of many individuals made it clear that they so recognized) the extent to which the institution has declared and pursues its own well-defined mission as contrasted with the extent to which it opportunistically seizes opportunities for support. When long-term goals have not been clarified, the bases for rejecting or accepting a new project or for assessing its beneficial or undesirable impact are lacking.

We propose to look at the effects on administrative organization and practice under a series of topics which are admittedly interrelated, but will serve to provide some organization for consideration of a number of issues. The first one of these is a matter of authority. Is the authority of central administrative offices eroded or strengthened? Is the importance of a department chairman or head in any way affected? Has the availability of funds not a part of the general and education budget decreased the authority of the administrator?

A second issue, closely related to the first one, involves the change in the role and function of adminstrators and, almost inseparably, the role and functions of the institutions as a whole. While related to the matter of authority, the concern here is the extent to which the hour-by-hour and day-by-day activities of the administrator take on something of a different character as a result of Federal and other funds.

The third category of concern will be with the budgeting process and more generally with financial policies and procedures which result from the availability of restricted funds.

A fourth issue, which could readily be subsumed under the others and will be dealt with but briefly, is that of the proliferation of paper work. Paper work is symptomatic of other problems, and it can become a problem of major proportions itself because of the time and costs involved and the displacement of other and more significant activities.

Effect on Authority

Though no dean, vice-president, or president claimed or even admitted that the authority of administrators has been eroded by Federal support of research and science education projects, there were many comments which would suggest that this has happened in some respects. Whether this is so, and whether it is good or bad, depends to a considerable extent on one's point of view about administration. The department or the individual who acquires sufficient funds to enable him to pursue his interests with minimal concern about administrators and administrative policy is quite sure that this is as it should be. Administrators tend to be less certain, but they recognize that the reputation and quality of an institution depend in large part on the reputation, quality and morale of departments and the individual faculty. A free interpretation of what we heard from many of these administrators would run something like this. If the administrator could have enough funds to keep all faculty members happy, he would prefer to distribute them himself and thereby keep administrative and budgetary lines coordinated and intact. Since funds at the administrator's disposal for support of anything other than instruction are meager, he is happy to see faculty members tap other resources. Furthermore, he may be pleased to have the responsibility for the allocations removed from his office and handled by a Federal agency, even though the same funds channeled through the institution might have been differently and perhaps more appropriately assigned. Even with institutional grants the administrator still may avoid personal decisions by invoking the necessity of faculty involvement, although the well-known tendencies of faculty committees are to give something to everyone rather than to face up to the harsh exigencies required by deciding on priorities and selecting areas to be promoted to excellence. More charitably, it might be said that the administrator does not see himself as omniscient and he understandably avoids, when he can, difficult decisions which he knows will be unpopular with many faculty members.

Repeatedly we were assured in our interviews with deans, vice-presidents, and others that review of research proposals was a very sensitive matter. A few departments reported some limited type of departmental review to insure that a research proposal is consonant with departmental interests and emphases and possibly, though less likely, to insure that the research idea itself is soundly based. Responses to the Faculty Questionnaire (Questions 38, 39) suggest that among those in institutions with project research experience over a period of years, less than 20 percent of the faculty accept review at the departmental level. Beyond the department, even in the institutions with the most elaborate system of assistance, substantive review of proposals is carefully avoided. One professor, indignantly commenting on an attempt of an administrator to review a proposal, stated the usual position: "No one other than possibly a scholar in the very same specialty is competent to review the research proposal of a scholar." Professors prize both the review by scholarly peers and the bypassing of judgments by administrators and faculty committees.

Administrators, too, see merit in the project system but also see some problems. One administrator, commenting on some remarks of faculty members who were irked because they had not received support, said that they had only themselves to blame the quality of the respective proposals which they had submitted was questionable (if not obviously unsound) on scholarly grounds. No one in the institution quite dared to say "nay" to the proposals, but administrators were relieved when the proposals were not funded. Another administrator expressed the view that there were really only a few top research people in any department, yet everyone was being encouraged to engage in research and being told that any researcher with a worthwhile idea could get support somewhere if he simply went after it. He further noted that negation locally of a proposal whether good or bad, appropriate or inappropriate to the institution becomes impossible in this context. Another administrator remarked that institutions have lost control over research. Whereas its primary function should be to strengthen and extend the educational program of an institution, it has become a means of establishing prestige, of sidestepping other institutional obligations, and an encouragement to exploit the institution rather than to serve it.

Other comments dealt with the fact that research proposals, once funded, tended to be closely controlled by the individual so that supervision is necessarily minimal. How can a chairman or a dean extend supervision to projects developed, managed, or mismanaged by an individual? And yet, as one administrator remarked, "When things don't go well, the institution is still expected to pick up the pieces, and this may mean finding funds to make up a deficit or to carry the project to a reasonable conclusion." Another expressed some concern about large grants which he said tended to turn good researchers into mediocre administrators.

Unquestionably, we were told repeatedly, Federal funds have encouraged the development of graduate education, but not always according to plan. Teachers attending summer or academic year institutes have sometimes been encouraged by the faculty members to continue for a degree and move to new educational levels rather than return to their former jobs. In research projects, the availability of support funds for graduate assistants creates demand for graduate students and augments the graduate program. Although generally deemed desirable by institutions in which this was happening, the point was made that, as a faculty member's time is diverted into graduate education, his activities are much less accountable than when he is engaged in teaching a full-time undergraduate load. Thus the interrelationship of research and graduate education accelerates the development of the latter, sometimes at a faster pace than administrators believe, yet in such guise that it is not easily controlled. One administrator pointed to the fact that there had been a long-standing definition of faculty load which increasingly had to be modified in individual cases and which, as a result, might soon lose its force even though state appropriations did not yet permit a general reduction.

A number of administrators expressed some dismay over the extent to which they found decisions forced by circumstance. Individuals under consideration for positions make explicit not only their salary demands but their teaching load and the research facilities and equipment required. Demands for assurance of summer employment, for research rather than for teaching, also have become more common. Decisions regarding the assignment of space, the purchase of equipment, and the allocation of contingency funds may result from a series of informal commitments made in negotiations with a prospect rather than by a conscious weighing of alternatives. The remarks of one recently employed assistant professor at one of the universities exemplify the problem. This individual stated bluntly that he came because of salary, research facilities, and minimal teaching assignment. He asserted that he was presently considering another offer which he hoped could be promoted to something even more advantageous. New sources of funds also pose some problems with departments. One vice-president remarked that one department on his campus now had over 65 percent of its total budget from non-general fund budget sources. "Obviously," he said, "this means less control."

Within most of the Michigan institutions, the non-departmental or interdepartmental unit often designated as institute or center, has not become a problem. Such units do appear in profusion in the three largest institutions and examples are found in two or three others. These units, oriented to research or to service, frequently originate as a result of or in the expectation of outside support. Federal agency indications of interest in interdisciplinary support encourage the creation of such units. Although several administrators suggested that the preferred pattern was to keep these institutes under the control of departments, it is not always possible to do so. The nature of the activity, problems of space, personal aspirations, and increasing size have resulted in such units taking on an independent life of their own, bypassing departmental and even college levels of authority to deal directly with central administration. The title of director usually used for such units is anomalous in the hierarchy of titles and can come to be interpreted as equivalent in level to anything from dean to something less than a department chairman. Directors, too, tend to fall outside the rotational or review patterns for deans and chairmen. Issues of appointment, tenure, curriculum, degrees, and budget can become troublesome. At least one clear case was found of a unit started originally as a center with a special grant which had developed into a full-fledged academic unit giving courses, granting degrees, and largely dependent on general fund money. Instances were also mentioned by faculty members where institute type units supposedly subsidiary to departments were tightly held satrapies, handicapping rather than forwarding departmental operations. Institutes, though serving distinctive and worthwhile purposes, pose some troublesome administrative problems.

Many of the issues discussed in preceding paragraphs are reflected in the marked difference in point of view found in views expressed by administrators and faculty members on project versus institutional grants. Only a relatively few faculty members endorsed the idea of institutional grants, and these they saw as largely for the purposes of providing initial encouragement to promising departments or young Ph.D.'s. One might expect that faculty would readily assent to institutional grants in the area of facilities, library, equipment, and the like, but, even here, many faculty members argued that these should be made at a departmental level so that the department can meet its needs directly rather than being subjected to the irrationalities of an administrator or the politics and backstabbing of a faculty committee. Administrators, on the other hand, while generally expressing an appreciation for the value of the project type of grant, argued strongly for institutional support which would place back in the hands of central administration and the total faculty the decisions as to the direction which the institution would take.

Most of the preceding remarks came from deans, vice-presidents, or presidents. With department chairmen, the impact upon authority is rather less clear. On one hand, there has been a widespread movement in higher education and, in many of these institutions, toward extensive involvement of the entire staff of a department in decision making. In many cases an administrative or executive committee determines most of the policies of the department, and the chairman then is viewed only as one who carries out these decisions. On the other hand, the enterprise of a department in its initial search for funds often depends upon the drive of the departmental chairman. In the early stages of research activity and project development, as found in some of these institutions, department chairmen may be actively involved, and their authority and prestige are, therefore, reinforced rather than otherwise. In several institutions, it was apparent that the changing character of the institution already had forced, or would shortly bring about, a change in certain department chairmanships to provide leadership consonant with current emphases and prospective future development.

Consequently, the reactions of faculty to question 36 on the Faculty Questionnaire as to whether funds for research from outside the institution have had an impact upon the organizational pattern and functioning of their department varied quite widely. In the main, the responses are closely correlated with the size of the institution and with the extent of the funds involved. The percentages of respondents feeling that significant impact had been made were: 62 percent at the U of M, 53 percent at MSU, and 49 percent at WSU. From there the percentage response so indicating shaded off to practically zero in institutions with no funds from this source. A follow-up question (no. 37) asked whether the overall effect on the department was to strengthen or weaken the influence of the department chairman or head. The responses varied in a manner which is not easily explained. WSU yielded responses in which 91 percent indicated that the influence of the department chairman or head had been strengthened considerably or strengthened somewhat, and none saw any weakening of influence. For the U of M and MSU, only about 25 percent and 27 percent of the faculty respondents saw the influence of the chairman being strengthened considerably or somewhat. But at the U of M, 16 percent of the respondents saw the influence as weakened somewhat and at MSU, 6 percent held the same view. In the remaining institutions omissions—that is, refusal to answer the question—accounted for 50-100 percent of the responses, and the remainder, on the whole, indicated either "don't know" or "no noticeable change." Certainly one finds little concrete evidence in these faculty responses to support the point of view that the influence of the department chairman has been weakened by outside support, although it is of some interest to note that 16 percent of the U of M response so asserted.

In discussing this matter Ross L. Mooney has stated: "Faculty members who obtain help for their research, whether through local committees or outside agencies, therefore do so by special channels separated from their normal departmental routes. Department heads and deans, when they see the papers passing through, tend to become spectators in a separate operation in which they have no crucial part. Department heads tend to restrict their views of themselves to that of being supervisors of arrangements for teaching, letting research become what it will as individual faculty members are motivated and controlling committees decide. A coordinator of research, acting for a dean at the college level, becomes little more than a communicative agent serving between two poles of power, one held by the individual faculty member who has the power of initiative, and the other by the agency which has the power of specific approval. Neither department heads nor deans have real leadership potential in this matter nor realistic capacity to assume responsibility for the integral functioning of the university activity."[·] There surely is something of truth in this point of view expressed by Mooney; yet our investigations in this particular study would not entirely justify this generalization. Rather we would conclude that the effect of additional funds depends upon the caliber and interest of the individual chairman and the attitudes of the members of his department. In a closely knit department with high morale, resources and assistance may be sought in every possible direction but used to advance the whole department. A chairman may aid and encourage and enhance his own stature in this process. There are also those individuals who see themselves as serving only a limited term as chairman and being, at most, temporarily first among equals. These individuals may prefer not to get very much involved in administrative matters, partly because this would interfere with their own scholarly activities, and partly because any attempt to exercise a strong hand would only make life difficult without any real accomplishment. External funds may then further weaken their role of leadership.

In summary, it does appear that Federal funds—primarily those forthcoming under the project system have weakened traditional lines of authority, but the general tendency toward departmental autonomy and increased faculty involvement in decision making makes it impossible to make any precise statement on the issue.

Ross L. Mooney, "The Problem of Leadership in the University," in *Learning and the Professors*, Ohmer Milton and Edward J. Shoben, Jr., Editors. Athens, Ohio: Ohio University Press, 1968, p. 177.

Role and Functions of Administrators and of the Institution

It is obvious that if there is indeed some erosion of the authority of administrators there is some attendant change in role and function. There are reported changes in the activity of administrators which suggest a shift from emphasis on planning and directing to expediting and following through on commitments or directions already pretty much determined.

The availability of outside funds, especially of Federal funds, has pushed all institutions of higher education more definitely into the political arena. Administrative officers and even, to some extent, individual faculty members display surprising awareness and concern about Federal legislation which relates to support of higher education. They are also concerned with inter- and intra-agency discussions and policies. There is a tendency to regard Federal support, diverse as it is and decentralized as it is, as a source of funds which, like those from the state legislature, should expand at some reasonable rate each year. There is no way to tell how many hours of time, how much correspondence, and how much phoning is involved in maintaining this awareness and in reacting to actions which increasingly tend to be regarded solely in terms of their effects on higher education, rather than in terms of their relations to national needs.

Educators readily and perhaps reasonably assume that not only are they the best qualified to determine how their dollars are spent, but that they are also the best qualified to determine what they should be doing and how many dollars they need to do it. This, in the state institutions, generates a second kind of political involvement, for state legislatures tend to see state-supported institutions as supported by the state in the interests of the state. Extensive additional funds are regarded with some suspicion, in that they may be used to develop projects in which the state benefits appear limited and yet the state investment, over a period of time, may inevitably increase. Alternatively, in the face of rapidly rising expenditures for higher education, the legislature may tend to seize upon the additional funds acquired by institutions as a basis for reducing state appropriations. The issues here are very real, and it would seem that, at some time, they must be faced up to forthrightly and resolved in a way understood by all parties concerned. This may ultimately happen, but it will require a new era of mutual trust and understanding. Meanwhile, the non-state sources of support complicate the relationship of the universities to the legislature and therefore influence the activities and attitudes of administrators who must interpret and justify the new patterns.

A third element of political involvement arises in that Federal legislators begin to display a concern about institutions of higher education in a fashion very similar to that found in state legislatures for years. Oath controversies, reaction to activist students, the attitude of institutions toward representatives of the armed forces on campus, and the like, all indicate that those who authorize money for higher education will have some interest in what happens in institutions of higher education. As a result, administrators must and do display a continuing political awareness. They become exceedingly sensitive to possibly provocative actions and statements of faculty members and students and spend many hours in discussing specific cases and in attempting to decide upon actions and policies to alleviate or avoid public criticism.

As a part of this scrutiny from the outside, there have developed a certain number of clichés accepted by administrators and faculty alike which are, in part, truth but certainly not the whole truth. These clichés arise out of a desire to ward off probing in depth by either internal or external critics, but they also contribute a statement of principle which individuals hope is true. One, for example, is that research and graduate study are inseparable. There is certainly some validity in this statement, particularly with regard to the Ph.D. degree, which assumes significant research accomplishment by the individual to justify the degree. It is also true that professors involved in graduate instruction must themselves be doing some research. The statement also reflects reality in that most faculty members engaged in graduate instruction will be involved in some research, and most of those involved in research will in a university, at least have some relationship to graduate instruction. Yet, on the whole, the statement is stretched too far. There is a great deal of research done outside of the university, and it is not directly related to graduate instruction. There is a considerable amount of research done in many universities which is not related, or only incidentally related, to graduate instruction. The incidental relationship may lie only in providing some employment for graduate students. There are research projects being done by faculty members in some of the primarily undergraduate colleges in Michigan which have very limited relation to graduate education, and almost none to undergraduate education. Indeed, there is a considerable portion of graduate education, particularly at the master's level, in which the research involvement of the student is non-existent, and the research involvement of the faculty members is minimal.

The existence of offices or administrators with titles involving research or research development is in itself an interesting commentary upon the oft repeated statement that graduate education and research are inseparable. A situation in which there exists a dean of a graduate school and another person with a title of director, vice-president, or some other alternative, coupled with research demonstrates that, for certain purposes at least, a distinction is made. One vice-president who carries both responsibilities emphasized that he must maintain a clear distinction between the operations concerned with research and those concerned with graduate education. The reasons for this are evident. Much of the deliberation concerning graduate education is concerned with curriculum development and with rules, regulations, and procedures. Research programs help to support and reinforce graduate education, but they are not specifically developed out of the needs of graduate education and the role of research in graduate education. Graduate faculty members will assent to the need for some uniform practices and policies with regard to curriculum requirements, standards, specifications for dissertation, dates, etc., but research does not lend itself to this kind of formal organization. The role of a graduate office is that of direction, review, and maintenance of standards; that of research development is facilitation. Seven of the twelve institutions have found that their activities require the designation of a person with some major portion of his time to activities which might be called research development, with most of the activities related to Federal programs.

The cliché concerning the inseparability of research and graduate education is really an expression of an ideal: in the university, research and graduate study should be inseparable and both are essential to the university. If, by repetition, general acceptance of this view can be achieved, some probing and criticism might be warded off. Furthermore, the admittedly difficult task of accounting for funds in relation to the programs supported and results achieved might be avoided. So long as research and instruction are largely supported by different fund sources, the ideal will be difficult to achieve.

A second generalization or cliché is that research institutes and centers are under the control of departments. It is uncertain just how much of the institute-center development can be credited to the additional sources of support, but there are many institutes or centers in which the availability of funds and the existence of a pattern of organization independent of the departmental college structure deny the validity of the statement. There is also reason to doubt that the departmental organization is sufficiently adaptive to provide for certain types of research, instruction, or services. The large university has become exceedingly complex to administer, and it may be necessary to overhaul the administrative structure to more clearly define functions, fix responsibility, and provide for accountability.

A third type of cliché is that expansion of research and graduate education had no detrimental effect on undergraduate instruction. One must assume that most of the people who make this statement really believe it. The real difficulty with it lies in the definition of undergraduate education. If improved equipment and increased competency of a departmental staff in terms of subject matter and methodology are viewed as providing improved instruction for undergraduates it is because the goal of undergraduate education is seen as greater mastery of content and some contact with research. Then there is at least some rationale for the statement, although no real proof. If an undergraduate education is viewed in a larger sense as requiring close interaction with a faculty devoted to undergraduate instruction with goals inclusive of broad competencies and value commitments, then the case for a detrimental effect on undergraduate education is much stronger. There was repeated evidence in the comments and emphases in interviews that faculty interests and even institutional concerns have gone more and more strongly to graduate education and research activity. The undergraduate oriented to graduate school and specialization gets some attention; the individual seeking a liberal education may be ignored. But what seems obvious to many students and to most administrators is not so to the faculty. The refrain continues: "Undergraduate education has not suffered." Even administrators are chary of making any public statement to the contrary, for political considerations are ever in mind.

In the preceding discussion we have, in some ways, lost sight of the major theme of the changing role and functions of administrators. To return to this and to mention briefly a number of the points which arose in discussions will clarify the issues. A number of chairmen and deans referred to the splits which were evident among and within departments as a result of increased support. The humanities, while not needing the same kind or the same extent of support as the sciences, are sometimes embittered by the apparent preference for the sciences and, if not embittered, at least feel largely ignored. Even when undesignated gifts or endowment fund income is channeled into the humanities the sums involved may be insufficient to eliminate the dissatisfaction, and the recognition is less apparent than that accorded the sciences. And unless the sciences are surfeited, there may be complaints that their enterprise is being penalized because of its success in seeking funds outside the university. There are, of course, signs that this situation may change.

Within departments, despite the reiterated emphasis on the necessity of research involvement for good teaching, many of the faculty are not seriously involved in research. One finds, of course, marked differences between those institutions that have had graduate programs and research activity for many years and those institutions which have more recently embarked upon this activity. Nevertheless, in almost any department in any of the universities in this study one can find a few people, frequently of an earlier generation, who are primarily concerned with teaching and whose scholarly work has been limited to extensive reading rather than to writing. Administrators report some unhappiness, loss of morale, and a resulting consumption of time in comforting individuals whose dissatisfaction is fueled by the fact that, only a few years ago, in terms of the pattern of faculty success at that time, these individuals had looked forward to inheriting prestige and control of their departments. In fact, they now may find themselves often regarded as ineffective supernumeraries, and this may include a long-time chairman or department head who has been displaced to usher in a new emphasis. Attempts to recognize the effective teaching and other contributions of such individuals not uncommonly generate strong reactions from the younger segments of the faculty who believe, and have been told, that research should be the primary basis for reward. Therefore, even if the resources were unlimited, it would be difficult to adjust the situation to everyone's satisfaction.

Several administrators in institutions which have only recently begun to receive support in any substantial amounts express concern about how their outlook was molded by circumstances and the strain and chagrin resulting. For example, the comment was made in several institutions that what was really needed was money to reduce the student-faculty ratio, to provide sabbaticals, to strengthen the advising program, to set up institutional research activity, to provide a computing center, to improve the library, or to provide for travel to scholarly meetings. One interviewee referred to a current report from Biafra which noted that the people there had plenty of fruit available, but needed protein to ward off disease and a rapidly increasing death toll. His point was that they needed in his institution more money for the basic operations, but that faculty attention was directed to the more glamorous opportunities extant in research and special programs which, although good in themselves, tend usually to throw an additional strain on already limited resources. It was pointed out in several cases, for example, that the financing for science education institute programs was extremely tight, and that all too frequently the institution ended up having to supplement a grant to carry the program through in a satisfactory manner. Other administrators pointed to the fact that what was really needed in their institution was a broad interdisciplinary-based research program closely related to some of their basic undergraduate fields, but that the availability of money directed more toward the departmental and disciplinary organization diverted attention from this need and, in the process, also diverted attention from teacher education and from broad gauge graduate work to more specialized programs. In one institution heavily concerned with technical education, the comment was made that any extensive involvement with Federal grants at this point would probably result in a complete change in the character of the institution.

Among other points which reflect the changing function of administrators are the following:

A. Definition of new types of employees: to serve in research projects, to provide technical skills needed in departments, to relieve faculty and chairmen of budgetary, advising, and other responsibilities, to provide assistance to faculty in the development of research proposals, and to keep track of the many details required in processing contracts and grants.
B. Negotiating, bargaining, and resolving differences of opinion which arise in relating university policy to the exigencies of external fund projects. For example, in an institution with a standard 12-hour teaching load, what happens in the case of a person who achieves a grant to which it has been agreed that he contribute, or the institute contribute, 50 percent of his time? With the grant containing no money for his salary and therefore nothing to hire a replacement, how is the load to be handled?
C. Institutional goals are subtly changed as individuals bend their efforts in thedirection of available funds, and as the resulting projects arouse interest in and demands for continuation and extension of the activity. Thus the effective handling by a department of summer and academic year institutes may quickly generate a sizable graduate program without anyone really having made this commitment.
D. A great deal of time is spent in talking about proposals, encouraging their development, and in consoling individuals who are unsuccessful. Individuals who are successful are to be complimented and recognized for their achievement which is but slightly less significant than completion and publication of research.

These various comments make the point that the administrators' day in 1968 is different from what it was in 1958. Though few, if any, would question that the overall impact of additional funds on education has been desirable, it is clear that administrators have to spend much of their time with details and with problems generated by these funds.

Budgeting Process

The existence of several different types of support poses problems in presenting budgetary requests to the legislature and opens the door to a variety of questions which are not easily answered. The relationships between source of money, programs supported, and ultimate benefits are not easily traced In an earlier and simpler day, when legislative support and student fees counted for 90 percent and better of the income of the institutions, this situation created no significant problem. In the present day, as other sources of income increase, state officials find themselves faced with budgetary requests which deal with only a portion of the income of the institution, and which are justified by only a partial picture of the total institutional operations. This produces a basic inconsistency. Universities contend that the functions of research, instruction, and service are so closely interrelated as to be virtually inseparable. Nevertheless, the presence of restricted funds necessitates some such separation and complicates enormously any attempt to fully justify the budget request submitted. It is not surprising that legislatures express concern about the additional funds coming to institutions and seek for more information on their relationship to the programs which the legislature is asked to support.

In developing their budget requests departments operate with their dean and other administrators in the university in much the same way as the university operates with respect to the state—that is, they express their needs solely in terms of the general fund budget and say little or nothing about the dollars available for other projects. Thus a departmental instructional program may benefit because full-time researchers paid from other funds voluntarily teach a course, lead a seminar, or direct a dissertation. The department picks up a bonus in staff time and decreases the load on its general fund supported faculty. It is also possible for a department that has a number of research contracts with salaries of researchers included to arrange for the transfer for a month or more of the researcher's time to a general fund account, thus retaining special fund monies which remain available after the termination of the fiscal year. The transferring of individuals from one account to another can usually be justified on the basis of some interpretation of the cost sharing, and it may correspond to a real change in the assignment of the individual for a period of time. One can take several views about these matters. One and the usual one expressed by department chairmen and faculty—is that the department which shows the enterprise to go out and get additional funds should not be penalized in its general fund budget by the fact that it has shown this initiative.

The fact remains that a dean or an academic vice-president reviewing departmental budget requests is unable to examine the total departmental operation. He would undoubtedly create some real difficulties for himself if he attempted to determine the general and educational fund allocation of a department in reference to its total support. His position relative to the department is in many ways very similar to that of state legislators and budget officers with respect to the university.

The handling of indirect cost funds has aroused concerns both within and outside of the institutions. Justified because of the many services provided in an institution which cannot be directly costed and assigned to a project, the indirect cost income has often been assigned to special funds and expended in a grea. variety of ways: new computer facilities, new buildings, research equipment, cost sharing for new projects, fellowships, etc. It is difficult either for a faculty member responsible for a project or for a member of the legislature to understand this practice The faculty member sees indirect cost charges as draining funds from his project and believes that he or his department should have access to some of this accumulation. Members of the legislature may see the use of indirect cost funds as strong evidence that state appropriations are supporting research and other projects not specifically mentioned in state budget requests. Furthermore, when indirect costs are channeled into the acquisition of additional facilities or projects the requests for support from the the state legislature will ultimately be increased.

The issues raised by Federal support and indirect costs are not new. They have come to the fore largely because of the size of the sums involved and because concurrently institutions are growing and continually require more funds. All gifts, grants, and contracts tend to expand the activities of an institution, raise its sights in regard to ultimate goals, and leave residual activities or generate new programs for which continuing support must be found. In private institutions, student fees, endowment income, and extensive fund raising have been the sources for this support, since increases in these sources are not automatic when new obligations are assumed. Federal support begets needs which generate demands for more Federal support, as well as increased tuition, annual giving, and endowment and capital fund campaigns. In state institutions, the tendency has always been to assume that continuing increase in state appropriations will carry the programs generated by one-time restricted gifts. In addition, money must be found to encourage and initiate innovations for it is difficult to acquire gifts, grants and contracts without evidence of careful planning, exploratory work, or matching funds. Hence it is not surprising that state institutions have viewed indirect cost accumulations as funds to be used for institutional improvement. The current trend in Michigan, encouraged by state auditors, is for institutions to commit indirect cost accumulations to the general fund. The routine assignment of these dollars to the general fund will almost certainly reduce institutional flexibility and potential because they will become the basis for decreased state appropriations. No doubt, the institutions will be forced to look to institutional grants for development of institutional potential.

Cost sharing features also raise certain difficulties in the internal budget allocations. If an individual acquires a contract which involves contribution of 25 percent of his time by the university, there is no assurance that this 25 percent is a realistic indication of the amount of time spent. There may or may not be a formal commitment by the university, and records may or may not be adjusted to show this. Presumably, this individual would have done something else with his time if he had not been involved in this particular project. If it is simply that the individual does more or better research because of the contract, there is obviously no problem. If somehow there is a diminution of his teaching assignment by increasing section size, by transferring his teaching assignment to a graduate assistant, or by eliminating a course, it is clear that the cost sharing decision has diverted instructional funds to support of research, and primarily, if usual faculty norms are used, by lowering the quality of the instructional program. If the individual whose time is assigned to a project simply reduces—as some administrators complain—his committee activities, his advising, and his contribution to curriculum development or his consultation with other staff members, then again it is clear that a decision has been made about allocaton of resources which modifies the university's formal pattern of operation. When unassigned dollars are not available to allocate for cost sharing, cost sharing can come about only by diverting dollars from other programs and hence by operating these programs at a lower cost than originally planned.

Much of what has been said, of course, applies primarily in relationship to the project system of grants and contracts. Some of it also applies with regard to general institutional grants, for these, too, are placed in special funds and allocated therefrom on a one-time basis, rather than becoming a part of the general fund budget which establishes a base to which the university and each unit in the university expects some increment each year. This distinction is a necessary one in the pattern of operation. Nevertheless, it does complicate the budget-making operation, internally and externally. One academic officer remarked that he was seriously considering a double budgeting scheme in which each unit would have to include a picture of its general fund needs and also indicate clearly its funds available from all other sources, and its expectations with regard to their use in the coming year. But then he remarked, "Since new grants are apt to come through most any time, I suppose I would only end up involving myself in another major chore without having gained any insight or any control." A further difficulty is that grants to individuals in a department may not augment departmental resources, and may even strain them. There are indirect costs at the departmental level.

Paper Work

A recurring complaint of minor but nevertheless irritating nature is the paper work involved. The determination of indirect costs requires many hours of effort and collection of detailed data, for agencies involved in making grants and contracts continually demand more detailed reports and conduct endless questionnaire studies. There is always the concern about the auditor in the offing. As a result, the institutions complain of collecting data which, in nature and in form, are not useful to them otherwise. They are further distressed by the fact that state government, the State Board of Education, and a goodly number of Federal offices demand extensive and uncoordinated information from publicly-supported higher education. All of the state institutions in Michigan are subject to a state audit, in addition to their own internal audit and an audit by Federal personnel. Each auditing team looks at records in a little different way, and, indeed, is looking for something different. The net result, however, is that many university administrators feel that the collection of data needed internally for understanding and effective operation is sacrificed to the collection of data to fit the concerns and interests of external groups. There is a further feeling that the requests from external sources for data are often motivated by concerns and suspicions which are seldom documented by the data collected, but that the lack of confirmation only results in a demand for more or different kinds of data in the subsequent years.

Within the institution, the increase in the number of types of personnel and the increase in the number of split appointments, the shifting of individuals from one fund to another, the necessary steps required in reviewing and approving projects, all combine to multiply paper work. Some of this is essential to the institution, some is accepted as reasonable in accounting for use of funds, but some is regarded as an unreasonable expenditure of time which adds nothing of worth to anyone. It is curious, noted one administrator, that Federal agencies can demand time and effort information on faculty and obtain something on paper from them, whereas the same kind of information demanded by the institution might create a revolt, and certainly would not yield anything really useful. The really insidious factor is that required reports on matters which are very difficult to judge encourage indifferent and contrived responses and highly unreliable and invalid evidence. The time expended might better have been used in supervision, discussion, or other sorts of activity which would provide real incentive and assurance that each individual is doing his job.

Summary Remarks

Institutions of higher education are characterized in their operations by liberal dosages of competition, expediency, and opportunism. Each of these is reflected in certain comments made by individuals interviewed, although probably relatively few people would accept the characterization of higher education in terms of these three factors. Yet, much of the success of higher education in this country is a result of the operation of these three factors. Institutions compete with each other in the offering of programs, in the seeking of funds, and in the number of graduates listed in *Who's Who in America*. Institutions also operate, to a great extent, on the basis of expediency—they do what works on the principle that the ends justify the means. There is, finally, a considerable element of opportunism, the seeking of immediate advantages without regard for long-run consequences.

The fact that other institutions have succeeded in getting government funds from various sources certainly stimulates more institutions to do so. Two or three administrators indicated that they had in effect said to individuals or to the faculty that other institutions were getting money, that money was available, and that the faculty should get to work and draw up some proposals to get it. There was also some indication in places that the availability of funds for a particular program encouraged the stretching of imaginations to determine how the institution might qualify, even though in its original form the program seemed more or less irrelevant. There exists in the minds of quite a few people the general thought that an institution should do whatever is necessary to get as much money as possible and maintain the maximum flexibility in its use. As it often turns out, the money is not quite so easily available as it seemed to some individuals, and the chagrin and pessimism even cynicism indicated by some who had tried several times to get a grant or contract and failed may be an indication that the opportunistic approach is not sufficient. Indeed, some of the government agencies dealing with requests have indicated that they do not believe that institutions can be trusted to decide whether they have the competency or the capability of handling a project, or whether it is really in accord with the fundamental purposes of the institution. Thus there seems to be a considerable gap between the actuality and the ideal. In the ideal situation, a project is generated by an institution or an individual in an institution. The institution accepts the project as important, and perhaps can partially support it but needs additional funds to carry it out. In this ideal situation, cost sharing is perfectly natural. The institution approaches an appropriate agency and indicates that it is interested in the project, and would require certain additional funds to pursue it. The trouble is that projects and even, to some extent, institutional grants don't quite work this way. Agencies announce interests or purposes, and persons or institutions seek to get money where they can. Hopefully, they try to get money for projects which approximate those things which they believe they should be doing, but institutions find it difficult to achieve this because:

1. They need money badly, so they can see some contribution to the needs for most any program, and they want at least their full share of the manna.
2. The missions and goals of an institution are not sufficiently clear to provide a basis for ruling out a given type of program.
3. Opportunities, time pressures, and application requirements do not permit deliberate consideration of alternatives that is to say, if an institution spends considerable time investigating a particular project, it is not likely that the time will be available to subsequently, or possibly simultaneously, investigate other alternatives to determine just which is most feasible and most appropriate to the institution.
4. The annual budgets of institutions and the budgets of projects and even the negotiations with agencies do not jibe. Thus, if one is trying to build a cost sharing situation in circumstances where dollars are accounted for in different ways and at different times, it becomes relatively easy to divorce the immediate project from the regular institutional operation.
5. A project of the ideal type may be so intrinsically involved with an institution that an agency will not be interested. They will then reply that it doesn't fit their specifications, a negation which can often be

avoided by tactful preliminary negotiation which molds the project to the agency specifications.

6. Funded projects are often somewhat redefined by the agency in the process of negotiation. The agency representative who has to sell it to his colleagues must be really enthusiastic, he must put his own stamp on it, and he must adjust it to the prejudices and the whims of his associates or of review committees.

The interaction and pressure of these various factors mean that, once one attempts to develop a project, he has embarked upon a chain of events which may produce a project somewhat different from the initial one.

Thus, at the initial stage of negotiation, the university has given up some of its autonomy and control. The administrative and budgetary adjustments and discomforts have also been set in motion at that point. State-supported colleges and universities have particular problems in this regard, for they serve and are supported by two levels of government, each purchasing supposedly different but ill-defined educational commodities which the university, with good reason, would like to say are inseparable.

Yet one can all too easily overemphasize the negative. Despite some problems and inconveniences, the state colleges and universities have benefited. Administrative, budgetary, and records problems are not solely the result of Federal and other non-state sources of support. The project system of research support does tend to erode the authority of central administration, but it has merits accepted by both faculty and administration. Tensions and difficulties in regard to budgetary requests and procedures may be gradually resolved as universities engage in complete revelation of their finances and as legislators are educated to the peculiarities and potentials of higher education.

VI. Major Issues and Policy Problems

In Chapter 1, the origin and purposes of the study were presented. In Chapters 2 through 5, data collected from the 12 institutions have been presented and summarized. A sense of dissatisfaction remains, for unambiguous answers to most of the questions do not emerge. Aside from specific statistics on personnel, grants, and expenditures which are certainly unique to the Michigan state-supported institutions, much of what has been found only underlines the findings of other somewhat similar studies dealing with a wider sample of institutions. Drafts of the preceding five chapters and an initial attempt at a sixth were sent to the institutional representatives. Both oral and written commentary were supplied by many of the representatives after consultation with some of their colleagues. Their comments have been invaluable in revision and especially in rethinking this last chapter which in its initial draft received the most severe criticism. In reflecting on their criticism, some of the underlying difficulties in producing this final chapter have been clarified. Our first task, then, is to delineate these difficulties. Next we shall attempt to point up some of these difficulties by remarking on a number of reports and points of view which have been presented by individuals, commissions, and committees. Following this, some of the common and conflicting views and conclusions present in the Michigan institutions will be presented. Finally, the project directors indicate some of their own views and undertake to suggest some possible approaches to Federal support of higher education which take into account both the experiences and findings of this study and concurrent developments within the state and nation.

Difficulties Faced in Summarizing This Study

The first and most pervasive problem faced is that the nature of Federal support to higher education has changed rapidly during the period covered by the study and promises to change even more radically in the future. From purchase of science research, Federal support has moved to include graduate education in the sciences, to include broad institutional grants, and to aid in purchase of facilities and equipment. Curriculum study, educational research generally, and instructional programs have also been added. In the process, some limited support has become available to the arts and the humanities. Various formulas for general institutional support are currently under discussion and, pending the resolution of the Vietnam situation, these almost certainly point the direction of future developments. Thus experiences of the past may have but limited significance in producing recommendations for the future.

A second and related difficulty is found in the fact that higher education is becoming more and more to be viewed as a national resource. Already there is widespread acceptance of the primary interest of the Federal Government in graduate education and research in the sciences, but there is emerging recognition that the higher enterprise must be supported on a broader base if institutions are not to become disrupted and unbalanced. It is becoming evident, too, that all higher education, private and public, must have multiple sources of support. Private institutional resources are strained, and only the Federal Government is politically able and in possession of the resources to assist them. States are hard pressed and find it difficult, if not impossible, to expand their support to meet educational needs in their own area. Increasingly the states look askance at those activities in their institutions which seem to be primarily national in their benefits. The quizzical attitudes toward out-of-state students and toward expansion in graduate and graduate professional education and research exemplify that point. As the Wescoe Report has indicated: "The artificial political boundaries that separate one state from another continue to decrease in significance, and in no respect is this tendency more marked than in higher education . . . most of their activities serve a wider community."[1] There is obvious need for more regional and national planning in higher education.

A third difficulty in preparation of this concluding chapter is found in the differing views as to the purposes to be served by this study and conflicting ideas as to the conclusions or recommendations which might reasonably emerge from it. Some would have liked more definitive statements as to the differing roles and impact of the support provided by various Federal agencies. Some differences are apparent, but have they much significance for the future? Administrators do not see certain issues in quite the same way as the faculty. And within the faculties there are also opposing views. Although the interests of the humanities and arts were largely ignored in this study, profound differences are found even

[1] The Wescoe Report. Report of the Advisory Committee on Higher Education to the Secretary of Health, Education and Welfare. W. Clarke Wescoe, chairman. Washington, D.C., July 1, 1968, p. 14.

within the science faculties, some of whom are almost solely concerned with research and graduate education while others retain their long-time commitment to undergraduate education. Thus there is usually not a unified view in any institution. Among the institutions involved, the variations in stages of development with respect to research and graduate education lead naturally to rejection of suggestions or recommendations which might prejudice their future development Yet all indications point to planned development and to definition of institutional roles in some larger plan. State coordination in Michigan is relatively new and weak, but state coordinating boards clearly have a perspective which does not coincide with that of the institutions. The state legislature has still another set of concerns arising primarily out of financial considerations but extending beyond that to wonder and doubt about the activities of students and faculty. Finally, there is a notable lack of a generally accepted Federal or national plan for higher education and hence vastly differing concepts of what higher education should be and of the role of the Federal government in its support.

A fourth difficulty arises in the existence of conflicting values and goals. The Wescoe Report notes " . . . that the predominant virtue of American higher education is pluralism. But pluralism, valuable as it is, also represents widespread fragmentation of the national effort."[2] Institutional autonomy is also regarded as a virtue--indeed, as essential to effective operation, academic freedom, and the development of excellence. But institutional autonomy, too, can lead to duplication and waste of resources as institutions vie with one another in seeking students, adding courses, expanding degree offerings, and engaging in an increasing array of research and service programs. Excellence is another byword of higher education, but excellence is too often confused with the range of programs offered and with increasing emphasis on research and graduate education. In truth, virtues carried to extremes become vices. Our concern with pluralism, autonomy, and excellence must be modified or be redirected to a focus on meeting the needs of our society and contributing to the solution of its problems. The attainment of equality of opportunity for all members of our society must be a predominant goal in the next decade. This broader view of the role of higher education has implications for the institutions and for all those individuals and agencies which contribute to its support. In brief, we need to give more thought to purposes and to development of a national *system* of higher education appropriate to the attainment of those purposes.

It must be apparent now that the difficulty faced in this final chapter is

[2] *Ibid.*, p. iii.

that the limited perspective of this study, focusing on the impact of external funds for support of science and science education on a group of 12 state-supported institutions in a single state hardly encompasses the broader issues that have been raised above, yet it inevitably brings them to the forefront of consciousness. To limit this final chapter to generalizations, implications and recommendations based only on the evidence collected in this study is to report an interesting bit of history having little relation to rapidly changing circumstances and probable future developments. Nevertheless, we believe it is possible to relate our experiences and findings in this project to current state and national concerns in such manner as to contribute to emerging views of the future role of Federal support.

Some Emerging Views About Federal Support of Higher Education

The Wescoe Report. An Advisory Committee on Higher Education was appointed in April, 1967 by the Secretary of Health, Education, and Welfare. The committee was chaired by W. Clarke Wescoe, Chancellor of the University of Kansas. This report notes that the Federal Government has, by progressive commitment, " . . . moved inadvertently into a position of primary responsibility for the destiny of higher education" but has done so " . . . hesitantly, fitfully, and without clear goals or a comprehensive set of related policies."

The report indicates that the already visible consequences are " . . . distortion of academic development, disruption of institutional integrity and the imposition of burdensome, sometimes inconsistent, administrative regulations." The report further states that lack of apparent concern about the impact of Federal funding has left some institutions without aid, others selectively assisted, and a few heavily involved and committed to Federal programs and thereby "prisoners of unstable financing."[3]

The following quotations are also much to the point in reference to our concerns:

"All institutions receiving Federal support are faced with problems of distortion in their academic programs."

"Matching requirements inevitably draw university funds into these fields. Consequently, the possibility of university support of other fields at equivalent levels has been precluded."

"Federal policy, furthermore, has put undue emphasis on innovation, new programs, and new facilities."

[3] *Ibid.*, p. ii.

"Furthermore, the controls and reporting requirements have proved to be extremely wasteful of faculty time and administrative effort. It is doubtful also that they have saved any of the taxpayer's money in the final analysis."[4]

A number of Federal policies are suggested by the Wescoe Report. These include: stabilization of Federal funding, recognition of past accomplishment by institutions, maintenance of diversity, special responsibilities for graduate and professional education, development of national and regional facilities, reasonable administrative procedures, provision for maintenance of support by state and local governmental units and private sources, revision of matching requirements, and planning for future needs. The establishment of a "National Council on Higher Learning" in the Federal Government is urged as a mechanism for communication and planning.

The Carnegie Commission on Higher Education. The main thrust of the report of the Carnegie Panel, chaired by Clark Kerr, is in the direction of vastly increased Federal aid for students. Other recommendations include expansion of medical and associated health education, funds for Ph.D. programs in all academic areas, and funds for construction, research, and for experimental programs such as improvement of undergraduate education and urban grant activities. The panel also anticipates that the Federal share of funding of higher education institutions would rise by 1976–77 to 32 percent and the state share fall to 17 percent. The private share would remain at approximately 50 percent. Even so, the panel observes that the financial burden of basic support of higher education by state and private sources by 1976–77 will rise and institutions must make economical and efficient use of available resources, exercise restraint in adding new programs and facilities, and reexamine budgetary standards and practices.[5]

The Philip Handler Statement. Handler remarks that without any explicit statement of policy or intent, the Federal Government has become the major single supporter of graduate education. He notes that the budgetary stringency of the moment has ". . . revealed the intrinsic inadequacy of the pluralistic system of graduate education through diverse mission-oriented Federal agencies."[6]

[4] *Ibid*., p. 5, 6.
[5] Carnegie Commission on Higher Education. (Clark Kerr, Chairman of the Commission). *Quality and Equality: New Levels of Federal Responsibility for Higher Education*. McGraw-Hill Book Co., Hightstown, N.J.,
[6] Philip Handler, *Academic Science and the Federal Government*. Robert A. Welch Foundation Research Bulletin No. 22, Houston, Texas, 1968, p. 10.

Handler finds a number of defects in the present distribution system. The payment of faculty salaries from individual research project grants or contracts has eroded faculty loyalty, degraded the individual professor, encouraged a flight from teaching, and forced upon the institutions instability in funding and inability to plan and budget for the future. Accounting procedures which have evolved are cumbersome and inappropriate in the university. Handler emphasizes that since graduate institutions are national rather than local resources, the Federal Government should authorize one or two agencies to disburse funds for graduate education in science and engineering and perhaps to graduate education generally.

National Science Board Report. This report examines the needs and problems of support for graduate education and recommends six major types of support.[7]

1. Institutional sustaining grants on a formula basis.
2. Sustaining grants to disciplinary departments and to encourage multi-disciplinary programs of research and education.
3. Developmental grants based upon a national competition, including strengthening of existing graduate programs, and establishing new ones either in existing or new institutions.
4. Graduate facilities grants for libraries, laboratories, computer centers, etc.
5. Graduate fellowships on a competitive basis.
6. Research project grants on a competitive basis to individuals or groups of faculty members. Only direct cost of research would be included since indirect costs would be supplied by other types of grants noted above.

Lyman A. Glenny on State Planning. In a paper presented before the Education Commission of the States, Glenny, then Executive Director of the Board of Education for the State of Illinois, presented some views relevant to the concerns of our study. He noted that "To keep pace with this extraordinary growth in number and size of graduate programs, single purpose teachers colleges rapidly give way to state colleges and finally to universities with graduate schools. Institutions formerly devoted primarily to instruction now undertake, also, research and public service. These aspiring colleges look to the leading public universities as their

National Science Board. *Toward a Public Policy for Graduate Education in the Sciences.* National Science Board, National Science Foundation, U.S. Government Printing Office, Washington, D.C., 1969, pp. 41 50.

model, each hoping to become the Michigan State University of its particular state. Many of these emerging institutions challenge the major public university for graduate and professional programs and for funds in the halls of the state capitols. Competition is intense."[8]

Glenny observes that because of these pressures governors and state legislators raise such questions as:

How can the state determine which colleges should become full-fledged universities and which should develop different roles and functions?

What type and extent of research and public service activities are appropriate for each campus?

What level of financing is really required for each campus to maintain a quality program?

Long range planning becomes a basis for providing some of the answers. But Glenny notes that "Concerted effort and coordination among the public agencies is essential . . ." and "Beyond the need for coordination among regular state agencies, the fact that the Federal Government now provides large sums of money for higher educational purposes raises other coordinative complications . . . Real problems arise if Federal grants are made to institutions for which the state master plan has established objectives different from, or contrary to, those which are supported by Federal funds."

Five Formulas for Support of Higher Education. This document analyzes five formulas which have been suggested as possible patterns for increased and broader support of higher education.[9] The first formula proposed in the Miller bill (HR 875, 90th Congress) would authorize $150 million for distribution to colleges and universities on the basis of project awards received, enrollment in science courses, and advanced degree output in the sciences. The second formula, proposed by Howard R. Bowen, President, University of Iowa, would have the Federal Government finance 50 percent of increased student expenditures for all students, and all the expenditures for 50 percent of the increase in students.

The third formula is a modification of that proposed in the State of New York for the support of higher education. It would make grants to all public and private institutions determined on the basis of a fixed amount per degree granted by level. Junior college subventions would be based on full-time equivalent students.

[8] Lyman A. Glenny, Long-Range Planning for State Educational Needs. A Paper Prepared for The Education Commission of the States, Denver, Colo., 1967.

[9] Robert L. Farrell and Charles J. Andersen, *General Federal Support for Higher Education: An Analysis of Five Formulas*. Final Report for the Commission on Federal Relations, American Council on Education, Washington, D.C., August, 1968.

The fourth formula relates general support grants to full-time equivalent enrollments and/or degrees. An institution's proportion of the total national full-time equivalent enrollment and degree output would determine the size of the grant.

The fifth formula would relate Federal institutional support to the changes in the general economy of the United States. Distribution among institutions would be based primarily on enrollments. However, the amount of the appropriation would depend upon the extent to which increases in higher education expenditures exceeded those in the GNP so that pressure for continuing support from normal sources would not be removed.

These extracts from and summarizing comments upon the Wescoe Report, the Carnegie Commission (or Kerr) Report and the National Science Board Report (although this latter is primarily oriented to science and graduate education) agree on the necessity of increased and broad institutional support. Several of the reports indicate concern that Federal support not be so developed as to erode other sources of support, but only the last of the Five Formulas proposes a definite vehicle for continued encouragement of other support. Only the statement by Glenny forthrightly addresses itself to the possible conflicts engendered by Federal support which is uncoordinated with state plans. Finally, it should be noted that all forms of general support (and especially those based upon enrollments and/or degrees awarded) if applied both to private and public institutions would almost certainly be to the disadvantage of the latter as state legislatures seized upon Federal allotments as grounds for reduction in state appropriations. Clearly, some of the emerging views about expanded Federal support do not take into account the problems of state-supported institutions and state systems of higher education.

Views Among the Twelve Michigan Institutions

In the introductory comments at the beginning of this chapter, the existence of contrasting views was noted as one of the difficulties in writing this chapter. These differences in views correspond rather closely to the present character of institutions and their success in obtaining Federal support. In the first group, composed of U of M, MSU, and WSU, the long-time involvement in graduate and professional education has made these institutions relatively successful in acquiring Federal support. The existence of many programs and support agencies has enabled individuals to seek support from those agencies with interests corresponding to their own. Though a few persons at the U of M felt that the institution may nearly have attained a saturation point in respect to project support, MSU and WSU definitely looked for increase in this type of support. Waiving the science departments and science faculty members, the possibility of expansion of Federal support into other fields and especially general institutional support was viewed with some favor. These institutions have already experienced some difficulties with the state legislature in regard to Federal monies (indirect cost accumulations in particular) and share a concern over the effect of expansion of Federal support on state appropriations. These institutions, too, as mature graduate, professional, and research institutions, are fully aware of the tremendous and rapidly increasing costs involved and, while sympathetic to the aspirations of other institutions, naturally have some fears that dispersion of funds (Federal and state) to a large number of developing institutions may sap their own vitality and quality. These institutions, having dealt with large sums, are much more aware of the untoward effects in terms of administration, accounting, and program balance.

The second group of institutions (WMU, EMU, MTU, and OU) is composed of more recent entrants into graduate education and have found their resources something less than fully adequate. They look to Federal funds to provide the extra necessary for achievement of quality and for more rapid development. Thus far, their participation in the project system has been limited with a relatively large proportion of their funds coming in support of science education. They have experienced fewer of the problems of Federal support and more of frustration in not being able to acquire sufficient support of the kind needed. The plurality of the Federal support system has been of limited value to them, for the mission-oriented approach to research of many Federal agencies is not suited to this group, since they presently lack the resources (especially in tenured faculty) to handle it. This group of institutions looks with distrust at any consideration of policies which would tend to hamper their further development. Some of their administrators argue cogently that each institution has an individuality and differing sets of aspirations so that support and freedom to develop would not lead to unbridled expansion but rather to measured and distinctive growth appropriate to the needs of the area served and to the overall diversity required in a strong state system of higher education.

The institutions included in the third group, to date, have been little involved in graduate education and have participated to a limited extent in Federal assistance. Nevertheless, these institutions have hopes of expanding Federal support and improvement of existing programs. They recognize a need for research funds (a) to assist non-research oriented institutions in faculty retention, (b) to permit faculty scholarship renewal and improvement of teaching effectiveness, (c) to provide small research grants without the necessity of individual faculty members spending many hours in proposal writing. Faculty teaching loads in these institutions tend to be higher, and there is little flexibility so that funding from non-general fund sources must be on a continuing basis, for the dislocations involved in temporary projects are well nigh unmanageable. These institutions, too, would like to see some support separated from the existence of graduate education and directed to the curriculums of undergraduate education. FSC, for example, has curriculums (some of which are non-degree) which are oriented toward vocational programs. These are important programs, filling a unique role, but under present policies largely ineligible for support. The aspirations (where evident) of this group of institutions in regard to graduate education are modest and directed largely to service-oriented master's or specialist programs. Research activity is not essential to such programs. Yet these institutions are at least hesitant if not antagonistic to the promulgation of Federal or state policies which would too closely define and hamper their development.

It is evident that all 12 institutions would welcome expansion of Federal support both in amounts and in range of programs. Continued concentration on graduate education and research would, if broadened to include more disciplines and provide for institutional grants and for facilities and equipment, meet most of the immediate concerns of the first group of three universities, but relief from burdensome administrative, accounting, and other details would greatly facilitate institutional operations and eliminate much wastage of time and inefficiency in use of funds.

The second group of institutions would also be reasonably well satisfied with such expansion of Federal support, since it would fit their plans for the development of graduate programs. The third group, however, being little involved in graduate education and with relatively dim prospects for such expansion in the near future, would find a Federal program solely or even heavily oriented to graduate education quite unsatisfactory. It would leave them entirely dependent on state support with little prospect of acquiring the margin necessary for excellence or establishment of a base for later expansion to other levels.

Issues and Conclusions as Viewed by the Research Staff

The diversity in the institutions in this study and the differences in views expressed by the various individuals and groups contributing to the study make it difficult to identify issues or conclusions upon which there would be consensus. It seems appropriate, therefore, that the researchers express here their own conclusions about some of the questions and issues originally raised.

Business and Industry Support of Research. First, it is appropriate to comment on two aspects of the study upon which evidence has been limited: business and industry support of research and graduate education, and the possibility of cooperation among institutions. Our data indicate that business and industry support of research and graduate education has been limited and has been of significance in only three or four institutions. Our interviews with business and industrial leaders indicate a sincere interest in higher education and full awareness of the importance of its graduates and its activities to their enterprises. However, the research interests of business and industry in Michigan are distinctly practical and applied, and it seems unlikely that extensive support of research in higher education will be forthcoming from this source. There is some support of graduate study and research through encouragement and support of employees engaging in further study and through grants for special research projects. These will probably continue and may expand somewhat but not sufficiently to be a major factor in meeting the rapidly increasing needs of the institutions.

Interinstitutional Cooperation. Few individuals in the institutions speak against cooperation among institutions in graduate education and research, but there are serious doubts expressed. Research endeavors which require that faculty members travel to another institution are difficult to schedule and exact a toll in time and energy. Faculty members would much prefer to have their research facilities close at hand and institutions would also prefer to develop their own programs. Cooperation is most likely to develop around use of major and expensive facilities such as libraries, computer centers, and various types of scientific research installations. Federal support of such facilities on a regional basis will encourage such cooperation. State planning can also bring about a form of cooperation by agreements among institutions in regard to programs and areas to be served. There has been some cooperation of this kind and there will be more, but it is unlikely that the aspirations of faculty and institutions for involvement in research and graduate education will be solved by cooperation with those institutions already heavily involved.

The Project System. We believe that the evidence is clear that the project system of support has seriously eroded the authority and the planning capabilities of central administration although we recognize that some institutions prefer and apparently are able to operate effectively by placing major responsibility on the faculty for defining and developing research programs. Yet the obvious satisfaction of faculty members in the independence achieved under the project system and their general unwillingness to entertain marked expansion in general institutional grants is a symptom of the extent to which institutional loyalties have been disrupted and replaced by commitment to research, to the discipline, and to personal advancement.

Certainly proposals are essential to the project award system, but there is inefficiency and waste in the present distribution system. Many proposals are laboriously prepared when there is little chance of support. Prescribed patterns and details cause many hours to be spent by individuals in preparation of proposals and by other individuals in their review. Federal agency officials in promulgating programs with ever more specific requirements greatly increase distribution costs without definite assurance that this expenditure is justified by quality. Institutions expect to account for their stewardship, but the record keeping and accounting requirements imposed by many Federal agencies place an unreasonable burden on institutions and one which is largely inappropriate and irrelevant to any other aspects of institutional operations. Cost sharing features which divert institutional resources to the support of areas of concern to the Federal agencies and interfere with institutional priorities represent either a misunderstanding of the resources available to higher education or a lack of concern about effects on institutions. The changing nature of Federal programs and specifications and the lack of continuity in support further jeopardize the planning and efficient operation of institutions.

The emphasis placed by Federal programs on research has encouraged an exodus from teaching and a disinterest in undergraduate education. The desire of faculty members for reduced teaching loads is well documented in our study. In this process, we believe undergraduate education takes second place to graduate education and research. Even the assurance of some department chairmen that everyone in the department does some undergraduate teaching suggests a moral commitment that may be executed half-heartedly. We believe that the availability of funds is a major factor in this trend, for funds imply values and priorities and encourage faculty activity in those directions. Funds for innovation and development of undergraduate education would undoubtedly help to correct this.

Although we recognize that administrators are at a disadvantage in the face of faculty demands for participation in governance and for departmental autonomy, we believe that many administrators have tended too easily to yield responsibility for planning, for review of proposals, and for supervision of faculty activities supported by grants and contracts. The large fully developed institution can absorb many projects with minimal disruption, but broad support of the majority of institutions in contrast to support of individual projects, institutes, and departments would help to restore institutional integrity and restore responsibility to administrators and the total faculty for determination of the directions of institutional development.

We believe that Federal support programs have encouraged faculty members and institutions in aspirations and programs which may be inappropriate to the capabilities present and to the roles appropriate to an institution which is part of a larger system. One aspect is that of balance which will shortly be discussed in detail. Another is that support of research may already have been expanded beyond the competent resource talent available and thus includes insignificant time and money wasting projects. We are not in a position to judge the quality of research, but the frequency of administrative demurrer and even of departmental chairmen and faculty members comments about some of the activities designated as research raise real doubts that differential faculty talents are being recognized and wisely used. We do not believe that every faculty member should be engaged in research, although certainly everyone must engage in scholarly effort to preserve and increase his understanding and competencies in his chosen field. We do not believe that every institution should aspire to graduate work and to extensive research and defend this as a social need and as an essential element in promoting a strong undergraduate program. Our interviews and our observations of developments in institutions in this and other states convince us that aspirations for graduate programs and research are generated in the faculty by the character of graduate school education and by concern for personal advancement, and in administrators because they see this as the route to building an institutional reputation. Accordingly we have no faith that incursions into graduate education in most institutions will long remain selective or limited if funds can be found for expansion.

There have been inequities in the distribution of funds. There are undoubtedly elements of risk in making any Federal grant or contract, and agency officers can avoid risk and possible criticism by directing their attention to widely recognized individuals and institutions. Suspicions were voiced among our contacts that mediocre proposals have been accepted from good institutions, but that a proposal must be really good when it comes from a poor or little known institution. We suspect, however, that, in some cases, the desire of Federal agencies to broaden the range of institutions had led to the acceptance of mediocre or poor proposals from weak institutions. We do believe that strong institutions have a better entree and that their faculty members have occasionally influenced the programs of Federal agencies so that some new programs have been tailor made to the interests and resources of particular institutions. One of the major problems of the developing institution is in the lack of information about the availability of funds and probability of success in acquiring them. Continuation grants often take a high proportion of available funds in a program, so that much time is wasted in developing proposals that have very little chance of success. Better information and communication would ease this somewhat, but any real solution is dependent upon a vast expansion of Federal support based upon definite objectives and accompanied by clear and simple procedures both for seeking and expending funds.

Balance. Several closely interrelated issues remain to be commented upon. One is that of balance, which is related to institutional autonomy and institutional planning on one hand and to state, regional, and Federal planning on the other. We propose to treat them together.

In discussions of the impact of funds for science and science education, possible institutional program imbalance has received much attention. In the formative stage of this project, several questions reflected this concern. Our reflections, in the light of dialogue carried on during the project, suggest that "balance" is a very complicated concept. All of the institutions in Michigan are imbalanced in some respect if one conjures up as the ideal an institution offering all possible programs and an equal level of excellence in each. MTU has long concentrated on engineering and the physical sciences. The former teachers' colleges suffer an imbalance growing out of that long-time emphasis and the fact that an institution emerging from this pattern cannot successfully develop all facets of the arts and sciences at the same time. U of M, WSU, and MSU each lack certain fields of study offered in other institutions and in each there is a range of quality in departments and disciplines.

Within a state system, a further concern about balance exists. Our contacts suggest that in all 12 institutions there are present individuals who anticipate ultimate involvement of the institutions in aspects of graduate education and research. Only one states firmly a continuing focus on undergraduate education and that one has real potential for certain types of graduate study which it may be requested to develop at some future date. Yet limited resources may force the state—and the Federal Government—to define and restrict institutional roles. Thus an imbalance in individual institutions may be created by plans aimed at achievement of a balance in the state or national enterprise. A reasonable balance at any level may be imbalanced if viewed by disparate sets of criteria or various vantage points. Balance may be determined relative to institutional traditions, aspirations, and purposes or in reference to the composite roles and contributions of institutions of a system designed to meet national needs and attain national goals. Perhaps balance can be achieved only through a dynamic interplay of imbalances.

Recognizing, then, that balance may have to be reexamined and redefined on a national basis as the Federal Government provides more support to higher education, our observations in this study nevertheless lead us to believe that past patterns of Federal support have been conducive to imbalance in several respects. But for reasons which will become apparent we do not wish to judge whether the imbalances created are good or bad. First, the humanities have thus far been largely ignored, but the extent of imbalance created is hard to determine since research in these fields does not require the expensive equipment and manpower of the sciences. Time release from teaching, travel funds, and library facilities are the more critical elements, and these have not been available in most of the Michigan institutions. Support for graduate students is a major element in development of graduate programs, and here the advantage of the sciences has been evident. However, a basic and difficult question remains. Are the sciences more critical for national security and for social and economic development than the humanities? We shall not even hazard an answer, but we suggest that any judgment regarding balance in our higher education system must be made in reference to an answer and that the future pattern of Federal support also depends upon an answer.

Second, there has been some imbalance encouraged within the institutions by Federals funds and by plans to obtain Federal funds. However, much of this is created by factors internal to each institution. Recognized competency and individual initiative has greatly influenced the success of institutions in obtaining Federal monies and the areas in which these monies have been obtained. We found that institutions had received the most support in traditional areas of strength. In some institutions, the difficult but necessary decision was reached to support a few individuals or departments to a level of competency where success in seeking external support might be realized. Such decisions are not always greeted with delight by the non-elect, but there is widespread recognition among faculty members that graduate study cannot be simultaneously initiated in all areas and that excellence is not likely to be achieved in all departments of an institution. Perhaps such imbalance by deliberate intent is a practical if not ideal form of balance.

Third, it should be noted that in some important respects, Michigan higher education does not seem to have been markedly altered by Federal support. From some vantage points, it appears that the "haves" received much and the "have nots" received little. On the whole, aspirations for university status and attainment of the associated characteristics antedated significant Federal support. However, there is no doubt that a number of institutions, especially those in the second group, hope that expansion of Federal support will permit entry into a new role not possible with state support alone. As the statement by Glenny indicates, lack of coordination between state plans and support, on one hand, and Federal plans and support, on the other, could raise serious problems of imbalance in a state system. In Michigan, only the possibility of such difficulty is now apparent.

State Support of Research and Graduate Education. There are individuals who are optimistic about the extent to which states can increase the support of higher education, but the consensus of the developing views cited earlier is that state support, while increasing, will be inadequate. In Michigan, graduate and professional education has been extensively supported in several institutions. Indirectly, but probably to a greater extent than either these institutions or the legislature has been aware, research has also been supported. This has happened because research is an integral part of graduate education and because the faculty member interested in research has worked many hours beyond those which might reasonably be demanded. The state has also overtly supported research by appropriations designated thereto at several of the institutions. But extensive increase in support of graduate education and research to include more institutions may exceed both state inclinations and resources in Michigan. It would be easy, therefore, to accept the views of Handler that Federal support of higher education should concentrate on research and on graduate and professional education. A number of administrators in Michigan institutions have decried this approach, because they visualize difficulties arising in such a dichotomy of support from two different levels of government, and because they believe that adequate development of some undergraduate programs may also require Federal support in the future. We believe this point of view deserves consideration, but we are quite certain that it underlines the necessity for a rational plan for relating Federal and state support.

Considerations in Expanding Federal Support

There is widespread expectation that once the current stringencies in the Federal budget are eased by resolution of the Vietnam conflict, Federal support of higher education will expand in amount and be enlarged in scope. We assume that this will happen, but it would be presumptuous and indeed beyond the scope of this project to suggest the specific patterns or aspects of higher education supported. Rather it is appropriate to draw together the various considerations and problems which require attention in the development of an enlarged program. These will be discussed and then collected into a brief set of recommendations.

Institutional, State, and Federal Planning. The demand for higher education in the United States is evidence that it has been successful. Much of this success has been attributed to a pluralistic system and to institutional autonomy. In this view, any program which would finally determine the role of each institution would destroy local initiative and enthusiasm and would be harmful to the total system. Competition among institutions provides a stimulating ingredient in the operation of the total system of higher education and should be preserved in some measure. However, autonomy which is evidenced in expediency, opportunism, and competition in adding new levels and programs can lead to inefficiency and ineffectiveness. State and regional coordination and planning for higher education have demonstrated their value and should be encouraged. But the task for the future becomes more complicated. Private institutions are receiving both state and Federal support. Cities and community college districts with state assistance are supporting community colleges. As broad institutional support (operating and capital expenditures) becomes increasingly available, local and state authorities might (indeed already have in Michigan) seize upon this as a basis for reducing their contributions. A natural concern is that institutions might play one source of support off against another thereby achieving institutional goals not specifically sanctioned by any of its sources of support. Just how institutional, state, regional, and national goals, and associated plans are to be interrelated in a program of support is not clear, but it is apparent that unless such composite plans are developed, publicly supported institutions stand to exchange one source of support for another while private institutions in former control of their income will be advantaged.

In this process of coordinating institutional, local, state, regional, and Federal goals in higher education into a total support program, certain considerations stand out clearly. There must be reasonable continuity in support, else planning is meaningless. A major concern should be equality of opportunity and hence freedom of choice by students. State boundaries which now give rise to differential charges for out-of-state students and differences in student charges between private and public institutions are hardly consonant with increased Federal support and certainly constitute barriers to freedom of choice by students. At the same time, the excellence of our outstanding institutions must not be destroyed by overemphasis on ready availability of higher education for all. Finally, as Federal support continues and expands, cost sharing requirements should be discarded, for a planned total program of support requires either total support of certain programs by certain agencies or coordinated support by several agencies.

Accounting, Budgetary, and Data Systems. One of the most grievous incursions into institutional autonomy has been in the accounting practices required and in the diversity of records which must be maintained. Proposals to various agencies have required distinctive data accumulations, each imposing a burdensome and often useless task. Institutions receiving support from several sources must not be burdened with such cumbersome and detailed procedures that the development of funding requests monopolizes the time of administrators and places further stress on the faculties. Some strides have been made in recent years toward uniform financial records and accounting practices and toward data systems applicable and useful to all institutions interested in efficient and effective management and planning. The ideas of program budgeting and the procedures involved in cost-benefit analysis are being explored by some institutions and, with help, some program useful for all of higher education may emerge. It is apparent that an institution receiving funds from several sources should develop accounting practices and records which reveal the use of funds from various sources. Even more important is the development of institutional studies and data systems which reflect the effectiveness of programs and the benefits ensuing to those involved in and supporting them.

Purchase and Support of Research. Despite the problems and complaints associated with the project approach to the support of research, it has had evident benefits which will not be met by broad institutional grants supporting research and graduate education and providing equipment and facilities. These latter will meet the basic research needs of the faculties including the young investigator, but they will not accommodate many promising projects of individuals and of groups. Furthermore, faculty researchers agree that the systematic review of such proposals and the competition for support has beneficial effects on the quality of research and on the initiative of the researcher. No doubt various Federal agencies will continue to have special interests and seek for individuals and institutions qualified to carry on special investigations. Large projects focusing on social and economic problems of particular regions or communities and possibly requiring cooperation among several institutions would appropriately be included in this sector of Federal support of higher education.

Summary and Implications

This study of 12 public colleges and universities in Michigan provides data which relate programs to amounts and sources of funding. The data also emphasize the differences which presently exist among these institutions in size, range of programs, and involvement in research. The institutions range from the University of Michigan, with mature graduate and graduate professional programs in almost every field and vast involvement in research, to the relatively new Saginaw Valley State College, which is still in the throes of developing its undergraduate program. But in all institutions, excepting possibly the University of Michigan, there is evidence of a desire to develop or expand the research function and enter into or extend programs of graduate education.

The following statements indicate some of the major funding patterns and their impact upon the institutions.

1. The expenditures for Separately Budgeted Research in the sciences at the University of Michigan in 1965–66 were more than twice the General Fund Expenditures for Instruction and Departmental Research. At Michigan State University they were about equal; at Wayne State University about one-half; at Michigan Technological University about one-fourth; at Oakland University about one-sixth; at Western Michigan University about one-thirteenth; and at other institutions a considerably smaller fraction.

2. The absolute differences among the institutions in expenditures for Separately Budgeted Research increased over the period 1957–66 despite increases in less well-funded institutions. Funds from Federal agencies in 1965–66 accounted for more than three-fourths of all Separately Budgeted Research funds spent by the Michigan institutions. The proportion of Federal funds between 1957 and 1966 either remained the same or increased at most institutions.
3. Funds from outside the institutions for specially organized Science Education Projects (such as institutes for science education teachers) were almost wholly Federal in source and were much more evenly distributed among the institutions than Separately Budgeted Research Funds.
4. Within each institution in which research funding was strong, there was great unevenness of expenditures among the areas of science. Usually, heavily funded areas of science received the great bulk of their funds from one to three Federal agencies.
5. Institutions seeking to become more strongly research oriented select and assist a few science disciplines in obtaining project grants by assigning internal resources to provide staff and facilities to initiate research.
6. Strong majorities of faculty sampled maintain that research programs are conceived internally rather than arising out of the availability of outside funds for specified purposes. However, similar majorities maintain that such funds strongly influence the actual initiation of projects. Thus some imbalance, or movement away from the pattern of activity desired by an institution, occurs.
7. Most faculty see a strong and necessary connection between a strongly funded research program and a graduate program of high quality in science.
8. Graduate training was facilitated in the largest institutions through the use of research plant and facilities funded by outside sources, by the use of sponsored research funds for major purchases of equipment employed both in research and graduate education, and by the use of sponsored research funds to provide direct financial support to the greatest proportion of graduate students holding research assistantships or traineeships. The greatest proportion of the funds were from Federal sources.
9. Most faculty see a helpful, but not necessary, relationship between a strongly funded research program and an undergraduate science program of high quality. At the three largest institutions, 30 percent of the faculty said that strong research programs were not

necessary for, or were harmful to, undergraduate science programs.

10. Both senior undergraduate and graduate student majors in science at the five institutions with Ph.D. programs in science were generally favorable toward the contribution made to their professional training by professors who were engaged in research activity. Some drawbacks were noted, however.

There is no doubt that the results of Federal support of science and science education have been beneficial to these institutions. The major concern of faculty members and of many administrators is that there be more Federal funds, and that these become more readily available, especially to younger faculty members and to faculty members in the less well known institutions. There is, especially among the smaller institutions which have received relatively little Federal money, a feeling that the form and distribution of project, broad institutional grants, and science education awards should be so adjusted as to promote the traditional and emerging purposes of these institutions, rather than encouraging projects and programs more suitable to the larger universities.

There are undesirable effects, however. The effort expended in developing proposals and in maintaining required records is very great and is frequently regarded as wasteful, for many proposals do not receive support, and much of the data is useful for no other purpose than satisfying Federal agencies. Institutional funds must often be diverted from other areas to provide additional support to individuals and departments seeking grants or contracts or to provide for continuance of programs started by them. Sizable research grants and contracts contribute to an autonomy of individuals and departments which erodes the authority and planning capacity of administrators. Undergraduate education and other institutional functions suffer as grant recipients seek reduced loads and greater involvement with graduate studies. The uncertainties of continuing Federal support of projects once initiated is an ever present worry. Broad institutional grants which would alleviate some of these difficulties are generally disliked by faculty members who prize the independence of administrators and local faculty committees conferred by the project system.

Without question, however, the most significant issue that emerges is the developing concern of state government that Federal funds are encouraging activities and programs in individual institutions which do not coincide with their traditional (though not explicitly assigned) roles and which cause increasing demands upon the state. This is evident in the questions raised by state budget officers, auditors, and legislative committees. It is evident in the scrutiny of new programs. There is an increasing tendency on the part of state officials to view Federal support as an alternative to state support, and they demand information which will make it possible for them to examine this possibility.

These state concerns are not unreasonable. There is real danger that, if Federal and state interests cannot be resolved so that the expectations of both levels of government are coordinated in the support flowing to institutions, state colleges and universities will suffer increased incursion into their autonomy of operation by the imposition of explicit limitations on how and for what state appropriations are to be expended. There are also dangers in some of the current proposals for broad institutional grants (to private and public institutions alike) based on degrees granted, students enrolled, etc., for state legislatures might readily reduce appropriations in the face of such grants.

Increased Federal support of higher education seems generally to be accepted as necessary and inevitable. Increased state coordination of higher education seems equally necessary and inevitable if our educational needs are to be met without the unjustifiable expense that would be required if all institutions were permitted to expand to meet the aspirations of their faculty, administrators, and regional supporters. Just how these developments are to be coordinated is not clear, for there are at present no policies and no mechanisms for developing them. The following suggestions are indicative of some of the policies and mechanisms which appear appropriate on the basis of this study.

Suggestions for Federal Support of Higher Education

1. Federal support programs should recognize institutional autonomy as an essential aspect of higher education and avoid development of programs or the imposition of procedures and requirements which unnecessarily complicate institutional operations, which erode usual channels of communication and authority, or which force diversion of institutional resources from other programs.
2. Federal support programs should recognize the existence of institutional, local, state, and regional as well as Federal goals and plans and seek for some system of communication and cooperation which requires continuing support from these sources and which, at the same time, avoids support of institutional aspirations which are

inconsistent with the role assigned by these other plans. Negotiation to change that role may be entirely appropriate.

3. Broad programs of Federal support should be coordinated through one or at most two Federal agencies. Otherwise there can be little hope for the cooperation demanded in 2. In addition, institutions faced with the task of developing annual or biennial fund requests which must be related to expected funding from other sources would find simultaneous negotiation with several agencies with distinctive requirements very time consuming, distracting, and so unpredictable as to destroy effective planning and budgeting.
4. The basis for broad institutional support requires careful study. Support of graduate education and research is attractive in some respects and is a natural outcome of Federal programs to date. However, this omits from consideration many important types of institutions. In addition, graduate education and research (as our experience shows) is not so readily identifiable in the budget as one might expect. Support based on degrees produced or on credit hours would use much the same basis as that used by states and thus raise numerous difficulties in relating Federal and state support without risking reduction in the latter.
5. A program for [illegible]ad institutional support should include funds for equipment, f[illegible]s, graduate students and faculty. Introduction of new progra[illegible] new levels of education should be subject to negotiation an[illegible] ome the basis for incremental support.
6. Support of project research should be continued and handled separately from the broad institutional grant program. Here the involvement of several Federal agencies with varying interests and competencies seems to be beneficial. However, steps should be taken to simplify procedures, to provide more information as to funds available, types of proposals entertained, and to procedures which make it evident that projects are supported solely on their merit rather than because of the reputation of the institution or the applicant.
7. It is expected that some Federal agencies will continue to be primarily interested in purchasing research on special problems relevant to national security or our social and economic development. Many of these will be large projects which only a few institutions (or groups of institutions) can manage. Such research programs should be separate (as they largely have been) from programs for general institutional support and for project research. If those research projects go to educational institutions, it should be solely on the basis of

demonstrated capacity and the *full* costs should be assumed by the agency.

8. The lack of communication between institutions of higher education and Federal agencies and the obvious need for a strong higher education voice in the formulation of national goals for higher education has led several individuals and groups to recommend a select commission of prestigious educators attached at some strategic spot in the Federal Government. The experiences in this study confirm the need for such a group which would hear all points of view, suggestions and complaints, which would formulate a total program of Federal support, seek for its acceptance, and monitor its operation. Higher education speaks with many voices, and the existence of the present confusing array of programs is evidence of this. As state supported institutions receive more Federal support, the difficulties of dealing with officials and legislators at two levels of government emphasize the need for these institutions of higher education to develop more effective communications and present in some unified way the social and economic benefits of higher education and the need for increased support.

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IMPACT OF FEDERAL SUPPORT OF SCIENCE ON THE PUBLICLY SUPPORTED UNIVERSITIES AND FOUR-YEAR COLLEGES IN MICHIGAN

SUPPLEMENT

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An Interinstitutional Study Supported by
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Preface

This Supplement includes materials which deal with the methods and means by which the study was conducted and which provide additional information resulting from the study and suggestions for reading in related studies. Parts 1 and 2 indicate the procedures for data collection and include copies of the instruments and forms employed in data collection. Part 3 contains supplementary tables of data based upon the study. The first part of the number of a given table in the Supplement shows the chapter of the report to which the table pertains, and the second part of the number gives direction to the particular part of the chapter. Thus a table numbered 2-7S would pertain to Chapter 2 and particularly to the section following Table 7 in that chapter. The Bibliography in Part 4 of this Supplement contains a list of the works cited in the footnotes of the report and a select list of other related materials.

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PART 1

Procedures of Data Collection

Some introductory remarks are in order with regard to the general problem of data collection. We have noted that in preliminary discussion some persons found it difficult to see how historical data on finance or personnel or subjective opinions could be collated and interpreted into policy statements. There were those who expressed doubt that any of the data collected would be really useful and pointed to experience in collecting data for many prior studies as evidence that a great deal of time and energy would be expended with little meaningful result. On the other hand, it seemed probable that significant conclusions, recommendations, or policy statements were unlikely to emerge solely from discussions among institutional representatives until they had reviewed their own institutional involvements. Though several of the institutions had participated in other studies and all had submitted some data in response to requests of Federal agencies, there had been no accumulation on a uniform basis of data for the twelve institutions. Many of the institutions felt that completion of this task would be of benefit to the individual institution and that the composite would be informational to all. There was, then, no real dissent to the development of financial and personnel data forms and questionnaires for collection of basic data and views. There was agreement that no study would be complete without extensive interviewing which would permit forthright expressions by individuals of their experiences, irritations, and suggestions.

In accord with the cooperative nature of our project, all data forms, questionnaires, and interview schedules were developed in initial rough draft by the staff, reviewed by the Steering Committee, liaison officers, and others on the individual campuses at the will of the liaison representative. The forms were all submitted to and reviewed by the National Science Foundation monitor, Dr. Frank Hersman, and by a number of his associates in the Foundation whose extensive experience in the preparation of such forms and in the analysis of data from them was most helpful. In the process of review and criticism by many persons, the forms and questionnaires were materially improved in that ambiguities and infelicities in organization or wording were eliminated. There was, however, the usual demand for expansion in detail and therefore in the length of the forms and instruments involved. Although in some cases the study staff doubted the utility of some of the additional detail, it was considered politic to include all reasonable suggestions for, after all, the project was a cooperative one, designed to yield desired information for all participants.

One unfortunate situation did arise in connection with the review. It had been anticipated that the review of the forms would result in consultation on each campus with those most familiar with the sources for the data required. This would permit a decision as to the feasibility, or indeed the possibility, of collecting the information specified. Although few comments indicated that any data were unavailable, the actual use of the forms demonstrated that some data were not available at all and that, for others, only approximations could be supplied. Incomplete records and inconsistencies or changes in patterns of recording were causal factors. One of the difficulties was that to provide an historical view reflecting some of the major changes in the amounts and types of Federal and nonFederal support, data were to be collected for the years 1957-58, 1960-61, 1963-64, 1964-65, and 1965-66. The year 1965-66 was determined by the fact that the study was initiated in February, 1967, and this was, at that time, the most recent complete year. The first expectation was that the initial year would be ten years prior to that date, but 1957-58 was settled upon as a more opportune starting point. Over that span of years, the increase in the funds and personnel involved and the demands of Federal agencies themselves for more detailed information for determination of indirect costs and for auditing forced material changes and increased detail in record keeping. This development, an incidental impact of the support, caused difficulty, for detail available in later years simply was not available for earlier ones.

In the preparation of the forms and questionnaires the original basic set of questions was continuously held in view. These questions, in turn, generated specific items upon which data or personal impression were sought. Thus in viewing the impact on undergraduate education it is appropriate to know whether teaching assistants have increased in numbers and whether the teaching load of senior tenured faculty decreased. It is also important to consider the impact on undergraduate education of improved facilities and equipment. For such qualitative judgments one must have recourse to the subjective opinions of faculty, administrators, graduate students and undergraduates. The first of our original questions was, "Do common goals characterize the science research and education activities of Michigan's public colleges and universities, or do they differ significantly in identifiable respects?" In considering this question, it was concluded that interviews with chief academic officers covering the general mission of the institution, the criteria employed in determining types of research conducted, and instructional programs established, and the relationship of research to instruction would be appropriate. Inferences of the current goals could also be made from data on curricular offerings and enrollments indicated by the personnel forms, from the graduate vs. undergraduate breakdown, from the number of research appointments supplied by the personnel forms, and from the relative emphasis among fields of science indicated by data derived from financial forms. The goals of the different institutions as seen by the faculty would be reflected in a faculty questionnaire dealing with professional activities in which the faculty actually engage, and those in which they would prefer to engage. Goals would also be reflected in views as to activities giving high status in the institution, in the number of applications for grants made by faculty, and in opinions on whether the developing direction of research activity has been in the best interest of the institution. Thus a number of distinct types and sources of data were viewed as relevant to providing answers to the basic questions posed in Chapter 1.

Figure 1 is a summary but not exhaustive attempt to suggest some of the major foci of concern and the way in which evidence relevant to these is keyed into the various data collection forms and questionnaires. The various forms and data collection procedures which are listed across the top of the figure are briefly discussed in the remainder of this chapter. The forms, questionnaires, and interview schedules are included in the Supplement to this report.

Figure 1. Relation Between Data Collection Procedures and Specific Problems

Problem	Questionnaires		Interviews					Personnel Data Forms	Financial Data Forms
	Faculty	Student	Top Admin.	Dept. Chm. and Faculty	Science Educ. Prog.	Advisory Comm.*	Business-Industry		
Impact on goals	6		6	10	3	2	3	4	1
Impact of research on instruction	6	43	2	4		2	1	4	2
Relationship grad.-un.grad.instruct.	7	1	3	1		1	1	2	1
Bal.in disciplines	3		3	1	2			2	1
Bal.research emphasis	9	2	5	7	1	1	1	6	6
Students,no.,quality	3	2	1	1	4	1	1	2	
Grants, contracts, gen.instit.support	17	2	11	7	3		3	8	10
Institution roles and cooperation	12		2	4	1				
Organiz. structure of institution	13	14	4	12	5				1
Impact of research on state, region	6		5		1	1	5		
Faculty,assignments	6	4	3	1	2	1		3	
Effect on department or dept. chairman	9		1	10	1				
Restrictions, irritations	6			5					
Facilities,equipment	4		3	4	2	2	1		3
Faculty,quality	10	15	2	6	2	2		2	
Organiz. functions, evaluation	2		4	3	4				
Interrelationship among awards	1		1	2	1				
Objectives, policies for grad.support		10	4	1				2	
Sponsored institutes for science education			1	1	23				

*Some of this committee were also interviewed as representatives of "Business or Industry"

Financial and Personnel Data Forms

Financial Data. The financial forms permit an examination of trends in the sources and uses of funds over a span of approximately ten years. These data document the wide range of research involvement of the several universities and provide a basis against which to weigh aspirations and goals. The forms and instructions are included in the Supplement. The instructions include definitions which, in general, have been selected to be consistent with those used in other somewhat similar surveys by the National Science Foundation. Examination of the forms and the instructions is unquestionably the best way to learn exactly what is involved in each. However, a brief characterization of the financial data requested in each form will be helpful in understanding this report.

Form A. Form A-1 requests data on separately budgeted R&D for six specific fields and "other" in Engineering; Form A-3 for four fields and "Other" in Physical Sciences; Form A-5 for three fields in Life Sciences; Form A-7 for three fields and "Other" in Social Sciences; and Form A-9 for Psychology and other Sciences from thirteen Federal sources:

A. Department of Defense
   1. Air Force
   2. Army
   3. Navy
   4. Other

B. Atomic Energy Commission

C. Department of Health, Education, and Welfare
   1. National Institutes of Health
   2. Public Health Service other than NIH
   3. Office of Education

D. Department of Agriculture

E. Department of Interior

F. National Science Foundation

G. National Aeronautics and Space Administration

H. All other Federal agencies

*Forms A-2 (-4, -6, -8, -10) request similar information from eight non-Federal sources as follow:

A. State Governments

B. Local Governments

C. Voluntary Health Agencies

D. Foundations

E. Industries
   1. Michigan based
   2. Non-Michigan based

F. Other Outside Sources

G. Institution's Own Funds

Form B. Form B calls for a partial breakdown of the direct costs of research and development for the years 1964-65 and 1965-66. The forms are limited to the broad groupings of Engineering, Physical Sciences, Social Science, and Other, and asked that the breakdown be given in terms of wages, equipment, and other direct costs. The same Federal and non-Federal agencies were included in Form B-1 and B-2 respectively, except that Form B prepared after Form A had been sent out, added to the Federal agencies the Department of Labor. It was noted in the instructions for Form B that the total direct cost expenditures would be less than the totals in Form A because the latter would include indirect costs assumed by the sponsoring agencies.

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*A-2 Engineering, A-4 Physical Sciences, A-6 Life Sciences, A-8 Social Sciences, A-10 Psychology and Other Sciences.

Form C. Form C requests information on funds awarded under the two methods of conveyance, grant and contract, for the five major science areas: Engineering, Physical Science, Life Sciences, Social Sciences, and Other Sciences, including Psychology, and for Federal and nonFederal sources separately. These data were asked only for the years 1964-65 and 1965-66.

Form D. This form requests the total indirect costs of the institution, broken down into reimbursed and nonreimbursed, and also the direct costs defrayed by the institution separated by Federal and nonFederal sources of support. These data, too, were requested for only the two years, 1964-65 and 1965-66.

Form E extracts from Form A data on general research support by NIH, institutional base grants by NSF, and sustaining university grants by NASA. The purpose is to show the development of this particular pattern of support over the period under study.

Form F. This form requests General Fund expenditures and Expendable Gift Fund expenditures in support of instruction and departmental research by the five fields of science used in other forms. Estimated dollar amounts of indirect costs for these two sources of support are also requested. The data were requested for each of the years under study.

Form G. This form requests information on capital expenditures for facilities and equipment, broken down by major science areas and fund sources and separately for Federal and nonFederal sources of support.

Form H requests data on expenditures for equipment from funds available for instruction and departmental research for each of the major science fields and for all years under study.

Form I requests information on the number of awards and the amount of funds expended for graduate fellowships, scholarships, and traineeships by Federal sources of funds and fields of science. Traineeships and supporting training grants are separated from fellowships and scholarships, Federal and nonFederal. Sources of support are again separated, and the information was requested for all of the years under study.

Form J. Form J requests information on funds for specially organized projects for the support and improvement of science education, separated by Federal and nonFederal sources of support. Expenditures included in other tables, such as those for separately budgeted R&D, capital expenditures, and funds for fellowships, scholarships, traineeships, are not included in this form.

Personnel Data. Form A requests, for the same years for which the financial data on research and educational grants were collected, the enrollments, graduate and undergraduate, and the several science areas. This permits analysis of relationships between types of enrollment and patterns of funding.

Form B. This form requests the student credit hours produced by year and level in each of the science fields and makes it possible to relate this to other data to study instructional productivity.

Form C. This form provides the full-time equivalent numbers of faculty who carry a full instructional activity load in the various science fields. It divides the teaching staff into regular faculty (professor-instructor) and others, and shows any shift which occurred in proportions between the groups over the years. Observed changes in proportion can be analyzed in the light of enrollment changes and, by reference to the financial data collected, to changes in research funding over the same years.

Forms D, E, and F. These forms are concerned with the numbers and salary sources of the science teaching staffs employed full time by the colleges and universities. From Forms D and E information is available on the number and percent of individuals employed full time who receive their total salary from the General Fund and what amount and what percent of their combined salaries came from the General Fund. The number and percent of the individuals in the total group who received part of their salary from other sources will also be gained, as well as the amount and percent of their combined salaries from other sources. In Form F, a detailed analysis for one year of the funding of the total salaries of individuals who are full-time members of the teaching staff will show the proportion of the salaries of these individuals which covers that part of their time specifically designated for research or other noninstructional activities and will provide some measure of the proportion of their time which they spend collectively on these activities.

Forms G and H. Form G exhibits data on the professional staff holding research appointments. Changes over time in the nonteaching staff in the various science areas can be noted. Observed changes can be related to changes in sources and amounts of funds for research on which data were collected for the same set of years in the financial data forms. Form H identifies, for the year 1966, the Federal and nonFederal sources of the salaries of the professional staff with research appointments.

Forms I and J. Form I shows changes over time in the number of graduate assistants employed in various capacities and changes in the relative proportions of graduate assistants supported by the institution's own funds as compared to funds from outside sources. These changes can be related to shifting patterns in the amount and sources of research support on which data are available in the financial data forms. Form J, for the year 1965-66, indicates in detail the Federal and nonFederal sources of funds for the support of graduate students employed to carry on different activities. The data are broken down by science areas and sources of support.

Survey of Opinions, Attitudes, and Concerns

In this portion of the data collection the emphasis is on acquiring opinions, points of view, concerns, and suggestions of individuals and of groups. A number of different approaches were used. The faculty questionnaire was designed to provide a picture of faculty views and impressions on the following matters:

A. Efforts to obtain research support. Participation in research by teaching faculty

B. Opinions on procedures and factors involved in the initiation of research proposals
   1. Role of fund availability in determining nature of proposals and affecting "balance"
   2. Procedures for departmental review of research proposals
   3. Factors contributing to success of applications for funds

C. Opinions on the impact on research of the conditions set by different outside sponsors and of the different mechanisms for conveyance of funds
   1. Differing systems of constraints and encouragement
   2. Variations in doing research under contract and grant

D. Opinion on the pattern of change in emphasis among areas of research activity
   1. Direction of change
   2. Relation of change in emphasis to funds from various sources
   3. Benefits and drawbacks to science and to the institution's science program stemming from the changes in emphasis

E. Opinion on the impact of research funds on the quality of graduate and undergraduate education - on the content, personnel, and processes of instruction

F. Opinion on the impact of research funds on the organization and functioning of the academic departments
   1. Internal structure and functioning
   2. Relationship among associated departments and between research institutes and departments

G. Opinion on the geographic and institutional distribution of research effort as the distribution is related to funding
   1. Types and amounts of research which should be carried on at different state institutions
   2. The desirability and feasibility of cooperative research effort among institutions

The expectation here was that the differences among institutions and among fields within institutions would be revealed in the faculty reactions.

The questionnaire for students is designed to use with three groups: advanced undergraduate students, master's candidates, and doctoral candidates, with or without assistance. The questions cover opinions as to impact on undergraduate and graduate education, on the availability of support for students, on the length of time required to get a graduate degree, on involvement in research, and on the impressions of relationships between research activity and instruction. Graduate assistants and teaching fellows are asked to comment specifically on their experiences.

In addition to the questionnaires, individual interviews were scheduled with administrators, deans, department chairmen, with faculty members involved in directing science education programs, with some students, and with business, industry, and governmental officials. Copies of the interview schedules or outlines prepared for each of these groups are included in the Supplement. In each case the main points of the question or outline were produced on separate pages with extensive blank space in between for the convenience of the interviewer to record his notes and impressions during the course of the interview. In addition to the individual interviews, several group sessions involving faculty or administrators were arranged, with the individuals who agreed to attend being sent in advance a set of questions for discussion. These sessions lasted about an hour and a half, of which the first fifteen to thirty minutes were usually spent with a brief explanation and a question and answer session about the nature of the project. The experience was that the discussion was rather free wheeling, with the project investigators only occasionally intervening to clarify a point or direct attention to some issue which had been largely ignored in the discussion thus far.

In the interviews, individuals were urged, wherever it was possible, to back up their statements with specifics. Thus, if, as was usually the case, a department chairman insisted that undergraduate education in his department had been improved by support of research and science education, he was then asked to indicate evidence in as specific form as possible. If, as usually was the case, he replied in terms of such items as equipment, facilities, quality of the faculty, he was asked to comment more specifically on instruction and to give as specific as possible indications of the effect on instruction. The interviews were all conducted by one of three persons: the investigator, associate investigator, or Dr. Lewis Pino, Assistant to the Chancellor, Oakland University. All had had prior extensive experience in conducting such interviews and some prior experience with study of at least some of the problems involved in this particular study. In general, so long as the interviewee stayed with the general area of concern, he was permitted to develop his thoughts as he wished. All of the individuals interviewed had received a set of questions which constituted the focus of the interview ahead of time, and most of them had obviously consulted it.

In addition to the on-campus personnel involved in the interviewing, a few people in government and a number of persons in labor, business, and industry, primarily members of the Advisory Committee, and some of their associates were interviewed. An interview schedule for the business and industry officials was prepared. No special form was prepared for the few people in government who were interviewed, since these interviews constituted primarily information exchange as to what the study was about and what was going on in government or known to be going on elsewhere that would be relevant. At an early point in the study some attention had been given to the possibility of interviews with a number of legislators and major state officials. As the study developed, it seemed politic to drop this aspect. It seemed very dubious that the circumstances or the time available to the investigators would permit a perceptive and useful contact with these officials.

Table S-1 indicates the various types of questionnaires and inventories used and an indication of the approximate number of people involved. "Approximate" is used advisedly because interviews scheduled with individuals sometimes gained a third party in progress and group sessions always involved some coming and going of individuals. Some questionnaire replies were incomplete, though usable so far as completed. Certainly the table indicates that a large number of people had an opportunity to express themselves in regard to the project. There is, however, always the problem of sampling. With the individual interviews with administrators through the department chairman level, response is not a problem since interview schedules were arranged in advance. With but one or two exceptions, the administrators were on hand for the interview. Faculty members, either individually or in group sessions, were most likely to have been chosen in terms of availability, interest, and willingness to participate. They represent, therefore, in the large, individuals who have had some involvement in types of projects and programs under study.

Table S-1

Types of Questionnaires and Inventories Used and Approximate Number of Persons Involved

Procedure and Type of Contact	Number of Persons Involved
Interviews	
Top Administrators (Individual interviews)	40
Faculty (Individual interviews)	67
Discussion Groups*	76
Business and Industrial Leaders	10
Student Questionnaire	
Graduate	1,215 (usable)
Undergraduate	505 (usable)
Faculty Questionnaire	519 (usable)

*This category includes both faculty and top administrators.

The sampling for the faculty and student questionnaires was planned by indicating for each science area a number of persons based on a variable percent of the faculty and students involved in the areas. The percentage was varied in relationship to the size of the institution. Questionnaires were sent to the campus in the case of the faculty and distributed from the office of the study liaison and returned there. As Table S-2 indicates, the return rate here for the various institutions was good.

Table S-2

Faculty Questionnaire

% of Staff	Institution	Sample (number sent)	Total usable returns	Percent	Total returns	Percent
10	U of M	119	96	80	96	80
10	MSU	101	97	96	98	97
10	WSU	54	43	80	43	80
20	WMU	43	42	97	42	97
20	MTU	35	35	100	35	100
40	CMU	46	46	100	46	100
40	EMU	42	38	90	38	90
40	NMU	30	27	90	28	93
40	OU	28	27	96	28	100
40	FSC	31	29	93	29	93
100	GVSC	41	39	95	41	100
100	SVSC *	5	-	-	3	60
Totals		575	519	90.26	527	91.65

*In the analysis of data Saginaw Valley State College was excluded.

For the student survey it was decided, after some discussion, that the response might be better if the questionnaire came to the students directly from the project office rather than through channels within the institution. Some of the questions had a critical bent which might cause the students to hesitate to reply if they felt that the response would be reviewed by faculty members, department chairmen, or others within the institution. Since both undergraduate and graduate science majors were included, only five institutions were included. These were asked to provide a list of names and addresses of their students enrolled in each of the science areas on the following basis: University of Michigan, Michigan State University, and Wayne State University--a 10% random sample of all graduate students and a 10% random sample of all undergraduates; Western Michigan University and Michigan Technological University--a 50% random sample of graduate students and a 20% random sample of undergraduates. The questionnaires were then mailed directly to students with a return envelope. Return rates, as are to be seen in Table S-3 are much less satisfactory.

Table S-3

Student Questionnaire Returns

Student level	Original sample size	Total returns	Usable returns	Usable returns as % of original sample
Undergrad.	996	509	505	50.7
Graduate	1,843	1,234	1,215	65.9

Summary Comments

The amount of data collected in this project is very extensive. In retrospect, it may have been overly ambitious on several counts. First, as indicated earlier, although all forms were channeled to the several campuses for review and checking against available data, several institutions found that, when they actually attempted to complete the forms, the data were simply not available. Second, although the reactions of most of the reviewers had been in terms of greater specificity and detail, at the stage of filling out the forms the difficulties of digging out certain data and the repeated necessity of estimating or approximating raised questions about the usefulness of the information. Third, these problems, coupled with the inevitable tendency to delay a difficult additional task in the face of pressing daily burdens resulted in the data collection process extending over a much longer period of time than had been originally anticipated. The project, initiated in the early months of 1967, began with the expectation that data collection forms would be completed and in the hands of institutions within two or three months, and that most of the data would be in hand by June or July. The reviewing process and the successive editings extended this period into more than twice the time originally envisaged. Delay in state legislative action on budgets until after July 1 combined with the necessity of developing next year's budget requests in September and October, led to inevitable delay by the institutions in filling out forms. Thus, by force of circumstance, January 1, 1968 became the target date, and was further deferred until March 1 by the problems in two or three of the large institutions. In one of these, completed data were found to be so inconsistent and full of errors that it had to be redone. In another, a succession of delays postponed the actual steps in data collection until late spring, and only then was it detected that records were totally inadequate to complete many of the forms.

The original plan had been to collect, analyze the data, and then to hold a number of sessions of liaison representatives, drawing upon study of the data and reflection upon it on their own campuses, to consider the appropriateness of the conclusions, recommendations, as well as the analysis. An additional hope was that the group would reexamine the problem of policy on the basis of a fuller understanding of experience. This has been done, but to a much lesser extent than originally envisioned.

The effect of the stretch out of the study on budget, the encroachment of other obligations upon the time of the investigators, the changing complexion of the higher education scene in Michigan, and the decrease rather than anticipated increase in Federal funding have all modified and somewhat reduced the expectations held for the study. It became evident, too, that some of the tensions existing in higher education in Michigan make it impolitic to formulate at this time some types of conclusions, recommendations, or policy statements however appropriate they might seem. Data interpretation, especially as it relates to policy formation is subjective, and the interpretation inevitably depends upon values, aspirations, and resources. In such circumstances firm policies are not easily come by, but alternatives may be examined for feasibility and for implications.

Part 2

Data Collection Instruments and Forms

Faculty Questionnaire
on Impact of Funds for Science Research on
Michigan Public Institutions of Higher Education

To: Faculty Members in the State Supported Colleges and Universities of Michigan

This questionnaire is one of several data-collecting instruments being employed in a study of the impact of Federal and nonFederal funds for science research and education upon the twelve, four-year, state-supported colleges and universities in Michigan. The study is sponsored by the National Science Foundation and has the support of each of the twelve state institutions. The Michigan State Board of Education and an Advisory Group of representatives from business, industry, and labor are related parties.

The questionnaire has been sent to selected members of the teaching staffs of each of the twelve institutions in the areas of Engineering, Life Science, Physical Science, and Social Science. Responses are solicited both from those who are actively engaged in sponsored research in science and from those who are not.

A purpose of the total study is to develop some bases for policy decisions which may be made during the next ten years in the system by which scientific research and educational activity are undertaken and supported. These decisions will take into account not only the needs of the institutions but also those of their Federal and nonFederal sources of support representing various segments of the American public.

The information gained through this questionnaire will make an important contribution to the conclusions of the study. Hence we hope you will give this your immediate and thoughtful attention. Please return the completed questionnaire to the department or division head from whom you received it within the next ten days.

Paul L. Dressel
Director of Institutional Research, Michigan State University
and
Director of Study on Impact of Federal and nonFederal Funds on Science Research and Education

Please respond in the appropriate manner to the following items.

I. Personal information

Name ______________________

Department ______________________

Institution ______________________

1. Present academic rank (check one)
   - ____ 1. Professor
   - ____ 2. Assoc. professor
   - ____ 3. Asst. professor
   - ____ 4. Instructor
   - ____ 5. Lecturer
   - ____ 6. Asst. instructor
   - ____ 7. Teaching fellow or graduate teaching assistant

2. Highest academic degree held ______________________

3. Primary area of science activity and interest ____________

4. On a best judgment basis, estimate by percent the current allocation of your effort among the following professional activities. (Attain a 100% total).
   1. Instruction (including teaching, preparation, dissertation direction, committees for graduate students, grading, counselling, course development) ________%
   2. Research (sponsored or non-sponsored) ________%
   3. Administration (including committee activities) ________%

   ________ 100%

5. Term or semester credit hours of courses taught during the current session
   1. Freshman - sophomore level ________
   2. Junior - senior level ________
   3. Graduate level
      - a. scheduled courses ________
      - b. direction of unscheduled study and dissertations (estimated credit-hour equivalent) ________

   Total ________

6. Are you currently a:

   Department chairman or head ____ Yes ____ No

   Administrative assistant, associate head or associate chairman ____ Yes ____ No

7. Source of current university salary by percent
   1. From General Fund of University or College ____ %
   2. From separately budgeted funds for research

      University or college source
        Please specify (e.g. Name of fund or agency administering it)

      ______________________________ ____ %

      Other nonFederal source
        Please specify (Name of corporation, foundation or agency)

      ______________________________ ____ %

      Federal source
        Please specify (Name of agency)

      ______________________________ ____ %

   3. From other source or sources

      Please specify

      ______________________________ ____ %

      100 %

II. Experience in Participation in the Use of Federal and nonFederal Grants and Contracts

8. Do you consider yourself well informed about the current programs (if any) of Federal and nonFederal agencies, corporations and foundations in support of research in your area of professional activity and interest?

   Federal agencies

   a. ____ Yes ____ No

   NonFederal

   b. State and local governmental agencies*
      ____ Yes ____ No

   c. Private corporations
      ____ Yes ____ No

   d. Private foundations
      ____ Yes ____ No

*In this and subsequent items, the category of state and local governmental agencies, or state and local government, excludes the college or university.

9. Individuals sometimes participate in research studies supported by a grant or contract awarded to another individual or group. During the last five years, how many such studies have you participated in to the extent of contributing at least the equivalent of 20% of your professional effort for a period of three months?

a. Federally supported studies

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

NonFederally supported studies

b. By state or local governmental agencies

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

c. By private profit-making corporations

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

d. By private foundations

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

10. How many applications have you made in the past five years (individually or with others) to an agency, corporation, or foundation for a research grant or contract? (If the same proposal was submitted to more than one agency, corporation or foundation, count each submission. Also, count each renewal as an application).

a. Federal agencies

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

NonFederal support

b. State or local government agencies

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

c. Private profit-making corporations

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

d. Private foundations

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

11. How many of the above applications (if any) have resulted in award of funds? (Check appropriate number).

a. Federal agencies

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

NonFederal support

b. State or local governmental agencies

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

c. Private corporations

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

d. Private foundations

____ None ____ 3-5
____ 1 ____ 6-10
____ 2 ____ 10 or more

12. This item may be omitted if you have not made application for research funds. If you have applied, please answer, whether or not award of funds has been received. Among the factors to which success from application for research funds has been attributed are the following:
    1. Relevance of a research proposal to the mission or needs of an agency, corporation, or foundation.
    2. Personal reputation of an investigator
    3. Reputation of a college or university in a given field or area of science
    4. Existing facilities in the institution for research in the area of a proposed study
    5. Skill of an investigator in formulating a proposal
    6. Assistance of administrative officers of a college or university in formulating and presenting a proposal

    For each of the categories of sponsors of research indicated below please list, insofar as possible in order of descending significance, the factors which you believe are very important for success from application. The list of six factors is merely suggestive; others deemed important should be included and unimportant ones omitted. If you have had no experience in applying for funds from a given type of sponsor, or if you have no opinion even though you have made application, this may be indicated by checking the appropriate response.

    a. Federal agencies
    _____ No experience _____ No opinion
    List of factors

    b. State or local governmental agencies
    _____ No experience _____ No opinion
    List of factors

    c. Private profit-making corporations
    _____ No experience _____ No opinion
    List of factors

    d. Private foundations
    _____ No experience _____ No opinion
    List of factors

Instructions: If you have received an award of research funds from any agency, corporation, or foundation, or if you have participated in a study supported by an award received by someone else, to the extent of contributing the equivalent of 20% of your professional effort for a three month period, please answer items 13 through 18. Otherwise, omit these items and go on to item 19.

13. In your experience, has there been an important difference between conducting research under the terms of a contract as compared to the terms of a grant?

____ Yes ____ No (If no, go on to item 15)

14. Are awards conveyed by a contract usually <u>more</u> restrictive than grants in delimiting scientific objectives important to you?

____ Yes ____ No ____ Have no opinion

If the answer is <u>Yes</u>, please answer parts a and b of item 14.

a. Restrictions (whether under grant or contract) are usually evident or are sensed (check as many as are applicable)

____ 1. in the formulation of the study
____ 2. in the conduct of the study
____ 3. in the interpretation and dissemination of the results
____ 4. other (please state)

b. In your opinion, how serious are these restrictions in limiting the scope of research? (Check one)

____ 1. Serious or great importance
____ 2. Some importance, but not serious
____ 3. Little importance

15. a. In your experience, have you sensed any restrictions upon research funded by profit-making corporations which are not evident when funds come from other sponsors?

____ 1. Yes ____ 2. No ____ 3. No opinion
____ 4. No experience on which to make this judgment

b. If the answer to 15a is yes, please specify these restrictions.

16. Within your discipline, what is the major role of research funds from outside the institution on research programs?

____ 1. Give research programs a focus which was not previously contemplated.
____ 2. Give necessary financial backing and support to previously conceived programs.
____ 3. No major common pattern can be discerned.
____ 4. No opinion.

17. Within your discipline, are relatively small research grants from an institution's own funds effective in drawing larger support from outside sources?

____ 1. Often ____ 2. Occasionally ____ 3. Seldom
____ 4. Very seldom or practically never ____ 4. No opinion

18. In the determination at your institution of the new research projects which will be initiated in your discipline, what do you conceive to be the role played by the availability of funds in the budgets of sponsors for certain types of research?

Availability of funds:
____ 1. Has a dominating influence
____ 2. Has a significant, but not a dominating influence
____ 3. Has some, but not a significant, influence
____ 4. Has little or no influence
____ 5. Cannot make a judgment

III. Focus and Emphasis in Research Programs Among and Within Academic Fields and Disciplines of Science

19. Have funds for research from sources outside of your institution contributed to major change in the focus or emphasis among science research programs in your institution throughout, or at some time within, the period of the last ten years?
____ 1. Yes ____ 2. No ____ 3. Don't know
____ 4. Short tenure at the institution precludes a judgment

(If your answer is Yes, indicate the areas of science (1. Engineering sciences; 2. Physical sciences; 3. Life sciences: Agricultural; 4. Life sciences: Biological; 5. Life sciences: Medical; or 6. Social sciences) or sub-categories within them, which you believe have been given increased emphasis.

Please specify:

Instructions: Answer items 20 and 21 only if your answer to item 19 is Yes. If your answer is not Yes, go on to item 22.

20. Indicate the importance of the following sources in supplying funds which have brought about change in the emphasis among research programs in the sciences at your institution.

	Sources	1. Very important	2. Important	3. Of small importance	4. Of no importance
a.	Federal government	____	____	____	____
b.	State government	____	____	____	____
c.	Local governments	____	____	____	____
d.	Private profit-making corporations	____	____	____	____
e.	Private foundations	____	____	____	____

21. Do you consider the change in emphasis, resulting from outside support of research, which has occurred throughout, or at some time within, the period of the last 10 years in your institution to have promoted the

a. best interest of your institution
____ 1. Yes
____ 2. No
____ 3. No opinion

b. best interest of your field of science
____ 1. Yes
____ 2. No
____ 3. No opinion

22. a. Within your field of science, do you feel that outside funds for research have resulted in overemphasis for certain types of research?
____ 1. Yes, this is a serious problem
____ 2. The problem exists to some extent, but is not serious
____ 3. No, the problem is negligible in importance, or non-existent
____ 4. No opinion

b. If this is recognized by you as a serious problem, please check the source of funds which contributes most strongly to the problem. Otherwise omit part b.
____ 1. Federal
____ 2. State and local governments
____ 3. Private profit-making corporations
____ 4. Private foundations
____ 5. No one source can be so identified

23. The proportionate dollar amounts of Federal grants and contracts to colleges and universities for research are the greatest in the natural sciences, much less in the social sciences and still less in the humanities. Do you believe that the current apportionment of funds promotes the
a. best interest of your institution
____ 1. Yes ____ 2. No ____ 3. No opinion
b. best interest of your field of science
____ 1. Yes ____ 2. No ____ 3. No opinion

24. If an increase in the support for research in the social sciences were to occur, what ought to be the chief source of the additional funds?
    ____ 1. Federal government
    ____ 2. State and local governments
    ____ 3. Private, profit-making corporations
    ____ 4. Private foundations
    ____ 5. No opinion

25. If an increase in the support for research in the humanities were to occur, what ought to be the chief source of the additional funds?
    ____ 1. Federal government
    ____ 2. State and local governments
    ____ 3. Private, profit-making corporations
    ____ 4. Private foundations
    ____ 5. No opinion

Could you state the main reason or reasons for the opinions expressed in items 24 and 25?

IV. Impact of Federal and nonFederal Funds on Departmental Instructional Programs

26. Do you believe that there is a tendency for the most able undergraduate students to be attracted to those institutions and departments which are most heavily supported in research?
    ____ 1. Strong tendency in this direction
    ____ 2. Some tendency in this direction
    ____ 3. No tendency can be observed
    ____ 4. Some tendency in the opposite direction
    ____ 5. Strong tendency in the opposite direction
    ____ 6. No opinion

27. Do you believe that there is a tendency for the most able graduate students to be attracted to those institutions and departments which are most heavily supported in research?
    ____ 1. Strong tendency in this direction
    ____ 2. Some tendency in this direction
    ____ 3. No tendency can be observed
    ____ 4. Some tendency in the opposite direction
    ____ 5. Strong tendency in the opposite direction
    ____ 6. No opinion

28. Do you believe that there is a tendency for the most able faculty to be attracted to those institutions and departments which are most heavily supported in research?
____ 1. Strong tendency in this direction
____ 2. Some tendency in this direction
____ 3. No tendency can be observed
____ 4. Some tendency in the opposite direction
____ 5. Strong tendency in the opposite direction
____ 6. No opinion

29. What general relationship do you see between obtaining contract or grant funds for research and the development of a graduate program of high quality in your field of science?
____ 1. Without research funds, a graduate program of high quality is impossible
____ 2. Research funds help to promote a graduate program of high quality, but are not necessary for its existence
____ 3. There is not an important or fundamental relationship between obtaining research funds and a graduate program of high quality
____ 4. Such funds hinder the development and conduct of a graduate program of high quality
____ 5. No opinion

30. What general relationship do you see between obtaining contract or grant funds for research, and the development of an undergraduate program of high quality in your field of science?
____ 1. Without research funds, an undergraduate program of high quality is impossible
____ 2. Research funds help to promote an undergraduate program of high quality, but are not necessary for its existence
____ 3. There is not an important or fundamental relationship between obtaining research funds and an undergraduate program of high quality
____ 4. Such funds hinder the development and conduct of an undergraduate program of high quality
____ 5. No opinion

31. a. In your department, have research grants and contracts from sources outside of your institution had an impact upon the content of the undergraduate instructional program or upon the means and methods of instruction employed?
____ 1. Yes ____ 2. No ____ 3. Don't know

If Yes, please answer part b; otherwise part b should be omitted.

b. Because of this impact, the overall quality of instruction as it affects the undergraduate student has been

____ 1. Greatly bettered ____ 4. Somewhat worsened
____ 2. Somewhat bettered ____ 5. Greatly worsened
____ 3. Unchanged ____ 6. No opinion

If bettered in any degree, please specify in what ways:

If worsened in any degree, please specify in what ways:

32. a. In your department, have research grants and contracts from sources outside of your institution had an impact upon the content of the graduate instructional program or upon the means and methods of instruction employed?

____ 1. Yes ____ 2. No ____ 3. Don't know
____ 4. No graduate program in the department

If Yes, please answer part b; otherwise part b should be omitted.

b. Because of this impact the overall quality of instruction as it affects the graduate student has been

____ 1. Greatly bettered ____ 5. Greatly worsened
____ 2. Somewhat bettered ____ 6. No opinion
____ 3. Unchanged
____ 4. Somewhat worsened

If bettered in any degree, please specify in what ways:

If worsened in any degree, please specify in what ways:

V. Impact of Federal and nonFederal Funds for Research on the Administration and Internal Relationships of Departments and Agencies

33. In your department, which of the following types of activity contributes more to an individual's status than any one of the other types of activity?

____ 1. Instruction
____ 2. Research
____ 3. Publication
____ 4. No one activity can be so designated
____ 5. Don't know

34. If two men in your department were equal in ability and equal in scholarly productivity in teaching and research, which one would be regarded more highly?
   ____ 1. One whose research is financed by a substantial grant of funds from an outside source
   ____ 2. One whose research is independent (non-sponsored)
   ____ 3. No distinction would be made
   ____ 4. Don't know

35. What allocation of the use of your effort in professional activities would you currently prefer?

Activity	Percent of effort
1. Instruction	____ %
2. Research	____ %
3. Administration	____ %
	100 %

36. Do you believe that funds for research coming from sponsors outside of your institution have had an impact upon the organizational pattern and functioning of your department?
   ____ 1. Yes ____ 2. No (if No, omit items 37 through 39 and go on to item 40)
   ____ 3. Don't know

37. In your opinion, what has been the overall effect of the flow of outside research funds into your department upon the influence within the department of your chairman or head? His influence has
   ____ 1. Strengthened considerably
   ____ 2. Strengthened somewhat
   ____ 3. Undergone no noticeable change
   ____ 4. Weakened somewhat
   ____ 5. Weakened considerably
   ____ 6. Don't know

38. Does your department have an established mechanism for a formal, substantive review of research proposals of its members so that the conduct of research under a grant or contract award will be coordinated with educational objectives of the department?
   ____ 1. Yes ____ 2. No

39. Whether or not your department has a mechanism for reviewing proposals on the basis of definitely formulated criteria, do you favor such a system?
   ____ 1. Favor strongly
   ____ 2. Favor somewhat
   ____ 3. Undecided
   ____ 4. Disfavor somewhat
   ____ 5. Disfavor strongly

40. Does your college or university have a research institute, bureau, or other agency which actively carries on research in areas closely related to your discipline in science?
____ 1. Yes ____ 2. No (if No, omit items 41 through 43, and go on to item 44)
If the answer is yes, please specify the one most closely related to your discipline in science:

Others:

41. Do you feel that the establishment of the institute, bureau, or agency most closely related to your discipline in science was
____ 1. mainly a reflection of the growing needs of your department and other related departments
____ 2. mainly the creation of an organization to perform a special function and was superimposed upon the existing departmental structure
____ 3. Don't know

42. Is this institute, bureau, or agency for the most part separately staffed, with participation in its functions by members of related departments bei difficult?
____ 1. Yes ____ 2. No ____ 3. No opinion

43. How effectively do the members of related departments participate in policy-making for this institute, bureau, or agency?
____ 1. Very effectively ____ 4. Ineffectively
____ 2. Effectively ____ 5. Very ineffectively
____ 3. Undecided

VI. The Balance of Science Research Among the State Institutions in Michigan

44. Is there a common core of research areas in science which should be strongly supported in every state institution?
____ 1. Yes ____ 2. No ____ 3. No opinion
If Yes, could you state the main benefit or benefits to be derived from this system of support?

45. If a common core of research areas in science were to be strongly supported, do you think that this would require a major increase in the flow of research funds to your institution?

____ 1. Yes ____ 2. No ____ 3. No opinion

46. Do you believe that each institution should have strong financial support for at least one, or a few, specialized areas of science research?

____ 1. Yes ____ 2. No ____ 3. No opinion

If Yes, could you state the main benefit or benefits to be derived from this system of support?

47. If it were determined that some of the institutions in the state would need major increases in research funds to support a fundamental group of research areas, or at least a few specialized areas, which one of the following sources do you think should assume the major responsibility of supplying these funds?

____ 1. Federal government through grants and contracts
____ 2. State government through general fund appropriations
____ 3. Private, profit-making corporations through grants and contracts
____ 4. Private foundations through grants and contracts
____ 5. No opinion

48. If there were 6 or fewer major university centers of scientific research in the state in which the greater part of such research were conducted, would this be:

a. In the best interest of higher education in Michigan

____ 1. Yes
____ 2. No
____ 3. No opinion

b. In the best overall interest of the state and nation

____ 1. Yes
____ 2. No
____ 3. No opinion

49. Is inter-institutional participation in specific, sponsored research projects feasible as a major means of providing adequate research facilities for scientists in the state institutions in Michigan?

____ 1. Yes ____ 2. No ____ 3. No opinion

a. If Yes, please answer item 50
b. If No, omit item 50, and please specify the major reasons for your opinion: (Continue on next page if necessary)

50. Should inter-institutional participation in scientific research be developed on the basis of
____ 1. individual invitation and cooperation
____ 2. formalized arrangements between comparable departments
____ 3. formalized arrangements between administrative units representing broader scientific interests than departments
____ 4. other methods - please specify:

51. Should the sources of funds for scientific research purposefully pursue a policy of promoting inter-institutional participation in sponsored research?
____ 1. Yes ____ 2. No ____ 3. No opinion

52. Have you participated in the conduct of a sponsored research project with a person or persons from the other state institutions in Michigan?
____ 1. Yes ____ 2. No (if No, omit items 53 and 54)

53. Where was the research mainly based?
____ 1. At my own institution
____ 2. At another institution
____ 3. At no one institution

54. How would you generally evaluate your experience in such inter-institutional participation?
____ 1. Very favorably
____ 2. Favorably
____ 3. Favorably, but with some reservations
____ 4. Unfavorably
____ 5. Very unfavorably
____ 6. No opinion

GENERAL INSTRUCTIONS FOR PROVIDING DATA TO COMPLETE THE FINANCIAL DATA FORMS

1. This survey of financial characteristics covers science research, development, and educational programs of all branches and other units of the twelve parent institutions, both on and off the main campuses. Research centers managed by universities for the Federal Government are to be included.

2. Unless otherwise requested, report funds on an expenditure basis. In addition to where it is specifically requested, receipts may be substituted in those cases in which it is not feasible to identify expenditures for the requested time period.

3. Reasonable estimates will be satisfactory in the case of those items for which more precise information is not available from records normally maintained by your institution. If totals for data have been maintained in the records, even though detailed breakdowns are not available, please enter the appropriate totals where they are requested. Please enter "not available," "not applicable," or "none" where appropriate.

4. Definition of Research and Development (R&D) to be employed in the study.

   Research and Development include basic and applied research in the sciences and in engineering, and design and development of prototypes and processes.

   Research is systematic, intensive study directed toward fuller knowledge of the subject studies. Research may be either basic or applied.

      Basic research is directed toward increase of knowledge; it is research where the primary aim of the investigator is a fuller knowledge or understanding of the subject under study rather than a practical application thereof.

      Applied research is directed toward practical application of knowledge. The definition of applied research differs from the definition of basic research chiefly in terms of the objectives of the investigator.

   Development is the systematic use of knowledge directed toward the design and production of useful prototypes, materials, devices, systems, methods, or processes. It does not include quality control or routine product testing.

5. The classifications of disciplines in the various fields of science which are necessary for the completion of certain of the financial forms should follow the chart on the following page of these instructions labeled "Classification of Fields."

CLASSIFICATION OF FIELDS

A. ENGINEERING

Aerospace
Agricultural
Architectural
Chemical
Civil
Electrical
Engineering Graphics
Engineering Mechanics
Geological
Industrial
Mechanical
Metallurgical
Meteorology and Oceanography
Mining
Naval Architecture and Marine Engineering
Other Engineering Fields

B. PHYSICAL SCIENCES

Astronomy
Chemistry
Geography (physical)
Geology
Geophysics
Mathematics and Mathematical Statistics
Metallurgy
Mineralogy
Physics
Other physical sciences

C. LIFE SCIENCES

a) Biological Sciences

Anatomy
Anthropology (physical)
Bacteriology
Biochemistry
Biology
Biophysics
Botany
Entomology
Genetics
Microbiology
Nutrition
Paleontology
Pathology
Pharmacology
Physiology
Zoology
Other biological sciences

b) Agricultural Sciences

Animal Husbandry
Crops
Dairy Husbandry
Fisheries
Food Technology
Forestry
Horticulture
Range Management
Soils
Wildlife
Other agricultural fields (except agricultural engineering and agricultural economics: see categories A and E)

c) Medical Sciences

Anesthetics
Community Health Service
Dermatology
Environmental Health
Epidemiology
Health Development
Industrial Health
Internal Medicine
Neurology
Obstetrics & Gynecology
Ophthalmology
Otolaryngology
Pediatrics
Pharmacy
Psychiatry
Public Health
Radiology
Surgery
Other clinical sciences

D. PSYCHOLOGY

Social Psychology
Other Psychology

E. SOCIAL SCIENCES

Agricultural Economics
Anthropology (social)
Economics
Geography (econ. and social)
Political Science
Sociology
Other social sciences (excluding history)

F. OTHER SCIENCES

This category includes sciences which cannot be readily classified under one of the above named fields, but excludes most of the areas generally included in education, accounting, business administration, history, home economics, law, and library science.

6. Some definitions of funding units employed in the study.

a. In reporting Federal funds expended within the category of "Federal Sources," include those Federal Funds channeled through State agencies. Exclude funds related to R&D contracts which are subcontracted by your institution to be performed by other organizations.

b. Under "State Governments," include only funds designated or "earmarked" for special R&D or educational projects or capital projects by the state government and its agencies. Exclude general purpose appropriations by the legislature to the institution.

c. Under "Local Governments," include funds from county, municipal, or other local governments and their agencies.

d. Under "Foundations" include funds received directly from non-profit philanthropic foundations and trusts not affiliated with your institution, such as the Carnegie, Ford, Kresge, or Rockefeller Foundations. Funds from foundations which are affiliated with, or grant solely to, your institution should be included under "Institution's Own Funds."

e. Under "Voluntary health agencies" include funds received directly from voluntary health agencies, such as the American Cancer Society and the American Heart Association. Funds specifically designated for R&D, a capital project, or an educational project and derived from a health agency that is a unit of a State or local government should be reported under "State" or "local government." Funds from professional societies such as the American Medical Association and the American Dental Association should be reported under "Other Outside Sources."

f. Under "Industries" (including trade associations) include all funds received directly from profit-making organizations, whether engaged in production, distribution, research, service, or other activities. Do not include grants and contracts from non-profit foundations - financed by industry, which should be reported under "Foundations." Include under "Michigan based" industries not only those with home offices in Michigan, but those which carry on within the state one of the profit-making, economic activities noted above.

g. Under "Other Outside Sources" report any additional funds received from outside sources other than those already noted, and which were earmarked for R&D, a capital project, or an educational project by the source. Examples include gifts, grants, or contracts received from private individuals or professional societies.

h. Under "Institution's Own Funds" include any funds which the institution was free to designate for R&D, for capital expenditures, and for specially organized projects for improvement of science education, and which were in fact so budgeted. The sources of these funds may include endowment income; tuition and fees; general-purpose State or local government appropriations; general-purpose grants from industry, foundations, health agencies or other outside sources; and re-imbursed overhead expenses received from sponsors of R&D.

i. In distinguishing between Michigan based and non-Michigan based industries, as defined in "6-f" above, The Directory of Michigan Manufacturers, published by the Michigan Manufacturer and Financial Record, may be used as a suitable guide.

INSTRUCTIONS FOR FORM A

1. Data will be collected for the years 1957-58, 1960-61, 1963-64, 1964-65, and 1965-66.

2. Operating expenditures include all expenditures, both direct and indirect, spent currently during a given year on research and development in progress. Capital expenditures for facilities and equipment, which are included in Form G, should be excluded from Form A.

3. To be included as a research and development expenditure, under "Institution's Own Funds," the funds for the expenditure must be separately budgeted. This would include funds specifically budgeted for research which are subsequently distributed among a number of projects. Funds not specifically budgeted for research but which are eventually so used should be included under Expenditures for Instruction and Departmental Research.

4. Funds spent on the operation of computers used in research in several areas of science should be entered on forms "A-9" and "A-10" under Other Sciences, with the designation, Computer, specified.

5. Please note that data is requested for the five periods listed above in the number 1 instruction. A set of "A" forms for each year should be completed.

Financial Data Form: A-1

Institution ____________

Year ____________

Operating Expenditures for Separately Budgeted R&D
in Engineering by Federal Sources
(In Thousands of Dollars)

Federal Sources	Total	Aerospace	Chemical & Metal-lurgical	Civil	Electrical	Mechanical	Industrial	Other Engineering Fields
A. Dept. of Defense 1. Air Force								
2. Army								
3. Navy								
4. Other								
B. Atomic Energy Commission								
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. of Health								
2. Publ.Health Ser. other than NIH								
3. Office of Education								
D. Department of Agriculture								
E. Department of Interior								
F. National Science --Foundation								
G. Nat'l Aeronautics and Space Admin.								
H. All Other Federal Agencies								
TOTALS (sum of A through H)								

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Financial Data Form: A-2

Institution ____

Year ____

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D IN ENGINEERING BY NON-FEDERAL SOURCES (IN THOUSANDS OF DOLLARS)

Non-Federal Sources	Total	Aerospace	Chemical and Metal-lurgical	Civil	Electrical	Mechanical	Industrial	Other Engineering Fields
A. State Governments								
B. Local Governments								
C. Voluntary Health Agencies								
D. Foundations								
E. Industries								
1. Michigan based								
2. Non-Mich.based								
F. Other Outside Sources								
G. Institution's Own Funds								
Total (sum of A through G)								

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Financial Data Form: A-3

Institution

Year

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED
R&D IN THE PHYSICAL SCIENCES BY FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

Federal Sources	Total	Chemistry	Earth Sciences	Physics	Mathematics	Other Physical Sciences
A. Dept. of Defense 1. Air Force						
2. Army						
3. Navy						
4. Other						
B. Atomic Energy Commission						
C. Dept. of Health Educ. & Welfare 1. Nat'l Instit. of Health						
2. Publ. Health Serv. other than NIH						
3. Office of Education						
D. Department of Agriculture						
E. Department of Interior						
F. National Science Foundation						
G. Nat'l Aeronautics and Space Admin.						
H. All Other Federal - Agencies						
TOTALS (sum of A through H)						

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Financial Data Form: A-4

Institution ____________

Year ____________

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED
R&D IN THE PHYSICAL SCIENCES BY NON-FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

Non-Federal Sources	Total	Chemistry	Earth Sciences	Physics	Mathematics	Other Physical Sciences
A. State Governments						
B. Local Governments						
C. Voluntary Health Agencies						
D. Foundations						
E. Industries 1. Michigan based						
2. Non-Mich.based						
F. Other Outside Sources						
G. Institution's Own Funds						
TOTALS (sum of A through G)						

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Financial Data Forms: A-5

Institution

Year

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D IN THE LIFE SCIENCES BY FEDERAL SOURCES (IN THOUSANDS OF DOLLARS)

Federal Sources	Total	Agricultural Sciences	Biological Sciences	Medical Sciences
A. Dept. of Defense 1. Air Force				
2. Army				
3. Navy				
4. Other				
B. Atomic Energy Commission				
C. Dept. of Health Education & Welfare				
1. Nat'l Institute of Health				
2. Public Health Serv. other than NIH				
3. Office of Education				
D. Department of Agriculture				
E. Department of Interior				
F. National Science Foundation				
G. Nat'l Aeronautics and Space Admin.				
H. All Other Federal Agencies				
TOTALS (sum of A through H)				

Financial Data Form: A-6

Institution

Year

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D
IN THE LIFE SCIENCES BY NON-FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

Non-Federal Sources	Total	Agricultural Sciences	Biological Sciences	Medical Sciences
A. State Governments				
B. Local Governments				
C. Voluntary Health Agencies				
D. Foundations				
E. Industries				
1. Michigan based				
2. Non-Michigan based				
F. Other Outside Sources				
G. Institution's Own Funds				
TOTALS (Sum of A through G)				

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Financial Data Form: A-7

Institution ____________

Year ____________

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D IN THE SOCIAL SCIENCES BY FEDERAL SOURCES (IN THOUSANDS OF DOLLARS)

Federal Sources	Total	Economics	Political Science	Sociology	Other Social Sciences
A. Dept. of Defense 1. Air Force					
2. Army					
3. Navy					
4. Other					
B. Atomic Energy Commission					
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. of Health					
2. Publ.Health Ser. other than NIH					
3. Office of Education					
D. Department of Agriculture					
E. Department of Interior					
F. Department of Labor					
G. National Science Foundation					
H. Nat'l Aeronautics and Space Admin.					
I. All Other Federal Agencies					
TOTALS (sum of A through I)					

Financial Data Form: A-8

Institution

Year

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D
IN THE SOCIAL SCIENCES BY NON-FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

Non-Federal Sources	Total	Economics	Political Science	Sociology	Other Social Sciences
A. State Governments					
B. Local Governments					
C. Voluntary Health Agencies					
D. Foundations					
E. Industries					
1. Michigan based					
2. Non-Mich. based					
F. Other Outside Sources					
G. Institution's Own Funds					
TOTALS (sum of A through G)					

Financial Data Form: A-9

Institution ____________

Year ____________

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D IN PSYCHOLOGY AND IN THE CATEGORY OF OTHER SCIENCES BY FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

Federal Sources	Total	Psychology	Other Sciences (please specify)				
A. Dept. of Defense 1. Air Force							
2. Army							
3. Navy							
4. Other							
B. Atomic Energy Commission							
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. of Health							
2. Publ. Health Ser. other than NIH							
3. Office of Education							
D. Department of Agriculture							
E. Department of Interior							
F. Department of Labor							
G. National Science Foundation							
H. Nat'l Aeronautics and Space Admin.							
I All Other Federal Agencies							
TOTALS (sum of A through I)							

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Financial Data Form: A-10

Institution ______

Year ______

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D IN PSYCHOLOGY
AND IN THE CATEGORY OF OTHER SCIENCES BY NON-FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

	Total	Psychology	Other Sciences (please specify)				
Non-Federal Sources							
A. State Governments							
B. Local Governments							
C. Voluntary Health Agencies							
D. Foundations							
E. Industries							
1. Michigan based							
2. Non-Mich.based							
F. Other Outside Sources							
G. Institution's Own Funds							
TOTALS (sum of A through G)							

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INSTRUCTIONS FOR FORM B

1. This form asks for a partial breakdown of the direct costs of research and development for the years 1964-65 and 1965-66. The figures for total direct cost expenditures will be less than the totals in Form A inasmuch as Form A will include those indirect costs assumed by the sponsoring agencies.

2. Include costs of fringe benefits, beyond regular wages and salaries, if they can be directly attributed to the costs of separately budgeted research and development.

3. Please note that data is requested for the two periods listed above in the number 1 instruction. A set of "B" forms for each year should be completed.

Financial Form: B-1

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D
BY DIRECT COST ITEMS, FEDERAL SOURCES OF FUNDS, AND FIELD OF SCIENCE
(IN THOUSANDS OF DOLLARS)

INSTITUTION

Year

	Engineering			Life Sciences			Physical Sciences			Social Sciences			Other Sciences		
	Wages and salaries	Equipment	Other direct costs	Wages and salaries	Equipment	Other direct costs	Wages and salaries	Equipment	Other direct costs	Wages and salaries	Equipment	Other direct costs	Wages and salaries	Equipment	Other direct costs
Federal Sources A. Dept. of Defense 1. Air Force															
2. Army															
3. Navy															
4. Other															
B. Atomic Energy Commission															
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. of Health															
2. Publ.Health Serv. other than NIH															
3. Office of Education															
D. Department of Agriculture															
E. Department of Interior															
F. Department of Labor															
G. National Science Foundation															
H. Nat'l Aeronautics and Space Admin.															
I. All Other Federal Agencies															
TOTALS (sum of A through I)															

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Financial Form: B-2

OPERATING EXPENDITURES FOR SEPARATELY BUDGETED R&D
BY DIRECT COST ITEMS, NON-FEDERAL SOURCES OF FUNDS, AND FIELD OF SCIENCE
(IN THOUSANDS OF DOLLARS)

Institution ____________

Year ____________

	Engineering			Life Sciences			Physical Sciences			Social Sciences			Other Sciences		
	Wages and salaries	Equip-ment	Other direct costs	Wages and salaries	Equip-ment	Other direct costs	Wages and salaries	Equip-ment	Other direct costs	Wages and salaries	Equip-ment	Other direct costs	Wages and salaries	Equip-ment	Other direct costs
Non-Federal Sources															
A. State Governments															
B. Local Governments															
C. Voluntary Health Agencies															
D. Foundations															
E. Industries															
1. Mich. based															
2. Non-Mich. based															
F. Other Outside Sources															
G. Institution's Own Funds															
TOTALS (sum of A through G)															

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INSTRUCTIONS FOR FORM C

1. Data will be collected for the years 1964-65 and 1965-66.

2. The request is for funds awarded under the two methods of conveyance, grant and contract, rather than for expenditures under grants and contracts. If data is supplied on the basis of expenditures, please make a note of this on the form.

3. Please note that data is requested for the two periods listed above in the number 1 instruction. A set of "C" forms for each year should be completed.

Financial Data
Form: C-1

FUNDS AWARDED FOR SPONSORED RESEARCH AND DEVELOPMENT THROUGH GRANT OR CONTRACT, BY FEDERAL SOURCES OF FUNDS (IN THOUSANDS OF DOLLARS)

Institution

Year

	Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences incl. Psychology	
Federal Sources	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract
A. Dept. of Defense 1. Air Force										
2. Army										
3. Navy										
4. Other										
B. Atomic Energy Commission										
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst.Health										
2. Publ. Health Serv. other than NIH										
3. Office of Education										
D. Department of Agriculture										
E. Department of Interior										
F. Department of Labor										
G. National Science Foundation										
H. Nat'l Aeronautics and Space Admin.										
I. All Other Federal Agencies										
TOTALS (SUM OF A THROUGH I)										

Financial Data Form: C-2

Institution

Year

FUNDS AWARDED FOR SPONSORED RESEARCH AND DEVELOPMENT THROUGH GRANT OR CONTRACT, BY NON-FEDERAL SOURCES OF FUNDS (IN THOUSANDS OF DOLLARS)

	Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences including Psychology	
	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract
Non-Federal Sources:										
A. State Governments										
B. Local Governments										
C. Voluntary Health Agencies										
D. Foundations										
E. Industries										
1. Michigan based										
2. Non-Michigan based										
F. Other Outside Sources										
TOTALS										

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INSTRUCTIONS FOR FORM D

No further instructions

inancial Data
Form: D-1

Institution

INSTITUTIONAL COST PARTICIPATION IN SEPARATELY BUDGETED R&D PROJECTS SPONSORED BY FEDERAL DEPARTMENTS AND AGENCIES, 1964-65 and 1965-66
(IN THOUSANDS OF DOLLARS)

	1964-65				1965-66			
Federal Sponsors	Total indirect costs to the institution	Indirect costs reimbursed by the sponsor	Unreimbursed indirect costs	Direct costs defrayed by the institution	Total indirect costs to the institution	Indirect costs reimbursed by the sponsor	Unreimbursed indirect costs	Direct costs defrayed by the institution
A. Dept. of Defense 1. Air Force								
2. Army								
3. Navy								
4. Other								
B. Atomic Energy Commission								
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. Health								
2. Publ. Health Serv. other than NIH								
3. Office of Education								
D. Dept. of Agriculture								
E. Dept. of Interior								
F. Dept. of Labor								
G. National Science Foundation								
H. Nat'l Aeronautics and Space Admin.								
I. All Other Federal Agencies								
TOTALS (sum of A through I)								

Financial Data Form: D-2

Institution

INSTITUTIONAL COST PARTICIPATION IN SEPARATELY BUDGETED R&D PROJECTS
SPONSORED BY NON-FEDERAL DEPARTMENTS AND AGENCIES, 1964-65 and 1965-66
(IN THOUSANDS OF DOLLARS)

	1964-65				1965-66			
	Total indirect costs to the institution	Indirect costs reimbursed by the sponsor	Unreimbursed indirect costs	Direct costs defrayed by the institution	Total indirect costs to the institution	Indirect costs reimbursed by the sponsor	Unreimbursed indirect costs	Direct costs defrayed by the institution
Non-Federal Sponsors								
A. State Governments								
B. Local Governments								
C. Voluntary Health Agencies								
D. Foundations								
E. Industries								
1. Michigan based								
2. Non-Mich. based								
F. Other Outside Sources								
TOTALS								

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INSTRUCTIONS FOR FORM E

The amounts of funds entered here would also be included in appropriate categories of Federal Sources of funds in Form A. They are extracted as a means of indicating the development of this particular pattern of support.

Financial Data Form: E

Institution

BROAD FORMS OF SCIENCE SUPPORT BY FEDERAL AGENCIES
(IN THOUSANDS OF DOLLARS)

	1957-58	1960-61	1963-64	1964-65	1965-66
National Institutes of Health (General Research Support Grants)					
National Science Foundation (Institutional Base Grants)					
National Aeronautics and Space Administration (Sustaining University Grants)					
TOTALS					

INSTRUCTIONS FOR FORM F

1. Exclude expenditures from the General Fund or from Expendable Gift Funds reported under "Institution's Own Funds" for Separately Budgeted Research in Form A.

2. Exclude expenditures from the General Fund or from Expendable Gift Funds reported under "Institution's Own Funds" for Projects for the Support or Improvement of Science Education in Form J.

3. Percentage estimates for departmental research as a percent of Total Expenditures for Instruction and Departmental Research will be sufficient. It is recognized that the accounting systems of institutions of higher education may not yield an exact breakdown between expenditures for instruction and expenditures for departmental research. However, estimates of the proportion of faculty time devoted to non-separately budgeted research may serve as a useful guideline in estimating the share of departmental expenditures allocable to departmental research.

   Note: The time spent by faculty or other staff members in supervising the thesis work of graduate students should be reported as an expenditure for instruction, not for departmental research.

4. Current expenditures for instruction and departmental research in the sciences and engineering represent direct expenditures incurred by an institution in carrying out these functions. An estimate of the overhead or indirect costs associated with these direct expenditures would include an appropriate share of the institution's expenditures for general administration, student services, libraries, and the operation and maintenance of physical plant.

Financial Data Form: F-1

Institution ______

GENERAL FUND EXPENDITURES FOR INSTRUCTION AND DEPARTMENTAL RESEARCH BY FIELD OF SCIENCE (IN THOUSANDS OF DOLLARS)

	1957-58		1960-61		1963-64		1964-65		1965-66	
	Total expenditures	Dept. research as % of total expenditures	Total expenditures	Dept. research as % of total expenditures	Total expenditures	Dept. research as % of total expenditures	Total expenditures	Dept. research as % of total expenditures	Total expenditures	Dept. research as % of total expenditures
Fields of Science										
Engineering										
Physical Sciences										
Life Sciences										
Social Sciences										
Psychology										
Other Sciences										

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Financial Data Form: F-2

Institution

EXPENDABLE GIFT (RESTRICTED) FUNDS USED FOR INSTRUCTION AND DEPARTMENTAL RESEARCH BY FIELD OF SCIENCE (IN THOUSANDS OF DOLLARS)

	1957-58		1960-61		1963-64		1964-65		1965-66	
	Total of funds used	Dept. research as % of total funds	Total of funds used	Dept. research as % of total funds	Total of funds used	Dept. research as % of total funds	Total of funds used	Dept. research as % of total funds	Total of funds used	Dept. research as % of total funds
Fields of Science										
Engineering										
Physical Sciences										
Life Sciences										
Social Sciences										
Psychology										
Other Sciences										

ESTIMATED DOLLAR AMOUNT OF OVERHEAD (OR INDIRECT COSTS) ALLOCABLE TO THE INSTRUCTION AND DEPARTMENTAL RESEARCH ACTIVITIES FUNDED BY THE GENERAL FUND AND EXPENDABLE GIFT FUNDS (IN THOUSANDS OF DOLLARS)

	1957-58	1960-61	1963-64	1964-65	1965-66
Overhead Allocable to Instruction and Departmental Research					

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INSTRUCTIONS FOR FORM G

1. Data will be collected for each year from 1956-57 through 1965-66.

2. For any given year, report funds expended on plant and facilities on the basis of the cost of plant and facilities completed and put into use during that year. Report equipment expenditures on the basis of equipment first used during that year.

3. Include expenditures on
   (a) new plant and facilities or major renovations of them;
   (b) initial or original equipment in the new or renovated plant and facilities;
   (c) equipment replacements or additions

4. Exclude equipment expenditures made from the Institution's fund for Instruction and Departmental Research. (Report on Form H)

5. Exclude equipment expenditures made from special funds earmarked for the purchase of equipment for the support or improvement of science education. (Report on Form J)

6. Expenditures for administration buildings, steam plants, residence halls, and other such facilities should be excluded unless utilized principally for research, development, or instruction in engineering or in the sciences. Land costs should be excluded.

7. Facilities and equipment expenditures include the following: (a) fixed equipment such as built-in equipment and furnishings (hoods, fixed laboratory tables and benches, and ventilation equipment); (b) movable scientific equipment such as oscilloscopes, pulse-height analyzers, spectrometers, and plasma and protein separators; (c) movable furnishings such as bookcases, desks, file cabinets, tables, and simple tools; (d) architect's fees, site work, extension of utilities, and the building costs of service functions such as integral cafeterias and bookstores of a facility; and (e) special separate facilities used to house scientific apparatus such as hypersonic tunnels, accelerators, and oceanographic vessels.

(Instructions for Form G - page 2)

8. Capital expenditures should be divided into two parts: (1) R&D and graduate instruction and (2) undergraduate instruction. Prorate capital expenditures for multi-purpose structures. The space utilized for particular functions may be used as a guide in prorating. Thus, if 50 percent of the total square footage of a science building is allocated to R&D and graduate instruction, the remaining 50 percent to undergraduate instruction, then capital expenditures should be distributed accordingly between these two functions. The following guidelines may be helpful in determining the functional usage of space:

   (1) Research and development (R&D) are described in the General Instructions. Graduate instruction is a course of study which is given to or offered primarily for students who have attained a first-level degree and is designed to lead to a second-level or doctoral degree in a given field. Included is post-doctoral education which is defined as advanced training beyond the Ph.D. or Sc.D. degree, as well as the training of interns and residents.

   (2) Undergraduate instruction is a course of study designed to lead to the first-level (Bachelor's or first professional) degree in a given field. Instruction of students enrolled in a medical school for the purpose of attaining the M.D. degree should be classified as undergraduate instruction.

9. Please note that data is requested for the ten periods indicated above in the number 1 instruction. A set of forms should be completed for each year: 1956-57, 1957-58, 1958-59, 1959-60, 1960-61, 1961-62, 1962-63, 1963-64, 1964-65, 1965-66.

10. Funds spent on computer facilities used in research in several areas of science should be entered under "Other Sciences." If possible, indicate on the form the funds spent on these facilities.

Financial Data
Form: G-1

CAPITAL EXPENDITURES FOR FACILITIES AND EQUIPMENT FOR RESEARCH, DEVELOPMENT, AND INSTRUCTION BY FEDERAL SOURCES OF FUNDS, FIELD OF SCIENCE, AND PURPOSE (IN THOUSANDS OF DOLLARS)

______ Institution

______ (Year facility completed and equipment first used)

	Field of Science and Purpose											
	Engineering		Physical Science		Life Sciences		Social Sciences		Psychology		Other Sciences Please Specify	
Federal Sources	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.
A. Dept. of Defense 1. Air Force												
2. Army												
3. Navy												
4. Other												
B. Atomic Energy Commission												
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. Health												
2. Publ. Health Serv. other than NIH												
3. Office of Education												
D. Department of Agriculture												
E. Department of Interior												
F. Department of Labor												
G. National Science Foundation												
H. Nat'l Aeronautics and Space Admin.												
I. All Other Federal Agencies												
TOTALS (sum of A through I)												

Financial Data
Form: G-2

CAPITAL EXPENDITURES FOR FACILITIES AND EQUIPMENT FOR RESEARCH, DEVELOPMENT, AND INSTRUCTION BY NON-FEDERAL SOURCES OF FUNDS, FIELD OF SCIENCE, AND PURPOSE
(IN THOUSANDS OF DOLLARS)

Institution ______

(Year facility completed and equipment first used) ______

	Fields of Science and Purpose											
	Engineering		Physical Sciences		Life Sciences		Social Sciences		Psychology		Other Sciences Please specify	
Non-Federal Sources	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.	R&D and Grad. Instr.	Under-grad. Instr.
A. State Government Capital Appropriations												
B. Local Governments												
C. Voluntary Health Agencies												
D. Foundations												
E. Industries												
1. Michigan based												
2. Non-Mich.based												
F Other Outside Sources												
G. Institution's Own Funds												
TOTALS (sum of A through G)												

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INSTRUCTIONS FOR FORM H

1. Report all expenditures for equipment made from funds for Instruction and Departmental Research.

2. Employ the definitions used by your institution to distinguish between equipment and supplies.

Financial Data Form: H

Institution

EQUIPMENT PURCHASES FOR RESEARCH, DEVELOPMENT AND INSTRUCTION
FROM THE INSTITUTION'S EXPENDITURES FOR INSTRUCTION AND DEPARTMENTAL RESEARCH
BY SCIENCE FIELD AND YEAR OF PURCHASE

	Totals	1957-58	1960-61	1963-64	1964-65	1965-66
Fields of Science						
Engineering						
Physical Sciences						
Life Sciences						
Social Sciences						
Psychology						
Other Sciences						
Totals						

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INSTRUCTIONS FOR FORM I

1. Data will be collected for the years 1957-58, 1960-61, 1963-64, 1964-65, and 1965-66.

2. Data will be collected on graduate fellowships and scholarships on Forms I-1 and I-2. Include in graduate fellowships and scholarships essentially non-duty grants made to students who were pursuing a degree beyond the bachelors or beyond a first professional degree.

3. Under traineeship awards and supporting training grants, enter in appropriate places the funds awarded to both graduate and undergraduate students. This data will be collected on Forms I-3 and I-4.

4. In the amounts of funds entered, include family allowances and compensation granted to the institution in lieu of tuition and other charges, as well as personal stipends to individuals.

5. Define No. (number) of awards in terms of the number of individuals receiving fellowships and scholarships or traineeships.

6. If only totals, and not a complete breakdown, of data are available, please enter the totals in appropriate places.

7. Please note that data is requested for the five periods listed above in the number 1 instruction. A set of "I" forms for each year should be completed.

8. The abbreviations "U" and "G" which are placed beside the Federal and Non-Federal sources stand for Undergraduate and Graduate.

Financial Data
Form: I-1

Institution ____________

Year ____________

NUMBER OF AWARDS TO INDIVIDUALS AND AMOUNT OF FUNDS EXPENDED
FOR GRADUATE FELLOWSHIPS AND SCHOLARSHIPS
BY FEDERAL SOURCES OF FUNDS AND FIELD OF SCIENCE
(IN HUNDREDS OF DOLLARS)

	Totals		Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences incl. Psychology	
	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent
Federal Sources												
A. Department of Defense												
B. Atomic Energy Commission												
C. Department of Health, Education, & Welfare 1. National Institutes of Health												
2. Public Health Services other than NIH												
3. Office of Education												
D. Department of Agriculture												
E. National Science Foundation												
F. National Aeronautics and Space Admin.												
G. All Other Federal Agencies												
Totals												

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Financial Data
Form: I-2

Institution

Year

NUMBER OF AWARDS TO INDIVIDUALS AND AMOUNT OF FUNDS EXPENDED
FOR GRADUATE FELLOWSHIPS AND SCHOLARSHIPS
BY NON-FEDERAL SOURCES OF FUNDS AND FIELD OF SCIENCE
(IN HUNDREDS OF DOLLARS)

	Totals		Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences incl. Psychology	
	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent
Non-Federal Sources												
A. State Government												
B. Local Governments												
C. Voluntary Health Agencies												
D. Foundations												
E. Industries												
1. Michigan based												
2. Non-Mich. based												
F. Other Outside Sources												
G. Institution's Own Funds												
Totals												

BEST COPY AVAILABLE

Financial Data
Form: I-3

Institution ______

Year ______

NUMBER OF AWARDS TO INDIVIDUALS AND AMOUNT OF FUNDS EXPENDED FOR TRAINEESHIPS AND SUPPORTING TRAINING GRANTS, UNDERGRADUATE AND GRADUATE, BY FEDERAL SOURCES OF FUNDS AND FIELD OF SCIENCE (IN HUNDREDS OF DOLLARS)

		Totals		Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences incl. Psychology	
Federal Sources		No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent
A. Dept. of Defense	U.												
	G.												
B. Atomic Energy Commission	U.												
	G.												
C. Dept. of Health Educ. & Welfare													
1. Nat'l Inst. of Health	U.												
	G.												
2. Publ. Health Serv. Other than NIH	U.												
	G.												
3. Office of Education	U.												
	G.												
D. Department of Agriculture	U.												
	G.												
E. National Science Foundation	U.												
	G.												
F. Nat'l Aeronautics and Space Admin.	U.												
	G.												
G. All Other Federal Agencies	U.												
	G.												
Totals	U.												
	G.												

Financial Data
Form: I-4

Institution

Year

NUMBER OF AWARDS TO INDIVIDUALS AND AMOUNT OF FUNDS EXPENDED FOR TRAINEESHIPS AND SUPPORTING TRAINING GRANTS, UNDERGRADUATE AND GRADUATE, BY NON-FEDERAL SOURCES OF FUNDS AND FIELD OF SCIENCE (IN HUNDREDS OF DOLLARS)

		Totals		Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences incl. Psychology	
		No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent	No.	Amount Spent
Non-Federal Sources													
A. State Government	U.												
	G.												
B. Local Governments	U.												
	G.												
C. Voluntary Health Agencies	U.												
	G.												
D. Foundations	U.												
	G.												
E. Industries 1. Michigan based	U.												
	G.												
2. Non-Mich. based	U.												
	G.												
F. Other Outside Sources	U.												
	G.												
G. Institution's Own Funds	U.												
	G.												
Totals Undergraduate													
Graduate													

INSTRUCTIONS FOR FORM J

1. Include expenditures on special programs, such as support for instructional equipment; institutes for science, mathematics and engineering teachers; research participation and science activities for teachers; science education for students; and course content improvement.

2. Exclude expenditures in support of science education from the Institution's Own Funds unless they are for a specially organized and budgeted program for improvement. Do not include an expenditure under both Form J and Form F (Expenditures for Instruction and Departmental Research).

Financial Data
Form: J-1

Institution

FUNDS FOR SPECIALLY ORGANIZED PROJECTS FOR THE SUPPORT OR IMPROVEMENT OF SCIENCE EDUCATION, BY FEDERAL SOURCES (IN THOUSANDS OF DOLLARS)

Exclude funds included under Expenditures for Separately Budgeted R&D, Capital Expenditures, and Funds for Fellowships, Scholarships and Traineeships

Federal Sources	1961-62		1962-63		1963-64		1964-65		1965-66	
	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects
A. Dept. of Defense 1. Air Force										
2. Army										
3. Navy										
4. Other										
B. Atomic Energy Commission										
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. Health										
2. Publ.Health Serv. other than NIH										
3. Office of Education										
D. Department of Agriculture										
E. Department of Interior										
F. Department of Labor										
G. National Science Foundation										
H. Nat'l Aeronautics and Space Admin.										
I. All Other Federal Agencies										
Totals (Sum of A through I)										

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Financial Data
Form : J-2

Institution

FUNDS FOR SPECIALLY ORGANIZED PROJECTS FOR THE SUPPORT
OR IMPROVEMENT OF SCIENCE EDUCATION, BY NON-FEDERAL SOURCES
(IN THOUSANDS OF DOLLARS)

Exclude funds included under Expenditures for Separately Budgeted R&D, Capital Expenditures, and Funds for Fellowships, Scholarships, and Traineeships

	1961-62		1962-63		1963-64		1964-65		1965-66	
	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects	Equip. for Instr.	Other educat'l projects
Non-Federal Sources										
A. State Government										
B. Local Governments										
C. Voluntary Health Agencies										
D. Foundations										
E. Industries										
1. Michigan based										
2. Non-Mich. based										
F. Other Outside Sources										
G. Institution's Own Funds										
Totals										

GENERAL INSTRUCTIONS FOR PROVIDING DATA TO COMPLETE THE PERSONNEL DATA FORMS

1. This survey covers personnel involved in science research, development, and educational programs of all branches and other units of the twelve parent institutions both on and off the main campuses. Research centers managed by universities for the Federal Government are to be included.

2. Reasonable estimates will be satisfactory in the case of those items for which more precise information is not available from records normally maintained by your institution. If totals for data have been maintained in the records, even though detailed breakdowns are not available, please enter the appropriate totals where they are requested. Enter "not available," "not applicable," or "none" where appropriate.

3. Enter data for the period during the academic year which is the most typical or representative period of the year for which data is available. If a time period is indicated on the form, approach this as closely as the availability of data permits.

4. Include under teaching faculty and staff those persons who normally carry on teaching activity as part of their regular duties. Other activities of the teaching faculty may include research and administration related to instruction. Teaching encompasses activities connected with degree credit courses or which are intended to lead ultimately to the granting of degrees or certificates or to professional certification or licensing. In determining those who are full-time members of the teaching staff exclude those persons who are included in the category of Professional Staff with Research Appointment even though such persons may engage in some instructional function incidental to their research activities.

5. Include in the category of Professional Staff with Research Appointments those persons with at least a bachelor's degree who are specifically designated by the college or university as occupying research positions and who engage directly in research or development, or the administration of it.

6. Undergraduate instruction is a course of study designed to lead to the first-level (Bachelor's or first professional) degree in a given field. Instruction of students enrolled in a medical school for the purpose of attaining the M.D. degree should be classified as undergraduate instruction. Graduate students enrolled in a course designated and primarily offered for undergraduates shall contribute to the figure of undergraduate student credit hours in Form B.

7. Graduate instruction is a course of study which is given to or offered primarily, but not necessarily exclusively, for students who have attained a first-level degree and is designed to lead to a second level or doctoral degree in a given field. Instruction to persons in such courses of study who have already received a professional or doctorate degree will be included within the definition of graduate study. Undergraduates enrolled in courses designated and primarily offered for graduate students shall contribute to the figure of graduate student credit hours in Form B.

8. The reporting institution is requested to use its own definition of what constitutes full-time and part-time employment. In estimating the full-time equivalents of part-time personnel, each institution should use its own definition of such equivalents.

9. The classification of disciplines in the various fields of science which are necessary for the completion of certain of the personnel forms should follow the chart on the following page of these instructions labeled "Classification of Fields."

CLASSIFICATION OF FIELDS

A. ENGINEERING

- Aerospace
- Agricultural
- Architectural
- Chemical
- Civil
- Electrical
- Engineering Graphics
- Engineering Mechanics
- Geological
- Industrial
- Mechanical
- Metallurgical
- Meteorology and Oceanography
- Mining
- Naval Architecture and Marine Engineering
- Other Engineering Fields

B. PHYSICAL SCIENCES

- Astronomy
- Chemistry
- Geography (physical)
- Geology
- Geophysics
- Mathematics and Mathematical Statistics
- Metallurgy
- Mineralogy
- Physics
- Other physical sciences

C. LIFE SCIENCES

a) Biological Sciences

- Anatomy
- Anthropology (physical)
- Bacteriology
- Biochemistry
- Biology
- Biophysics
- Botany
- Entomology
- Genetics
- Microbiology
- Nutrition
- Paleontology
- Pathology
- Pharmacology
- Physiology
- Zoology
- Other biological sciences

b) Agricultural Sciences

- Animal Husbandry
- Crops
- Dairy Husbandry
- Fisheries
- Food Technology
- Forestry
- Horticulture
- Range Management
- Soils
- Wildlife
- Other agricultural fields (except agricultural engineering and agricultural economics: see categories A and E)

c) Medical Sciences

- Anesthetics
- Community Health Service
- Dermatology
- Environmental Health
- Epidemiology
- Health Development
- Industrial Health
- Internal Medicine
- Neurology
- Obstetrics & Gynecology
- Ophthalmology
- Otolaryngology
- Pediatrics
- Pharmacy
- Psychiatry
- Public Health
- Radiology
- Surgery
- Other clinical sciences

D. PSYCHOLOGY

- Social Psychology
- Other Psychology

E. SOCIAL SCIENCES

- Agricultural Economics
- Anthropology (social)
- Economics
- Geography (econ. and social)
- Political Science
- Sociology
- Other social sciences (excluding history)

F. OTHER SCIENCES

This category includes sciences which cannot be readily classified under one of the above named fields, but excludes most of the areas generally included in education, accounting, business administration, history, home economics, law, and library science.

INSTRUCTIONS FOR PERSONNEL FORM A

1. Include the number of students who are enrolled as undergraduate or graduate majors in all departments within each of the fields of science. Include those enrolled in regularly scheduled courses for definite credit and those earning variable credit in scheduled or non-scheduled work.

2. No individual should be counted more than once. The count is of individuals as majors, not of enrollments in courses.

3. Enter data for a single point in time during the academic year. Select that period which will provide data most representative for the year and for which data is available.

Personnel Form A

Institution

ENROLLMENTS BY MAJORS FOR FALL TERM OR SEMESTER,
UNDERGRADUATE AND GRADUATE
BY YEAR AND BY FIELD OF SCIENCE

Year		Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
1957-58	U G T							
1960-61	U G T							
1963-64	U G T							
1964-65	U G T							
1965-66	U G T							

U = Undergraduate
G = Graduate
T = Total

INSTRUCTIONS FOR PERSONNEL FORM B

1. Student credit hours are computed by multiplying the credits earned per student in a course by the enrollment.

2. Enter all student credit hours produced during the year, including those in summer and off-campus work.

Personnel
Form B

Institution

STUDENT CREDIT HOURS TAUGHT
UNDERGRADUATE AND GRADUATE
BY YEAR AND BY FIELD OF SCIENCE

Year		Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
1957-58	U							
	G							
	T							
1960-61	U							
	G							
	T							
1963-64	U							
	G							
	T							
1964-65	U							
	G							
	T							
1965-66	U							
	G							
	T							

U = Undergraduate
G = Graduate
T = Total

INSTRUCTIONS FOR PERSONNEL FROM C

1. Enter the full-time equivalent number of persons who are employed on the teaching staff in the various fields of science and are paid from the General Fund. Two persons employed half time by the college or university would, for example, be counted as one full time equivalent person. The college's or university's definition of full-time and part-time employment will be acceptable as a basis for computation.

2. Members of the teaching staff may carry on research and provide direct administration of the teaching function as part of their duties. The time given to research should be excluded (1) if the terms of appointment for an individual specifically designate a proportion of his total time in a research position, or (2) if a proportion of his time is designated for research on a current project and is supported by funds contained in a separately budgeted account. The time given to administration should be excluded only if it is related to a non-instructional function.

3. Any time spent in teaching by persons in the category of Professional Staff with Research Appointments should be included in computing the full-time equivalent teaching staff if that time can be identified and if the person on Research Appointment contributes to student credit hours recorded by the institution.

4. Enter data for a single point in time during the academic year. Select that period which will provide data most representative for the year and for which data is available.

Personnel
Form C

FULL TIME EQUIVALENT TEACHING STAFF PAID FROM GENERAL FUND BY YEAR AND BY FIELD OF SCIENCE

Year		Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
1957-58	P - I Other Total							
1960-61	P - I Other Total							
1963-64	P - I Other Total							
1964-65	P - I Other Total							
1965-66	P - I Other Total							

P - I = Includes Professor through Instructor levels
Others = Includes Lecturer, Assistant Instructor, Graduate Teaching Assistant, Teaching Fellow

INSTRUCTIONS FOR PERSONNEL FORM D

1. The definition of teaching staff shall be that put forth in the General Instructions.

2. Exclude persons employed part-time, most notably graduate students who as teaching fellows or graduate teaching assistants are not full-time employees.

3. If a member of the teaching staff who is a full-time employee of the institution receives part of his salary from a non-General Fund source, either Federal or non-Federal, in order to carry on science research or education, he should be counted under "Total Number of Staff" but excluded from the category, "Number Paid Totally from General Fund."

4. The term "Salary" refers to the basic salary paid from institutional and/or outside sources which is designated by the institution as the individual's compensation for the performance of normal duties. Excluded is compensation for teaching or research during the summer, whether the summer compensation came from institutional or outside sources. Excluded are any supplements to the basic salary which are received during the academic year from outside sources for consultation or the conduct of research beyond the normal and regular duties.

5. Enter data for a single point in time during the academic year. Select that period which will provide data most representative for the year and for which data is available.

6. The percentage figure need not be calculated and entered if figures on Total Number of Staff and Number Paid Totally from the General Fund are entered.

Personnel Form D

Number and Percent of Teaching Staff Employed Full Time Receiving Their Total Salary from the General Fund (GF) by Year, Rank, and Field of Science

Institution

	Engineering			Physical Sciences			Life Sciences			Social Sciences			Psychology			Other Sciences			Totals		
	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF	Total No.of Staff	No.pd. tot'ly fromGF	% pd. tot'ly fromGF
1957-58 Prof.																					
Assoc.prof.																					
Asst.prof.																					
Instructor																					
Other																					
Total																					
1960-61 Prof.																					
Assoc.prof.																					
Asst.prof.																					
Instructor																					
Other																					
Total																					
1963-64 Prof.																					
Assoc.prof.																					
Asst.prof.																					
Instructor																					
Other																					
Total																					
1964-65 Prof.																					
Assoc.prof.																					
Asst.prof.																					
Instructor																					
Other																					
Total																					
1965-66 Prof.																					
Assoc.prof.																					
Asst.prof.																					
Instructor																					
Other																					
Total																					

INSTRUCTIONS FOR PERSONNEL FORM E

1. The definition of teaching staff shall be that put forth in the General Instructions.

2. The term "Salary" refers to the basic salary paid from institutional and/or outside sources which is designated by the institution as the individual's compensation for the performance of normal duties. Excluded is compensation for teaching or research during the summer, whether summer compensation came from institutional or outside sources. Excluded are any supplements to the basic salary which are received during the academic year from outside sources for consultation or the conduct of research beyond the normal and regular duties.

3. The amount of the salaries, paid to members of the teaching staff who are full-time employees of the institution, which comes from a non-General Fund source, either Federal or non-Federal, should be included in "Total Salaries" but should be excluded from "Amount from General Fund."

4. The percentage figure need not be calculated and entered if the figures on Total Salaries and Amount from General Fund are both entered.

Personnel Form E

Percent of Total Salaries of Teaching Staff Employed Full Time
Coming from the General Fund (GF)
by Year and by Field of Science

Institution

	Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
1957-58 Total salaries							
Amt. from GF							
% from GF							
1960-61 Total salaries							
Amt. from GF							
% from GF							
1963-64 Total salaries							
Amt. from GF							
% from GF							
1964-65 Total salaries							
Amt. from GF							
% from GF							
1965-66 Total Salaries							
Amt. from GF							
% from GF							

INSTRUCTIONS FOR PERSONNEL FORM F

1. The aim of Form F is to obtain for a single academic year a breakdown of salaries (exclusive of extra compensation which is paid for summer teaching, research, or other activity) of the members of the teaching staff employed full time, by source of the salaries. Apart from funds included under the category "Institution's Own Funds" (G of Non-Federal Sources), the funds from which salaries are paid would come from grants, contracts, or restricted gifts made to the colleges or universities for special research or educational projects.

2. The definition of teaching staff shall be that put forth in the General Instructions.

3. Some definitions of funding units employed in the study.

   a. In reporting salaries paid from Federal funds expended within the category of "Federal Sources," include those Federal funds channeled through State agencies.

   b. Under "State Governments," include only salaries paid from funds designated or "earmarked" for special R&D or educational projects by the state government and its agencies. Exclude salaries paid from general purpose appropriations by the legislature to the institution.

   c. Under "Local Governments," include salaries paid from funds from county, municipal, or other local governments and their agencies.

   d. Under "Foundations" include salaries paid from funds received from non-profit philanthropic foundations and trusts not affiliated with your institution, such as the Carnegie, Ford, Kresge, or Rockefeller Foundations. Salaries paid from funds of foundations which are affiliated with, or grant solely to, your institution should be included under "Institution's Own Funds", unless such funds were earmarked for a separately budgeted R&D or educational project by the original source and the foundation serves primarily as an accounting agency.

(continued)

(Instructions for Personnel Form F)

e. Under "Voluntary Health Agencies" include salaries paid from funds received from voluntary health agencies, such as the American Cancer Society and the American Heart Association. Salaries paid from funds specifically designated for R&D or an educational project and derived from a health agency that is a unit of a State or local government should be reported under "State" or "Local Government." Salaries paid from funds from professional societies such as the American Medical Association and the American Dental Association should be reported under "Other Outside Sources."

f. Under "Industries" (including trade associations) include all salaries paid from funds received from profit-making organizations, whether engaged in production, distribution, research, service, or other activities. Do not include salaries paid from grants and contracts from non-profit foundations financed by industry, which should be reported under "Foundations." Include under "Michigan based" industries not only those with home offices in Michigan, but those which carry on within the state one of the profit-making, economic activities noted above.

g. Under "Other Outside Sources" report salaries paid from any additional funds received from outside sources other than those already noted, and which were earmarked for R&D or an educational project by the source. Examples include gifts, grants, or contracts received from private individuals or professional societies.

h. Under "Institution's Own Funds, 2. Other Funds," include salaries paid from any funds, apart from the General Fund, the use of which the college or university was free to designate.

Personnel Form F
p. 1

Institution ____________

Amounts of the Salaries of Teaching Staff Employed Full Time
Paid by Federal Sources
Py Field of Science for the Year 1965-66
(In Thousands of Dollars)

Federal Sources	Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
A. Dept. of Defense 1. Air Force							
2. Army							
3. Navy							
4. Other							
B. Atomic Energy Commission							
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. of Health							
2. Publ.Health Ser. other than NIH							
3. Office of Education							
D. Department of Agriculture							
E. Department of the Interior							
F. Department of Labor							
G. National Science Foundation							
H. Nat'l Aeronautics and Space Admin.							
I. All Other Federal Agencies							
TOTALS							

Personnel Form F
p. 2

Institution

Amounts of the Salaries of Teaching Staff Employed Full Time
Paid by Non-Federal Sources
By Field of Science for the Year 1965-66
(In Thousands of Dollars)

	Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
Non-Federal Sources							
A. State Government							
B. Local Governments							
C. Voluntary Health Agencies							
D. Foundations							
E. Industries							
1. Michigan based							
2. Non-Mich. based							
F. Other Outside Sources							
G. Institution's Own Funds							
1. General Fund							
2. Other Funds							
TOTALS							

INSTRUCTIONS FOR PERSONNEL FORM G

1. Professional Staff includes those with at least a Bachelor's degree or its equivalent.

2. The term, "Research Appointment," shall apply to those who are specifically designated by the college or university as occupying research positions and who engage directly in research or development, or the administration of it. Any time given to teaching by members of the Professional Staff with Research Appointments should be excluded in computing full time equivalent research contributions if (1) the terms of appointment for an individual specifically designate a proportion of his total time to be used in a teaching capacity; or (2) by formal arrangement he assumes teaching responsibility and contributes to student credit hours recorded by the institution.

3. The proportion of the time of an individual on the teaching staff or faculty, which is designated by terms of his appointment to be spent in research, shall be included in the computation of the full-time equivalent of Professional Staff with Research Appointments.

4. Graduate students working toward a higher degree should be included only if they are <u>not</u> designated as graduate assistants.

5. Under the Number (No.) column, enter only a <u>total</u> figure. This figure would include a count of all professional staff with research appointments whether employed full or part time.

6. Enter data for a single point in time during the academic year. Select that period which will provide data most representative for the year and for which data is available.

Personnel Data
Form G

Institution

NUMBER AND FULL TIME EQUIVALENT PROFESSIONAL STAFF
WITH RESEARCH APPOINTMENTS (EXCLUSIVE OF GRADUATE ASSISTANTS)
BY YEAR AND BY SOURCE OF FUNDS FOR SUPPORT

	Engineering		Physical Sciences		Life Sciences		Social Sciences		Psychology		Other Sciences		Totals	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
1957-58														
General Fund														
Other Funds														
Total														
1960-61														
General Fund														
Other Funds														
Total														
1963-64														
General Fund														
Other Funds														
Total														
1964-65														
General Fund														
Other Funds														
Total														
1965-66														
General Fund														
Other Funds														
Total														

INSTRUCTIONS FOR PERSONNEL FORM H

1. Use the definitions of Professional Staff with Research Appointments put forth in the General Instructions and in Instructions for Personnel Form G.

2. Use the definitions of funding units put forth in Instructions for Personnel Form F.

Institution

Personnel Form H
p. 1

Amounts of the Salaries of the Full Time Equivalent Professional Staff With Research Appointments (Exclusive of Graduate Assistants) Paid by Federal Sources By Field of Science for the Year 1965-66 (In Thousands of Dollars)

	Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
Federal Sources A. Dept. of Defense 1. Air Force							
2. Army							
3. Navy							
4. Other							
B. Atomic Energy Commission							
C. Dept. of Health Educ. & Welfare 1. Nat'l Instit. of Health							
2. Pub.Health Ser. other than NIH							
3. Office of Education							
D. Department of Agriculture							
E. Department of the Interior							
F. Department of Labor							
G. National Science Foundation							
H. Nat'l Aeronautics and Space Admin.							
I. All Other Federal Agencies							
TOTALS							

Institution

Personnel Form H
p. 2

Amounts of the Salaries of the Full Time Equivalent Professional Staff
With Research Appointments (Exclusive of Graduate Assistants)
Paid by Non-Federal Sources
By Field of Science for the Year 1965-66
(In Thousands of Dollars)

BEST COPY AVAILABLE

	Engineering	Physical Sciences	Life Sciences	Social Sciences	Psychology	Other Sciences	Totals
Non-Federal Sources							
A. State Governments							
B. Local Governments							
C. Voluntary Health Agencies							
D. Foundations							
E. Industries							
1. Michigan based							
2. Non-Mich.based							
F. Other Outside Sources							
G. Institution's Own Funds							
1. General Fund							
2. Other Funds							
Totals							

INSTRUCTIONS FOR PERSONNEL FORM I

1. Enter the number of each category of graduate assistant paid by the Institution's Own Funds or Other Funds. Under Other Funds include Federal Funds or non-Federal Funds from outside the college or university.

2. Do not include students doing graduate work who were employed on a basis considered by the college or university to be full time.

3. Include Graduate Teaching Fellows under the category of Graduate Teaching Assistant (Grad. Tch. Asst.). If a graduate student is a full time teacher, include him in the proper category in Forms D and E.

4. Include under Graduate Research Assistant (Grad. Res. Asst.) those who were specially designated primarily to do research and were actively engaged in it. If a graduate student is employed as a full-time researcher include him in Forms G and H.

5. Include under Other Graduate Assistants those whose employment was neither clearly instructional (teaching) nor research in nature. A graduate student employed full time with mixed duties should be included in either Form D or G, dependent upon whether his activities are weighted toward instruction or toward research.

6. Enter data for a single point in time during the academic year. Select that period which will provide data most representative for the year and for which data is available.

Personnel Data
Form I

Institution ______________

NUMBER OF GRADUATE ASSISTANTS AND
GRADUATE TEACHING FELLOWS
BY YEAR, SOURCE OF SUPPORT, AND FIELD OF SCIENCE

BEST COPY AVAILABLE

	1957-58		1960-61		1963-64		1964-65		1965-66	
	Instit. Own Funds	Other Funds	Instit. Own Funds	Other Funds	Instit. Own Funds	Other Funds	Instit. Own Funds	Other Funds	Instit. Own Funds	Other Funds
Engineering										
Grad. Tch. Asst.										
Grad. Res. Asst.										
Other Grad. Asst.										
Physical Sciences										
Grad. Tch. Asst.										
Grad. Res. Asst.										
Other Grad. Asst.										
Life Sciences										
Grad. Tch. Asst.										
Grad. Res. Asst.										
Other Grad. Asst.										
Social Sciences										
Grad. Tch. Asst.										
Grad. Res. Asst.										
Other Grad. Asst.										
Psychology										
Grad. Tch. Asst.										
Grad. Res. Asst.										
Other Grad. Asst.										
Other Sciences										
Grad. Tch. Asst.										
Grad. Res. Asst.										
Other Grad. Asst.										
Total										

INSTRUCTIONS FOR PERSONNEL FORM J

1. The aim of this form is to obtain for a given period within one academic year (1965-66) the breakdown of the number of graduate assistants and teaching fellows paid from various sources of support.

2. Include Teaching Fellows under Teaching Assistants (Tch.Asst.). Employ the same bases as were used in Form I in distinguishing Research Assistants (Res. Asst.) and Other Graduate Assistants (Other).

3. Use the definitions of funding units put forth in Instructions for Personnel Form F.

4. Enter data for a single point in time during the academic year. Select that period which will provide data most representative for the year and for which data is available.

Personnel Form J
p. 1

BEST COPY AVAILABLE

Institution

Number of Graduate Assistants and Graduate Teaching Fellows
Paid from Federal Funds 1965-1966
By Field of Science and Source of Funds

	Engineering			Physical Sciences			Life Sciences			Social Sciences			Psychology			Other Sciences			Totals		
	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other
Federal Sources A. Dept. of Defense 1. Air Force																					
2. Army																					
3. Navy																					
4. Other																					
B. Atomic Energy Commission																					
C. Dept. of Health Educ. & Welfare 1. Nat'l Inst. of Health																					
2. Pub. Health Ser. Other than NIH																					
3. Office of Education																					
D. Department of Agriculture																					
E. Department of the Interior																					
F. Department of Labor																					
G. National Science Foundation																					
H. Nat'l Aeronautics and Space Admin.																					
I. All Other Federal Agencies																					
Totals																					

Personnel Form J
p. 2

Institution ____________

Number of Graduate Assistants and Graduate Teaching Fellows
Paid from Non-Federal Funds 1965-1966
By Field of Science and Source of Funds

	Engineering			Physical Sciences			Life Sciences			Social Sciences			Psychology			Other Sciences			Totals		
	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other	Tch. Asst.	Res. Asst.	Other
Non-Federal Sources																					
A. State Governments																					
B. Local Governments																					
C. Voluntary Health Agencies																					
D. Foundations																					
E. Industries																					
1. Michigan based																					
2. Non-Mich. based																					
F. Other Outside Sources																					
G. Institution's -Own Funds																					
1. General Fund																					
2. Other Funds																					
Totals																					

STUDENT QUESTIONNAIRE ON IMPACT OF FUNDS FOR SCIENCE EDUCATION AND RESEARCH ON MICHIGAN PUBLIC INSTITUTIONS OF HIGHER EDUCATION

To: Students in the State Supported Colleges and Universities of Michigan

This questionnaire is one of several data-collecting instruments being employed in a study of the impact of Federal and non-Federal funds for science research and education upon the twelve, four-year, state-supported colleges and universities in Michigan. The study is sponsored by the National Science Foundation and has the support of each of the twelve state institutions. The Michigan State Board of Education and an Advisory Group of representatives from business, industry, and labor are related parties.

The questionnaire is designed to be administered to senior majors, degree-seeking graduate students, and students pursuing first professional degrees in science and engineering. The purpose of the questionnaire is to obtain a sample of student perceptions of the impact of Federal and non-Federal funds on science research and education programs in the institutions. A specific end is to obtain data on the impact of different kinds of financial assistance upon the academic activities and career plans of students.

The information gained through this questionnaire will make an important contribution to the conclusions of the study. Hence we hope you will give it your immediate and thoughtful attention. The responses which are given will be treated confidentially. All tabulation and analysis of data will preserve the complete anonymity of the respondents.

Paul L. Dressel
Director of Institutional Research, Michigan State University
Director of Study on Impact of Federal and non-Federal Funds on Science Research and Education

Instructions:

1. An answer sheet is enclosed with the question booklet. Please mark the one answer to each item applicable to you in the appropriate space on the answer sheet.
2. In marking your answers, please use a No. 2 pencil or the pencil which is the closest one you have to a No. 2 in lead hardness.
3. Make only one mark for each item.
4. Do not make any marks in the 0 column.
5. When you have completed the questionnaire, please put it in the enclosed addressed envelope and return it by U.S. mail, unless other instructions for return are requested in an accompanying letter. Return both the questionnaire booklet and the answer sheet.

Background Information

1. Institution you are currently attending:

   1. Michigan State University
   2. Michigan Technological University
   3. University of Michigan
   4. Wayne State University
   5. Western Michigan University

2. Age at last birthday:

1.	20 or under	6.	29 or 30
2.	21 or 22	7.	31 or 32
3.	23 or 24	8.	33 or 34
4.	25 or 26	9.	35 or over
5.	27 or 28		

3. Marital status:

   1. Single
   2. Married, spouse employed
   3. Married, spouse not employed

4. Major field of study (the inclusions noted below indicate areas concerning which there might be debate, not the areas most clearly included in the categories)

   1. Engineering (include Agricultural Engineering in this category)
   2. Physical Sciences (include Mathematics, Statistics, and the Earth Sciences in this category)
   3. Life Sciences - Biological (include Physical Anthropology, Anatomy, Pharmacology, Pathology, and Physiology in this category)
   4. Life Sciences - Agricultural
   5. Life Sciences - Medical (include Health Sciences, Dentistry, Veterinary Medicine, and all clinical sciences in this category)
   6. Psychology
   7. Social Sciences (include Agricultural Economics, Social Anthropology, and Economic and Social Geography in this category)
   8. Other Sciences.

5. Degree currently being sought:

   1. Bachelor
   2. Master
   3. Ph.D.
   4. First professional degree (include M.D., D.D.S, and D.V.S.)
   5. Other

6. Current type of assistance being received (other than loans)

   1. None
   2. General duty assistantship
   3. Teaching assistantship or teaching fellowship
   4. Research assistantship
   5. Fellowship
   6. Scholarship
   7. Traineeship
   8. Other

7. Source of assistance (Federal) designated in Item 6

1.	NIH	7.	Other
2.	DOD	8.	None
3.	AEC		
4.	NASA		
5.	NSF		
6.	Office of Education		

8. Source of assistance (non-Federal) designated in Item 6

   1. Private foundation
   2. Private industry or business
   3. University
   4. Other
   5. None

Stretch-out of Graduate Study for a Master's Degree

Answer items 9 through 15 only if you are a graduate student, or intend to become a graduate student, pursuing a master's or Ph.D. degree. Otherwise, go on to item 16.

***

Use the following key to answer items 9 through 13:

Key:
1. One year or less
2. 1-2 years
3. 2 years
4. 2-3 years
5. 3 years
6. 3-4 years
7. 4 years
8. 4-5 years
9. 5 years or more

In your opinion, how much time is needed to complete the requirements for a master's degree in your field of science under the various conditions of student financial assistance described in items 9 through 13?

9. Time needed by a student who holds a graduate scholarship or fellowship without required duties.
10. Time needed by a student who holds a half-time teaching assistantship or teaching fellowship.
11. Time needed by a student who holds a half-time general duty assistantship.
12. Time needed by a student who holds a half-time research assistantship.
13. Time needed by a student who neither is employed nor requires any of the types of financial support described in items 9 through 12.

***

14. Do you think that the period of time it takes to obtain a master's degree is too long?

    1. Yes 2. No 3. Uncertain

If your answer to item 14 is Yes, answer item 15. Otherwise, go on to item 16.

15. As contributor to excessive time stretch-out in obtaining a master's degree
    1. the degree requirements set by the granting institution are of prime importance.
    2. the burden of the duties associated with an assistantship or teaching fellowship are of prime importance.
    3. both of the factors noted in choices 1 and 2 are very important, and it is impossible to distinguish which is more important.
    4. neither of the factors noted in choices 1 and 2 is of prime importance.

Stretch-out of Graduate Study for a Ph.D. Degree

Answer items 16 through 22 only if you are working for, or intend to work for, a Ph.D. degree. Otherwise, go on to item 23.

***

Use the following key to answer items 16 through 20.

Key:
1. 3 years or less
2. 3-4 years
3. 4 years
4. 4-5 years
5. 5 years
6. 5-6 years
7. 6 years
8. 6-7 years
9. 7 years or more

In your opinion, how much time is needed to complete the requirements for a Ph.D. degree in your field under the various conditions of student financial support described in items 16 through 20? Assume that the student starts with a bachelor's degree and receives a given type of assistance continuously from the start of the doctoral program through the completion of his dissertation.

16. Time needed by a student who holds a graduate scholarship or fellowship without duties.
17. Time needed by a student who holds a half-time teaching assistantship or fellowship.
18. Time needed by a student who holds a half-time general duty assistantship.
19. Time needed by a student who holds a half-time research assistantship.
20. Time needed by a student who neither is employed nor requires any of the types of financial support described in items 16 through 19.

***

21. Do you think that the period of time it takes to obtain a Ph.D. degree is too long?

    1. Yes 2. No 3. Uncertain

If your answer to item 21 is Yes, answer item 22. Otherwise, go on to item 23.

22. As contributor to excessive time stretch-out in obtaining a Ph.D. degree
    1. the degree requirements set by the granting institution are of prime importance.
    2. the burden of the duties associated with an assistantship or teaching fellowship are of prime importance.
    3. both of the factors noted in choices 1 and 2 are very important, and it is impossible to distinguish which is more important.
    4. neither of the factors noted in choices 1 and 2 is of prime importance.

Preferred Methods of Support

23. In your opinion, which method of assistance has the most prestige?
    1. General duty assistantship
    2. Teaching assistantship or fellowship
    3. Research assistantship
    4. Fellowship
    5. Scholarship
    6. Traineeship
    7. Other
    8. No opinion

24. Which method of assistance would you consider most helpful to your professional development?
    1. General duty assistantship
    2. Teaching assistantship or fellowship
    3. Research assistantship
    4. Fellowship
    5. Scholarship
    6. Traineeship
    7. Other
    8. No opinion

25. If you were planning to continue your studies next year and were able to obtain any type of support, which method of support would you prefer?
    1. General duty assistantship
    2. Teaching assistantship or fellowship
    3. Research assistantship
    4. Fellowship
    5. Scholarship
    6. Traineeship
    7. Other
    8. No opinion

26. Did the amount of financial aid to be received influence you to attend the institution where you have currently enrolled?
    1. Very much
    2. Somewhat
    3. Relatively little
    4. Not at all
    5. Not receiving aid

27. Without the financial aid you are receiving would you be able to pursue your studies at this time?

    1. Yes 3. Uncertain
    2. No 4. Not receiving aid

Educational Experience

***

Listed below in items 28 through 34 are some possible effects of the research carried on by professors upon their teaching activity. Use the following key to indicate whether or not you agree with the statement of effect set forth in each item.

Key:
1. Agree strongly
2. Tend to agree
3. Uncertain
4. Tend to disagree
5. Disagree strongly

28. Research keeps a professor abreast of his field.
29. Research leaves a professor too little time for classroom preparation.
30. Research results in the introduction of highly relevant material into a course.
31. Research results in the introduction of material which assumes a higher level of sophistication than most students have.
32. Research makes a professor unavailable for personal conferences regarding matters pertaining to the course.
33. Research stimulates a professor's desire to teach.
34. Research has no effect on the quality of teaching.

***

35. Are you, or were you, employed or supported financially as an <u>undergraduate</u> research assistant to a <u>member of the</u> faculty or research staff of the college or university which you are attending or attended as an undergraduate?

    1. Yes   2. No

If Yes, please answer item 36. Otherwise, go on to item 37.

36. Did the activity as an undergraduate research assistant contribute positively to your educational development in your area of scientific interest and focus?
    1. Very much
    2. Somewhat
    3. Relatively little
    4. Not at all

37. How would you evaluate your learning experience as a student in undergraduate courses taught by graduate teaching assistants or graduate teaching fellows?
    1. Very satisfactory
    2. Generally satisfactory
    3. Generally unsatisfactory
    4. Very unsatisfactory
    5. No such experience

The remaining items on the questionnaire are to be answered only by graduate students who are currently pursuing a master's or Ph.D. degree. If you are an undergraduate or a student pursuing a first professional degree, do not answer any item beyond item 37.

38. On the basis of your experience do you think that individual professors have more graduate students assigned to them than they have time adequately to supervise or assist?
    1. Usually
    2. Sometimes
    3. Rarely
    4. Never
    5. Uncertain

39. How would you evaluate your learning experience as a student in graduate courses taught by graduate teaching assistants or graduate teaching fellows
    1. Very satisfactory
    2. Generally satisfactory
    3. Generally unsatisfactory
    4. Very unsatisfactory
    5. No such experience

40. What do you plan as your primary activity after completing work on the degree you are currently pursuing?
    1. Pursue another graduate or professional degree program.
    2. Do research in a university without pursuing a degree.
    3. Engage in university or college teaching and research.
    4. Engage in elementary or secondary teaching and/or research.
    5. Engage in business and industry service and/or research.
    6. Engage in government service and/or research.
    7. Become self-employed.
    8. Other.

The remaining items on the questionnaire are to be answered only by graduate students who currently hold a graduate teaching assistantship or teaching fellowship, a graduate research assistantship, or a general duty graduate assistantship. If you are a graduate student not in one of these categories, do not answer any item beyond item 40.

Work Experience as a Graduate Assistant or Teaching Fellow

41. The most significant benefit that one could gain from holding the type of an assistantship or teaching fellowship which he deems most desirable is that it could provide
    1. a source of income.
    2. a means of becoming more proficient in the subject matter of a field of science.
    3. an opportunity to learn research techniques and methods.
    4. an opportunity to gain teaching experience.
    5. other.

42. Have your assistantship or teaching fellowship duties been related to the area of future employment you intend to pursue?
    1. Very much
    2. Somewhat
    3. Relatively little
    4. Not at all

43. How do you think you are viewed, as a graduate assistant or teaching fellow, in the eyes of the university's professional staff?

1. Accepted by most senior staff as a valued peer
2. Regarded and respected as an intern, but not as a full-fledged colleague
3. Regarded as a "hired hand", in a status between clerical and professional staff
4. Regarded on a par with clerical staff
5. Viewed as just another graduate student

44. How would you generally evaluate the procedures of supervision by faculty or research director over your work as a teacher, researcher, or general assistant?

1. Very satisfactory
2. Generally satisfactory
3. Uncertain
4. Generally unsatisfactory
5. Very unsatisfactory

45. Do you feel that you are too closely and rigidly supervised and directed by faculty or research director?

1. All of the time
2. Most of the time
3. Some of the time
4. Never

46. Do you feel that faculty or research directors pursue their individual interests to the neglect of adequate supervision and direction over your work as teacher, researcher, or general assistant?

1. All of the time
2. Most of the time
3. Some of the time
4. Never

47. What is the number of hours you spend per week fulfilling the duties of your graduate assistantship or teaching fellowship?

1. 0-2
2. 3-5
3. 6-8
4. 9-11
5. 12-14
6. 15-17
7. 18-20
8. over 20

48. Is the work connected with the duties of your graduate assistantship or teaching fellowship routine?

1. All of the time
2. Most of the time
3. Some of the time
4. Never

49. Do you feel that the duties you perform related to your assistantship or teaching fellowship make reasonable use of your abilities?

1. All of the time
2. Most of the time
3. Some of the time
4. Never

50. Do you feel that your duties are important as part of your professional training?

1. All of the time
2. Most of the time
3. Some of the time
4. Never

QUESTIONS FOR DISCUSSION WITH TOP ADMINISTRATORS

I. What relationship exists between the objectives and goals of the institution and the availability of outside funds, public or private, for science research?

A. What kind of a program of science research, if any, is basic for the attainment of the fundamental goals of the institution?

B. Is a significant contribution to the instructional program of the institution made by the support of science research? If significant, in what major ways?

C. Are science research funds from outside sources necessary or highly desirable for the attainment of the institution's goals or are the institution's own funds adequate?

II. What have been some of the specific impacts which the availability or lack of availability of outside funds for research have had upon the institution? Impact upon:

A. New academic programs established or which the institution desires to establish?

B. The historic balance or relative emphasis among the scientific disciplines?

C. The kinds of research conducted - e.g., areas of research; basic or applied; "big" science or "little" science

D. Quality and compensation of faculty and type of faculty needed to attain the institution's purposes

E. Numbers and quality of students in science areas

F. Other

III. If greater amounts of research funds from outside sources are needed and desired by the institution, are there any scientific areas which can be designated as having been assigned highest priority?

IV. If awards for science research by outside sources are needed and desired, are some means of conveyance of research awards considered more appropriate to the attainment of the institution's goals than other means? e.g.:

A. General or broad purpose awards vs. project awards

B. Grants or contracts?

C. Awards to the institution, to research bureaus, to academic departments, or to individuals

V. Are awards for scientific research from some outside sources of funds preferred over awards from other sources? If so, why? e.g.:

A. Are different programs supported by Federal and nonFederal sources?

B. Are the means of conveyance and the terms of awards of some sources more conducive to the attainment of the institution's goals than those of other sources?

VI. What is the level of coordination in the process of making science research awards to the various state colleges and universities?

A. Is there any evidence of the coordination of science research awards:

1. by the granting agencies?

2. by persons or groups within the State university and higher education systems?

B. Does an award from one source supplement an award from another or tend to stimulate a similar award from another source?

C. Do current patterns of support among the state colleges and universities give adequate consideration to:

1. Geographical spread of research opportunities among scientists?

2. Promotion of economic development of regions (also responses from some leading business and labor leaders in the state will be obtained on this)

3. Promotion of science education as a general social benefit or cultural gain?

4. Meeting the educational needs and demands for graduate programs in "new" or developing universities?

5. Promoting scientific advance as such, rather than specific missions of agencies?

6. Acceptable criteria of balance among the fields of science?

VII. In what ways, if any, do the institutions in the state presently cooperate to plan and conduct joint programs of scientific research and of science education at the graduate and undergraduate levels? Should such cooperation be increased?

VIII. What have been the most important, specific impacts upon the institution of outside funds which contribute to science education (instructional programs)? Such funds would provide for buildings and equipment, student assistance, and support of special programs. e.g.:

A. Contributions to the undergraduate science program?

B. Contributions to the graduate science program?

C. Relationships, if any, of institutes for elementary, secondary, and college teachers to curriculum and to program development, to faculty improvement, and to the public service function of the institution.

IX. What major changes, if any, have occurred in the organizational structure of the institution and in the functions of its personnel which have resulted from an increased use of outside funds for science research and science education programs?

A. Establishment of special bureaus or agencies for science research or education?

B. Establishment of a coordinating agency in the central administration?

C. Changed role of the business office?

D. Changed procedures in acquiring and administering science research or education funds? In the formulation and conduct of a science research or educational project, what is the role of:

1. the individual faculty member?

2. the peers of the faculty member who is an investigator or director of an educational program?

3. related deans and department chairmen?

4. members of the central administration?

X. If an increase in funds is needed and desired by the institution during the next few years for science research and education, what uses for the funds would be emphasized and what sources would be expected to provide these funds?

A. Ideally, how would the funds be allocated among uses for capital improvements and for direct expenditures on research, student assistance, and programs for improvement of science education?

B. What expectations, if any, does the institution have as to the relative roles of general state appropriations, special state and local grants, Federal grants and contracts, and private industry and foundation grants in providing the funds?

INTERVIEW ITEMS FOR DEPARTMENT CHAIRMEN AND FACULTY

I. How are the aims or goals of your department related to the conduct of scientific research?

A. Is there a relative ranking in importance among the aims of undergraduate instruction, graduate instruction, and conduct of research?

B. How are the aims and goals of the department related to the goals or mission of the college or university?

C. About what proportion of the members of your department spend at least 20% of their time in research activity?

D. Is the research activity of the members of your department strongly supportive and/or seriously restrictive of the instructional activity of the department?

II. What factors are important in determining the initiation and conduct of a research project at the college or university?

A. How significant are the following factors?

1. Interest of an individual researcher

2. Facilities of the institution for given types of research

3. Availability of professional personnel to assist in the project

4. Availability of "seed money" provided by the institution to begin a research project

a. Does the institution have an established policy of providing such funds?

b. Does funding of a project by one source help or hinder receiving funds from other sources for that project?

5. Availability of major outside funds to finance the project

6. Other

B. In the conduct of research sponsored by an outside agency which provides funds, do you customarily see conflict or coincidence between the aims of the principal investigator/s and the

1. mission of the sponsor

2. advancement of the state of the sciences

3. science instructional process

4. overall development and fulfillment of the aims of the college or university

III. What characterizes the type of research which you and others in your field of science at your institution would most like to have carried on at the institution? Why?

A. Preference for basic or applied research?

B. Research under grant or contract?

C. Research conducted under grants to individuals or to the institution, the department, or a special research bureau or institute

D. Research carried on by individuals or larger-scale projects with many persons involved.

E. Are there some outside sponsors providing funds for which you would prefer to do research in comparison to others? Why?

1. Federal (any particular agency or agencies you prefer or do not prefer)

2. Non-Federal - state and local governments, private industry or foundations?

F. Are there particular fields of research which you and others in your field of science think that your institution should seek to develop most strongly by gaining research grants from outside sources?

IV. What is the basic decision-making process in the initiation and conduct of science research or science education projects at your institution?

A. Who makes the following decisions?

1. Decision on the scientific or educational soundness of the proposal

2. Decision on the adequacy of the project to promote the institution's goals

3. Decision on released time for faculty and the availability of physical space

4. Decision on the ability of the institution to share direct costs or assume part of overhead costs

or

B. What role in proposal review and decision-making do the following play?

1. Individual investigator

2. Faculty committees

3. Department chairmen and deans

4. Members of the institutions central administration

C. Does your department have any long-range planning activities to consider:

1. Future research and instructional programs

2. Faculty and staff which will be needed

3. Funds needed and probable future sources for research and instructional programs

V. What are some specific impacts upon the institution and its policies which result from either the presence or the lack of funds for science research.

A. Impact on the recruitment and retention of the type of faculty needed to attain the institution's fundamental goals and purposes

B. Impact on the internal organization of your department and other science departments - role of departmental chairmen, of research oriented faculty compared to non-research oriented faculty

C. Impact on the availability of equipment for research and instruction

1. To what degree is research equipment eventually used in instruction?

2. Is the utilization rate of equipment purchased under research funds high or low? What are the criteria for judgment?

D. Impact on financial support programs for graduate students. What objectives does the institution pursue in its support of graduate students from its own or from outside funds?

1. Provide a livelihood for the students

2. Gain professional teaching and/or research assistance

3. Provide training to graduate students in teaching and/or research

VI. What is the extent of the use of outside facilities in research by the science faculty of your institution?

A. Are there numerous and common activities of inter-institutional cooperation in research between your institution and others? Examples, or problems making it difficult.

B. Have your faculty members made use of Federally-supported national centers for science research?

C. Does your faculty place major reliance on their own institution's facilities and local setting for research activity?

INTERVIEW QUESTIONS RELATING TO SCIENCE EDUCATION PROGRAMS

I. How are science education programs designed within the institution?

A. What criteria are used to decide what area of science should be emphasized within a program?

B. What criteria are used to decide what type of student shall be related to a program? In the institutes, what criteria of selection are employed?

C. What criteria are used to determine specific directions of a program?

1. If equipment purchase program - criteria for deciding the type of equipment needed.

2. If an instructional program - criteria for deciding specific course content and approach (e.g., emphasis on science methodology, science demonstration, science substantive content).

D. What role do persons in different positions in the institution play in initiating and developing a proposal to submit to a sponsor for consideration?

1. Individual faculty members

2. Department chairmen and deans

3. Academic administrators in the central administration

4. Fiscal officers

E. Do funds provided by an outside sponsor of a science education program tend to draw some of the institution's own funds to the program? tend to draw funds of other sponsors to the program?

II. What are the major impacts of science education programs on the institution?

A. How are staff selected for science education programs - how are they related to the regular academic departments and their functions?

B. How are science education programs related to research activity?

C. How are sponsored science education institutes related to the development of other science programs and curricula in the institution?

D. Do sponsored science education institutes help to attract high quality students into regular academic programs of the institution?

1. Attract freshmen who are influenced by secondary teachers attending institutes?

2. Attract graduate students who move toward higher degrees after attending institutes?

E. Have faculty members in the institution gained significant training from college teacher institutes held on other campuses?

F. How do you rate the level of equipment utilization provided through science equipment programs? High, medium, or low? What is the basis for the estimate?

II. Evaluation of science education institutes

A. Do you have a method of assessing the impact of a program on participants? If so, what are the results?

B. Do you have a method of assessing the impact of a program on the communities to which participants return? If so, what are the results?

C. Do you have means of determining whether the level of competence of participants is increasing, staying steady, or decreasing over time? If so, what is the tendency?

D. Do you have adequate means of communicating the existence of problems or a need for changes in a program to the sponsor?

1. If so, what means are employed?

2. If not, do you have proposals to better communication?

Some Questions for Written Response by Members of the Advisory Committee of the Science Research Impact Study

1. The rates at which our knowledge is expanding and our technology is changing are such that the goals of undergraduate education are shifting away from specific knowledge and skills toward mastery of modes of inquiry and problem solving. The assumption is often made that business and industry can and should supply training programs to provide the specific knowledge and skills. This trend places emphasis in the colleges and universities on research involvement of undergraduate faculties and students as well as of graduate and research faculties and their students. Such emphasis demands more in the way of facilities and time, and is more expensive than traditional patterns of structured group instruction, yet the individual may be less well prepared for initial employment.

Do you find the preceding statement essentially correct?

If not, wherein is it inaccurate?

How do you think these difficulties should be resolved?

2. Publicly supported institutions of higher education have been criticized because so little of their research appears to have direct and immediate application to problems of the state and the people, business, and industry which support the institutions. University faculties, however, point to the fact that the larger part of research support comes from federal or foundation sources which are usually not particularly oriented to the support of the type of research which has implications limited to a single state or region. Faculty members, too, often display concern about possible overemphasis on "applied" research or on development and argue that most of this should be done by other agencies than the university.

What comments do you have on these points of view?

Should there be more support of research devoted to state and regional problems?

How should such locally-oriented research be supported?

3. Even liberal arts colleges are finding it difficult to hold a strong faculty (especially in the sciences) unless teaching schedules are reduced and facilities and funds provided so that faculty members can

engage in research. Research involvement, in turn, leads to demands for graduate programs to supply graduate assistants to assist in research and often to assume some of the instructional load. One liberal arts college dean remarked recently: "It has about reached the point where one cannot maintain an institution of any quality without embarking on graduate education." Although costs are much greater at the graduate level and hence total higher education expenditures may increase markedly by this diffusion of research and graduate education, there are those who argue that there is no alternative. Research is becoming a way of life of faculty. Furthermore the demands for graduate degrees in education, business, government and other fields cannot be met unless graduate education is drastically expanded.

Do you believe that such expansion of graduate education and research is wise and necessary?

Can such expansion of graduate education and research be financed?

If so, what new or expanded sources of support are to be found?

Part 3

Supplementary Tables

List of Supplementary Tables

Table 2-6S

Federal and NonFederal Funds Expended for Separately Budgeted Research by Michigan Public Institutions*, by Year and by Area of Science

(In Thousands of Dollars)

Area of Science	1957-58 Amount	1957-58 %	1960-61 Amount	1960-61 %	1963-64 Amount	1963-64 %	1964-65 Amount	1964-65 %	1965-66 Amount	1965-66 %
Engineering										
Federal	3,059	74.5	4,461	74.7	6,811	79.4	8,051	82.4	9,278	84.3
NonFederal	1,048	25.5	1,513	25.3	1,772	20.6	1,724	17.6	1,724	15.7
Total	4,107	100.0	5,974	100.0	8,583	100.0	9,775	100.0	11,002	100.0
Physical Science										
Federal	6,847	93.9	10,215	94.1	16,799	95.8	18,822	95.7	19,354	89.9
NonFederal	447	6.1	643	5.9	728	4.2	851	4.3	2,173	10.1
Total	7,294	100.0	10,858	100.0	17,527	100.0	19,673	100.0	21,527	100.0
Life Science - Agr.										
Federal	402	15.8	633	21.9	1,122	33.6	1,506	36.3	2,475	47.6
NonFederal	2,148	84.2	2,260	78.1	2,214	66.4	2,644	63.7	2,724	52.4
Total	2,550	100.0	2,893	100.0	3,336	100.0	4,150	100.0	5,199	100.0
Life Science - Bio.										
Federal	2,049	59.7	3,001	63.9	6,059	76.8	6,637	74.4	7,122	72.9
NonFederal	1,385	40.3	1,693	36.1	1,826	23.2	2,283	25.6	2,644	27.1
Total	3,434	100.0	4,694	100.0	7,885	100.0	8,920	100.0	9,766	100.0
Life Science - Med.										
Federal	2,347	68.6	3,539	67.5	7,391	76.5	8,159	75.8	8,667	76.7
NonFederal	1,072	31.4	1,705	32.5	2,270	23.5	2,610	24.2	2,636	23.3
Total	3,419	100.0	5,244	100.0	9,661	100.0	10,769	100.0	11,303	100.0
Social Science										
Federal	842	45.5	1,167	44.8	1,687	53.1	2,061	46.8	2,347	43.7
NonFederal	1,007	54.5	1,437	55.2	1,493	46.9	2,342	53.2	3,027	56.3
Total	1,849	100.0	2,604	100.0	3,180	100.0	4,403	100.0	5,374	100.0

(continued)

Table 2-6S (continued)

Area of Science	1957-58 Amount	1957-58 %	1960-61 Amount	1960-61 %	1963-64 Amount	1963-64 %	1964-65 Amount	1964-65 %	1965-66 Amount	1965-66 %
Psychology										
Federal	444	86.0	733	87.3	1,229	95.1	1,328	88.1	1,545	89.8
NonFederal	72	14.0	107	12.7	63	4.9	180	11.9	175	10.2
Total	516	100.0	840	100.0	1,292	100.0	1,508	100.0	1,720	100.0
Other										
Federal	-		-		386	36.9	233	20.0	144	18.8
NonFederal	479	100.0	593	100.0	661	63.1	930	80.0	622	81.2
Total	479	100.0	593	100.0	1,047	100.0	1,163	100.0	766	100.0

*Data available and included for 1964-65 and 1965-66 from U of M, MSU, WSU, MTU, WMU, OU, CMU, NMU, and FSC; for 1963-64 from U of M, MSU, WSU, OU, CMU, NMU, and FSC; for 1960-61 from U of M, MSU, OU, CMU, NMU, and FSC; for 1957-58 from U of M and MSU.

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Table 2-7.1S

Sources of Funds for Separately Budgeted Research in Engineering by Institution and Year

(in Thousands of Dollars) **BEST COPY AVAILABLE**

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	2,973	77.7	4,303	77.7	6,506	83.9	7,339	87.5	8,460	89.4
Inst.O.F.	4	.1	391	7.0	624	8.0	369	4.4	579	6.1
Other NonF.	874	22.2	843	15.3	627	8.1	683	8.1	423	4.5
Total	3,824	100.0	5,537	100.0	7,757	100.0	8,391	100.0	9,462	100.0
MSU										
Federal	86	33.6	158	36.2	280	38.0	422	46.7	447	45.3
Inst.O.F.	114	44.5	210	48.0	350	47.5	351	38.9	376	38.1
Other NonF.	56	21.9	69	15.8	107	14.5	13[illegible]	14.4	164	16.6
Total	256	100.0	437	100.0	737	100.0	903	100.0	987	100.0
WSU										
Federal					25	28.1	57	43.2	148	78.7
Inst.O.F.							4	3.0		
Other NonF.					64	71.9	71	53.8	40	21.3
Total					89	100.0	132	100.0	188	100.0
MTU										
Federal							233	69.5	223	69.0
Inst.O.F.							25	7.5	11	3.4
Other NonF.							77	23.0	89	27.6
Total							335	100.0	323	100.0
WMU										
Federal										
Inst.O.F.									3	7.1
Other NonF.							14	100.0	39	92.9
Total							14	100.0	42	100.0

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Table 2-7.1.1S

Federal Sources of Funds Expended for Separately Budgeted Research in Engineering, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	645	934	1,412	1,590	1,769
2. Army	411	599	930	1,172	1,336
3. Navy	266	374	566	398	533
4. Other	-	-	-	9	122
B. Atomic Energy Commission	143	263	331	235	294
C. Department of Health, Education and Welfare					
1. Nat'l Instit. of Health	62	57	80	93	266
2. Public Health Service other than NIH	21	30	76	146	28
3. Office of Education	-	-	-	-	-
D. Department of Agriculture	33	31	34	57	106
E. Department of Interior	3	4	8	23	32
F. National Science Foundation	414	633	1,049	917	852
G. National Aeronautics and Space Administration	993	1,437	2,175	2,988	3,462
H. All Other Federal Agencies	68	99	150	423	478
Totals (sum of A through H)	3,059	4,461	6,811	8,051	9,278

*Includes data for U of M and MSU for all five years; for WSU 1963-66; for MTU and WMU 1964-66. OU, the other institution with an engineering program, did not report data.

Table 2-7.1.25

Expenditures from Federal Sources of Funds for R & D Among the Fields of Engineering, Michigan Public Institutions, 1965-66*

(in Thousands of Dollars)

Federal Sources	Total	Aero-space	Chemical & Metal-lurgical	Civil	Electrical	Mechanical	Industrial	Other Engineering Fields
A. Department of Defense								
1. Air Force	1,769	156	102	-	1,412	61	-	38
2. Army	1,336	50	18	10	902	196	-	160
3. Navy	533	25	18	12	437	-	-	41
4. Other	122	-	-	-	25	97	-	-
B. Atomic Energy Commission	294	-	202	-	-	-	-	92
C. Department of Health, Education and Welfare								
1. Nat'l Instit. of Health	266	-	8	51	-	71	112	24
2. Public Health Service other than NIH	28	-	-	-	-	-	-	28
3. Office of Education	-	-	-	-	-	-	-	-
D. Department of Agriculture	106	-	-	3	-	1	-	102
E. Department of Interior	32	-	2	-	-	-	-	30
F. National Science Foundation	852	-	50	54	134	136	4	474
G. National Aeronautics and Space Administration	3,462	1,639	90	2	1,531	113	-	87
H. All Other Federal Agencies	478	38	-	70	-	74	1	295
Totals (sum of A through H)	9,278	1,908	490	202	4,441	749	117	1,371

*Includes data for U of M, MSU, WSU, MTU, WMU. OU, the only other institution with an engineering program, did not report.

Table 2-7.2S

Sources of Funds for Separately Budgeted Research in Physical Sciences by Institution and Year

(in Thousands of Dollars)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	6,603	94.2	9,556	94.2	14,406	96.0	16,211	97.2	16,531	90.7
Inst.O.F.	17	.2	314	3.1	343	2.3	362	2.2	423	2.3
Other NonF.	390	5.6	276	2.7	257	1.7	114	.6	1,279	7.0
Total	7,010	100.0	10,146	100.0	15,006	100.0	16,687	100.0	18,233	100.0
MSU										
Federal	244	85.9	625	94.4	1,779	98.6	1,837	97.6	1,925	97.1
Inst.O.F.	5	1.8								
Other NonF.	35	12.3	37	5.6	26	1.4	45	2.4	58	2.9
Total	284	100.0	662	100.0	1,805	100.0	1,882	100.0	1,983	100.0
WSU										
Federal					579	86.0	610	86.4	736	88.7
Inst.O.F.					49	7.3	51	7.2	6	.7
Other NonF.					45	6.7	45	6.4	88	10.6
Total					673	100.0	706	100.0	830	100.0
MTU										
Federal							85	30.3	48	15.2
Inst. O.F.							10	3.6	14	4.4
Other NonF.							185	66.1	254	80.4
Total							280	100.0	316	100.0
WMU										
Federal							47	64.4	88	74.0
Inst.O.F.							8	11.0	11	9.2
Other NonF.							18	24.6	20	16.8
Total							73	100.0	119	100.0

(continued)

Table 2-7.28 (continued)

Institution and Sources of Funds	1957-58 Am't.	1957-58 %	1960-61 Am't.	1960-61 %	1963-64 Am't.	1963-64 %	1964-65 Am't.	1964-65 %	1965-66 Am't.	1965-66 %
CMU										
Federal			34	69.4					7	100.0
Inst.O.F.										
Other NonF.			15	30.6	7	100.0	4	100.0		
Total			49	100.0	7	100.0	4	100.0	7	100.0
NMU										
Federal					30	100.0	23	100.0	10	100.0
Inst.O.F.										
Other NonF.										
Total					30	100.0	23	100.0	10	100.0
OU										
Federal					5	83.3	9	50.0	9	31.0
Inst.O.F.										
Other NonF.			1	100.0	1	16.7	9	50.0	20	69.0
Total			1	100.0	6	100.0	18	100.0	29	100.0

Table 2-7.2.1S

Federal Sources of Funds Expended for Separately Budgeted Research in Physical Sciences, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	1,587	2,348	3,533	3,966	4,210
2. Army	1,811	2,596	3,904	4,001	4,078
3. Navy	341	544	809	938	711
4. Other	990	1,433	2,164	3,399	2,878
B. Atomic Energy Commission	915	1,433	2,095	1,870	2,258
C. Department of Health, Education and Welfare					
1. Nat'l Instit. of Health	214	336	790	1,135	1,052
2. Public Health Service other than NIH	86	124	187	148	4
3. Office of Education	-	7	13	-	7
D. Department of Agriculture	1	-	2	-	66
E. Department of Interior	7	10	22	2	91
F. National Science Foundation	506	820	2,430	2,201	2,309
G. National Aeronautics and Space Administration	343	497	745	930	1,181
H. All Other Federal Agencies	46	67	105	232	509
Totals (sum of A through H)	6,847	10,215	16,799	18,822	19,354

*Includes data for U of M and MSU for all five years; for CMU and OU 1960-66; for WSU and NMU 1963-66; for MTU and WMU 1964-66.

Table 2-7.2.2S

Expenditures from Federal Sources of Funds for R & D Among the Fields of Physical Science, Michigan Public Institutions*, 1965-66
(in Thousands of Dollars)

Federal Sources	Total	Chemistry	Earth Sciences	Physics	Mathematics	Other Physical Sciences
A. Department of Defense						
1. Air Force	4,210	18	-	4,107	85	-
2. Army	4,078	88	12	3,978	-	-
3. Navy	711	-	3	459	42	207
4. Other	2,878	-	-	2,878	-	-
B. Atomic Energy Commission	2,258	284	-	1,974	-	-
C. Department of Health, Education and Welfare						
1. Nat'l Instit. of Health	1,052	709	-	308	35	-
2. Public Health Service other than NIH	4	-	-	-	4	-
3. Office of Education	7	7	-	-	-	-
D. Department of Agriculture	66	19	-	47	-	-
E. Department of Interior	91	-	16	75	-	-
F. National Science Foundation	2,309	490	143	1,180	404	92
G. National Aeronautics and Space Administration	1,181	-	-	428	-	753
H. All Other Federal Agencies	509	-	46	420	-	43
Totals (sum of A through H)	19,354	1,615	220	15,854	570	1,095

*Includes data from U of M, MSU, WSU, MTU, WMU, CMU, NMU, AND OU.
EMU, FSC, GVSC, and SVSC either had no data to report or the data were not currently available.

Table 2-7.3S

Separately Budgeted Research Expenditures in Chemistry and Mathematics, 1963-66 at U of M, MSU, and WSU by Source of Funds

(in Thousands of Dollars)

	U of M		MSU		WSU	
Source of Funds	Chemistry	Math	Chemistry	Math	Chemistry	Math
Federal	1,333	1,330	1,049	434	1,410	147
NonFederal	169	10	77	0	232	1
Total	1,502	1,340	1,126	434	1,642	148

Table 2-7.4S

Sources of Funds for Separately Budgeted Research in Life Sciences - Medical, by Institution and Year

(in Thousands of Dollars)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	2,343	67.0	3,388	66.9	5,105	75.1	6,102	75.1	6,267	74.4
Inst.O.F.	473	13.5	760	15.0	794	11.6	928	11.4	1,009	11.9
Other NonF.	681	19.5	918	18.1	902	13.3	1,095	13.5	1,145	13.7
Total	3,497	100.0	5,066	100.0	6,801	100.0	8,125	100.0	8,421	100.0
MSU										
Federal	4	18.2	151	84.8	201	85.5	221	86.7	831	93.8
Inst.O.F.	12	54.5	13	7.3	26	11.1	26	10.2	28	3.2
Other NonF.	6	27.3	14	7.9	8	3.4	8	3.1	27	3.0
Total	22	100.0	178	100.0	235	100.0	255	100.0	886	100.0
WSU										
Federal					2,083	79.9	1,835	76.9	1,568	78.7
Inst.O.F.					-	-	66	2.6	-	-
Other NonF.					524	20.1	489	20.5	425	21.3
Total					2,607	100.0	2,385	100.0	1,993	100.0
FSC										
Federal					2	50.0	1	25.0	1	33.0
Inst.O.F.										
Other NonF.			7	100.0	2	50.0	3	75.0	2	67.0
Total			7	100.0	4	100.0	4	100.0	3	100.0

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Table 2-7.4.1S

Federal Sources of Funds Expended for Separately Budgeted Research in Life Sciences - Medical, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	16	23	37	8	20
2. Army	115	167	261	398	140
3. Navy	30	43	62	57	40
4. Other					
B. Atomic Energy Commission	71	103	369	290	251
C. Department of Health, Education and Welfare					
1. Nat'l Instit. of Health	1,684	2,437	5,550	5,891	5,730
2. Public Health Service other than NIH	290	420	649	1,037	1,141
3. Office of Education	8	11	17	-	-
D. Department of Agriculture	4	148	130	73	93
E. Department of Interior	-	-	-	-	-
F. National Science Foundation	58	83	163	191	134
G. National Aeronautics and Space Administration	38	56	83	4	-
H. All Other Federal Agencies	33	48	70	210	1,068
Totals (sum of A through H)	2,347	3,539	7,391	8,159	8,667

*Includes data for U of M and MSU for all five years; for FSC 1960-1966; for WSU 1963-66. No other institutions had programs in the field.

Table 2-7.5S **BEST COPY AVAILABLE**

Sources of Funds for Separately Budgeted Research in Life Sciences - Agriculture, by Institution and Year

(in Thousands of Dollars)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	23	62.2	41	67.2	54	73.0	96	78.7	166	98.8
Inst. O.F.										
Other NonF.	14	37.8	20	32.8	20	27.0	26	21.3	2	1.2
Total	37	100.0	61	100.0	74	100.0	122	100.0	168	100.0
MSU										
Federal	379	15.1	592	20.9	1,068	32.7	1,406	35.2	2,286	45.8
Inst.O.F.	1,619	64.4	1,812	64.0	1,660	50.9	2,029	50.8	2,153	43.1
Other NonF.	515	20.5	428	15.1	534	16.4	555	14.0	553	11.1
Total	2,513	100.0	2,832	100.0	3,262	100.0	3,990	100.0	4,992	100.0
MTU										
Federal							4	10.5	23	59.0
Inst.O.F.							4	10.5	2	5.1
Other NonF.							30	79.0	14	35.9
Total							38	100.0	39	100.0

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Table 2-7.5.1S

Federal Sources of Funds Expended for Separately Budgeted Research in Life Sciences - Agriculture, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	-	10	-	-	-
2. Army	13	10	32	29	5
3. Navy	-	-	-	-	-
4. Other	-	-	-	-	-
B. Atomic Energy Commission	31	43	73	332	1,016
C. Dept. of Health, Education and Welfare					
1. Nat'l Instit. of Health	23	60	296	311	379
2. Public Health Service other than NIH	-	-	-	-	-
3. Office of Education	-	2	4	-	-
D. Department of Agriculture	326	451	594	693	939
E. Department of Interior	-	-	17	53	64
F. National Science Foundation	8	19	96	75	51
G. National Aeronautics and Space Administration	-	-	-	-	-
H. All Other Federal Agencies	1	38	10	13	21
Totals (sum of A through H)	402	633	1,122	1,506	2,475

*Includes data for U of M and MSU for all five years; for MTU, 1964-65 and 1965-66. Other institutions do not have programs in the field.

Table 2-7.6S

Sources of Funds for Separately Budgeted Research in Life Sciences - Biological, by Institution and Year

(in Thousands of Dollars)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	1,555	70.7	2,246	70.7	3,388	78.2	3,682	76.9	4,024	74.8
Inst.O.F.	441	20.0	581	18.3	612	14.1	652	13.6	721	13.4
Other NonF.	202	9.2	348	10.9	334	7.8	456	9.5	637	11.8
Total	2,198	99.9	3,175	99.9	4,334	100.0	4,790	100.0	5,382	100.0
MSU										
Federal	494	40.0	720	48.5	1,811	68.7	2,044	66.7	2,299	68.5
Inst.O.F.	642	51.9	644	43.4	658	24.9	841	27.5	850	25.4
Other NonF.	100	8.1	120	8.1	169	6.4	177	5.8	204	6.1
Total	1,236	100.0	1,484	100.0	2,638	100.0	3,062	100.0	3,353	100.0
WSU										
Federal					832	94.0	857	87.0	684	77.3
Inst.O.F.							13	1.3	30	3.4
Other NonF.					53	6.0	115	11.7	171	19.3
Total					885	100.0	985	100.0	885	100.0
MTU										
Federal							12	33.3	15	38.5
Inst.O.F.							6	16.7	6	15.4
Other NonF.							18	50.0	18	46.1
Total							36	100.0	39	100.0
WMU										
Federal									7	50.0
Inst.O.F.							5	100.0	7	50.0
Other NonF.										
Total							5	100.0	14	100.0

(continued)

Table 2-7.6S (continued)

Institution and Sources of Funds	1957-58 Am't.	1957-58 %	1960-61 Am't.	1960-61 %	1963-64 Am't.	1963-64 %	1964-65 Am't.	1964-65 %	1965-66 Am't.	1965-66 %
CMU										
Federal			35	100.0	4	100.0				
Inst. O.F.										
Other NonF.										
Total			35	100.0	4	100.0				
NMU										
Federal					13	100.0	4	100.0	9	100.0
Inst.O.F.										
Other NonF.										
Total					13	100.0	4	100.0	9	100.0
OU										
Federal					11	100.0	38	100.0	84	100.0
Inst.O.F.										
Other NonF.										
Total					11	100.0	38	100.0	84	100.0

Table 2-7.6.1S

Federal Sources of Funds Expended for Separately Budgeted Research in Life Sciences - Biological, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	-	-	-	1	31
2. Army	44	37	139	147	61
3. Navy	17	25	38	63	40
4. Other	-	-	-	-	-
B. Atomic Energy Commission	75	142	308	337	382
C. Department of Health, Education and Welfare					
1. Nat'l Instit. of Health	1,241	1,904	3,933	4,283	4,458
2. Public Health Service other than NIH	118	170	261	163	200
3. Office of Education	-	7	1	-	3
D. Department of Agriculture	289	288	454	555	616
E. Department of Interior	-	-	2	13	23
F. National Science Foundation	254	413	752	907	1,118
G. National Aeronautics and Space Administration	1	1	150	130	84
H. All Other Federal Agencies	10	14	21	38	106
Totals (sum of A through H)	2,049	3,001	6,059	6,637	7,122

*Includes data for U of M and MSU for all five years; for CMU, 1960-66; for WSU, NMU, and OU, 1963-66; for MTU and WMU, 1964-66.

Table 2-7.7S

Sources of Funds for Separately Budgeted Research in Social Sciences by Institution and Year

(in Thousands of Dollars)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	641	49.0	928	49.0	1,389	58.6	1,662	49.6	1,838	43.4
Inst.O.F.	221	16.9	218	11.5	253	10.7	303	9.0	361	8.5
Other NonF.	447	34.1	750	39.5	730	30.7	1,385	41.3	2,033	48.1
Total	1,309	100.0	1,896	100.0	2,372	100.0	3,350	100.0	4,232	100.0
MSU										
Federal	201	37.2	233	33.2	270	34.8	316	34.9	462	43.7
Inst.O.F.	320	59.3	420	59.8	348	44.8	426	47.0	417	39.5
Other NonF.	19	3.5	49	7.0	158	20.4	164	18.1	178	16.8
Total	540	100.0	702	100.0	776	100.0	906	100.0	1,057	100.0
WSU										
Federal					13	76.5	4	9.3	11	50.0
Inst.O.F.					1	5.9				
Other NonF.					3	17.6	39	90.7	11	50.0
Total					17	100.0	43	100.0	22	100.0
WMU										
Federal							48	65.8	14	34.1
Inst.O.F.							25	34.2	27	65.9
Other NonF.										
Total							73	100.0	41	100.0
NMU										
Federal			6	100.0			27	100.0	16	100.0
Inst.O.F.										
Other NonF.										
Total			6	100.0			27	100.0	16	100.0

(continued)

Table 2-7.7S (continued)

Institution and Sources of Funds	1957-58 Am't.	1957-58 %	1960-61 Am't.	1960-61 %	1963-64 Am't.	1963-64 %	1964-65 Am't.	1964-65 %	1965-66 Am't.	1965-66 %
OU										
Federal					15	100.0	4	100.0	3	100.0
Inst.O.F.										
Other NonF.										
Total					15	100.0	4	100.0	3	100.0
FSC										
Federal									3	100.0
Inst.O.F.										
Other NonF.										
Total									3	100.0

Table 2-7.7.15

Federal Sources of Funds Expended for Separately Budgeted Research in Social Sciences, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	19	28	42	51	53
2. Army	8	11	16	9	9
3. Navy	15	22	33	20	24
4. Other	-	-	-	-	-
B. Atomic Energy Commission	-	-	-	-	-
C. Department of Health, Education and Welfare					
1. Nat'l Instit. of Health	247	345	439	496	571
2. Public Health Service other than NIH	27	40	60	60	60
3. Office of Education	76	116	194	414	509
D. Department of Agriculture	152	174	158	116	141
E. Department of Interior	-	-	-	-	120
F. Department of Labor	-	-	86	140	16
G. National Science Foundation	141	204	336	437	488
H. National Aeronautics and Space Administration	1	1	1	32	26
I. All Other Federal Agencies	156	226	322	286	330
Totals (sum of A through I)	842	1,167	1,687	2,061	2,347

*Includes data for U of M and MSU for all five years; for NMU 1960-66; for WSU and OU 1963-66; for WMU 1964-65; for FSC 1965-66.

Table 2-7.8S

Sources of Funds for Separately Budgeted Research in Psychology by Institution and Year

(in Thousands of Dollars)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
U of M										
Federal	437	92.0	633	91.9	968	94.4	975	85.2	1,216	88.4
Inst.O.F.	2	.4	2	.3	2	.2	98	8.6	103	7.5
Other NonF.	36	7.6	54	7.8	55	5.4	71	6.2	56	4.1
Total	475	100.0	689	100.0	1,025	100.0	1,144	100.0	1,375	100.0
MSU										
Federal	7	17.1	100	66.2	168	100.0	201	98.0	209	97.7
Inst.O.F.										
Other NonF.	34	82.9	51	33.8			4	2.0	5	2.3
Total	41	100.0	151	100.0	168	100.0	205	100.0	214	100.0
WSU										
Federal					79	98.7	106	99.1	93	96.9
Inst. O.F.										
Other NonF.					1	1.3	1	.9	3	3.1
Total					80	100.0	107	100.0	96	100.0
WMU										
Federal							5	45.5	17	68.0
Inst. O.F.							6	54.5	8	32.0
Other NonF.										
Total							11	100.0	25	100.0
CMU										
Federal					4	44.4	40	100.0	6	100.0
Inst. O.F.										
Other NonF.					5	55.6				
Total					9	100.0	40	100.0	6	100.0

(continued)

Table 2-7.8S (continued)

Institution and Sources of Funds	1957-58		1960-61		1963-64		1964-65		1965-66	
	Am't.	%	Am't.	%	Am't.	%	Am't.	%	Am't.	%
NMU										
Federal									2	100.0
Inst. O.F.										
Other NonF.										
Total									2	100.0
OU										
Federal					10	100.0	1	100.0	2	100.0
Inst.O.F.										
Other NonF.										
Total					10	100.0	1	100.0	2	100.0

Table 2-7.8.15

Federal Sources of Funds Expended for Separately Budgeted Research in Psychology, Michigan Public Institutions*
(in Thousands of Dollars)

Federal Sources	1957-58	1960-61	1963-64	1964-65	1965-66
A. Department of Defense					
1. Air Force	87	127	193	218	196
2. Army	9	13	20	19	11
3. Navy	1	1	1	-	-
4. Other	-	-	-	-	9
B. Atomic Energy Commission	13	18	28	-	-
C. Department of Health, Education and Welfare					
1. Nat'l Instit. of Health	185	298	547	733	923
2. Public Health Service other than NIH	-	-	-	-	2
3. Office of Education	77	130	196	91	132
D. Department of Agriculture	-	-	-	-	-
E. Department of Interior	-	-	-	-	-
F. Department of Labor	-	-	-	-	32
G. National Science Foundation	62	132	221	204	161
H. National Aeronautics and Space Administration	3	5	8	59	65
I. All Other Federal Agencies	7	9	15	4	14
Totals (sum of A through I)	444	733	1,229	1,328	1,545

*Includes data for U of M and MSU for all 5 years; for WSU, CMU, OU 1963-66; for WMU 1964-66; for NMU 1965-66.

Table 3-2S

Percent of Faculty Considering Themselves Well-Informed of the Research Support Programs of Four Types of Sponsors

(N = 514)

		Percent of Faculty Responding			
Institution	(N)	Federal	State or Local Government	Private Profit Corporation	Private Foundation
U of M	96	85.4	21.9	27.1	31.3
MSU	96	80.2	30.2	29.2	41.7
WSU	42	78.6	19.0	16.7	33.3
WMU	42	61.9	21.4	14.3	31.0
MTU	34	55.9	26.5	14.7	21.2
CMU	46	32.6	4.3	6.5	13.0
EMU	37	78.4	21.6	16.2	32.4
NMU	27	48.1	25.9	14.8	22.2
OU	27	77.8	7.4	11.1	25.9
FSC	29	37.9	10.3	10.7	10.3
GVSC	38	44.7	10.5	13.2	26.3

SVSC was omitted as there were only 3 responders.

Table 3-38

Tendency for the Most Able Faculty to be Attracted To Institutions and Departments Most Heavily Supported in Research

(No responses and no opinions eliminated, N = 497)

		Faculty Responses by Percent		
Institution	(N)	Strong + Tendency	Some + Tendency	No + or - Tendency
U of M	93	75.3	23.7	1.1
MSU	95	69.5	26.3	4.2
WSU	41	65.8	34.2	
WMU	40	72.5	27.5	
MTU	33	57.6	36.4	6.1
CMU	43	65.1	25.6	4.6
EMU	38	65.8	34.2	
NMU	25	52.0	48.0	
OU	27	74.1	25.9	
FSC	26	76.9	19.2	3.8
GVSC	36	50.0	41.7	8.3

Table 3-4S*

Broad Forms** of Science Support by Federal Agencies
to Michigan Public Institutions***
(in Thousands of Dollars)

	1957-58	1960-61	1963-64	1964-65	1965-66
U of M					
NIH			563	724	808
NSF			75	142	140
Total			638	866	948
MSU					
NIH		-	-	-	-
NSF		3	105	324	193
Total		3	105	324	193
WMU					
NIH			-	-	-
NSF			13	10	16
Total			13	10	16
OU					
NIH			-		-
NSF			9		12
Total			9		12
CMU					
NIH		18	4	40	6
NSF		27	-	-	-
Total		45	4	40	6
EMU					
NIH			-	-	-
NSF			4	12	11
Total			4	12	11
NMU					
NIH			-	-	-
NSF			10	8	8
Total			10	8	8
FSC					
NIH			-	-	-
NSF			2	1	1
Total			2	1	1

*Reference to p. 76 F. of the report

**Data was requested from each institution on NIH General Research Support Grants, NSF Institutional Base Grants, and NASA Sustaining University Grants. No institution reported data for this type of NASA grant.

***Institutions not listed either did not have applicable data or did not have data available at this time.

Table 3-8.1S*

Faculty Opinion on Whether Funds for Sponsored Research Brought Major Change in Emphasis Among Research Programs in Their Institution During the Period, 1957-1967

N = 519

		Percent of Faculty				
Institution	(N)	Yes	No	Don't Know	Short Tenure Precludes Judgment	No Response
U of M	96	55.2	12.5	18.8	11.5	2.1
MSU	97	47.4	9.3	17.5	25.8	-
WSU	43	32.6	20.9	27.9	18.6	-
WMU	42	38.1	9.5	16.7	35.7	-
MTU	35	31.4	14.3	28.6	25.7	-
CMU	46	15.2	13.0	34.8	28.3	8.7
EMU	38	31.6	13.2	26.3	26.3	2.6
NMU	27	40.7	0.0	9.0	7.0	-
OU	27	18.5	22.2	14.8	44.4	-
FSC	29	13.8	24.1	31.0	24.1	6.9
GVSC	39	10.3	15.4	7.7	48.7	17.9

*Reference to pp. 88-92 of the Report.

Table 3-8.2S*

Faculty Opinion on Whether a Major Change in Research Emphasis Resulting from Sponsored Research Funds During the Period, 1957-1967, was in the Best Interest of Their Institution and Their Field of Science

N = 519

Institution	(N)	Percent of Faculty			
		Yes	No	No Opinion	No Response**
U of M	96				
Best Interest of Institution		38.5	7.3	4.2	50.0
Best Interest of Field of Science		36.5	7.3	6.3	50.0
MSU	97				
Best Interest of Institution		39.2	7.2	5.2	48.5
Best Interest of Field of Science		37.1	11.3	2.1	49.5
WSU	43				
Best Interest of Institution		30.2		2.3	67.4
Best Interest of Field of Science		32.6			67.4
WMU	42				
Best Interest of Institution		28.6		7.1	64.3
Best Interest of Field of Science		28.6		7.1	64.3
MTU	35				
Best Interest of Institution		22.9		2.9	74.3
Best Interest of Field of Science		22.9			77.1
CMU	46				
Best Interest of Institution		8.7			91.3
Best Interest of Field of Science		8.7	2.2	2.2	87.0
EMU	38				
Best Interest of Institution		28.9		2.6	68.4
Best Interest of Field of Science		23.7	2.6	2.6	71.1
NMU	27				
Best Interest of Institution		29.6	3.7	7.4	59.2
Best Interest of Field of Science		29.6	3.7	7.4	59.2
OU	27				
Best Interest of Institution		14.8	3.7		81.5
Best Interest of Field of Science		11.1	7.4		81.5
FSC	29				
Best Interest of Institution		10.3		3.4	86.2
Best Interest of Field of Science		6.9	6.9		86.2
GVSC	39				
Best Interest of Institution		2.6	2.6	5.2	89.7
Best Interest of Field of Science		2.6		7.8	89.7

*Reference to pp. 88-92 of the Report

**No response includes those who did not recognize a major change in emphasis (those who did not answer Yes to the item in Table 3-8.1S)

Table 3-8.3S*

Faculty Opinion on Whether the Dollar Distribution of Federal Grants and Contracts Among the Natural Sciences, Humanities, and Social Sciences Has Been in the Best Interest of Their Institution and Their Field of Science

N = 519

Institution	(N)	Percent of Faculty Yes	No	No Opinion	No Response
U of M	96				
Best Interest of Institution		28.1	33.3	34.4	4.2
Best Interest of Field of Science		60.4	18.8	15.6	5.2
MSU	97				
Best Interest of Institution		33.0	27.8	39.2	-
Best Interest of Field of Science		51.5	32.0	16.5	-
WSU	43				
Best Interest of Institution		44.2	37.2	18.6	-
Best Interest of Field of Science		67.4	23.3	9.3	-
WMU	42				
Best Interest of Institution		21.4	47.6	31.0	-
Best Interest of Field of Science		47.6	35.7	16.7	-
MTU	35				
Best Interest of Institution		77.1	8.6	11.4	2.9
Best Interest of Field of Science		68.6	14.3	14.3	2.9
CMU	46				
Best Interest of Institution		23.9	28.3	37.0	10.9
Best Interest of Field of Science		32.6	32.6	23.9	10.9
EMU	38				
Best Interest of Institution		23.7	42.1	31.6	2.6
Best Interest of Field of Science		42.1	28.9	26.3	2.6
NMU	27				
Best Interest of Institution		14.8	37.0	48.1	-
Best Interest of Field of Science		37.0	37.0	25.9	-
OU	27				
Best Interest of Institution		22.2	40.7	37.0	-
Best Interest of Field of Science		40.7	33.3	22.2	3.7
FSC	29				
Best Interest of Institution		34.5	13.8	44.8	6.9
Best Interest of Field of Science		31.0	27.6	34.5	6.9
GVSC	39				
Best Interest of Institution		15.4	41.0	38.5	5.1
Best Interest of Field of Science		25.6	33.3	35.9	5.1

*Reference to pp. 88-92 of the Report

Table 3-8.4S*

Faculty Opinion on the Appropriate Source of Additional Funds for Research in the Social Sciences and Humanities

N = 519

	Percent of Faculty					
Institution (N)	Federal Government	State and Local Government	Private Corporations	Private Foundations	No Opinion	No Response
U of M 96						
Social Sciences	33.3	9.4		12.5	33.3	11.5
Humanities	29.2	7.3		15.6	38.5	9.4
MSU 97						
Social Sciences	24.7	8.2	1.0	13.4	42.3	10.3
Humanities	24.7	8.2	1.0	13.4	42.3	10.3
WSU 43						
Social Sciences	39.5	11.6	2.3	11.6	25.6	9.3
Humanities	39.5	2.3		25.6	27.9	4.7
WMU 42						
Social Sciences	31.0	2.4		9.5	40.5	16.7
Humanities	23.8	2.4		14.3	45.2	14.3
MTU 35						
Social Sciences	14.3	5.7	2.9	25.7	34.3	17.1
Humanities	14.3	5.7	2.9	25.7	34.3	17.1
CMU 46						
Social Sciences	23.9	6.5	2.2	17.4	30.4	19.6
Humanities	23.9	6.5		19.6	30.4	19.6
EMU 38						
Social Sciences	31.6	5.3		10.5	31.6	21.1
Humanities	26.3	5.3		18.4	36.8	13.2
NMU 27						
Social Sciences	37.0	3.7	3.7	11.1	37.0	7.4
Humanities	29.6		7.4	14.8	40.7	7.4
OU 27						
Social Sciences	40.7	7.4		14.8	22.2	14.8
Humanities	37.0			14.8	25.9	22.2
FSC 29						
Social Sciences	31.0	3.4	3.4	10.3	48.3	3.4
Humanities	27.6		3.4	6.9	51.7	10.3
GVSC 39						
Social Sciences	23.1	5.1	2.6	20.5	38.5	10.4
Humanities	20.5		2.6	17.9	46.2	12.8

*Reference to pp. 88-92 of the Report.

Table 3-8.5S*

Faculty Opinion on Whether Funds for Sponsored Research Have Resulted in Overemphasis for Certain Types of Research Within Their Own Field of Science

N = 519

Institution	(N)	Percent of Faculty				
		Serious Problem	A Problem but Not Serious	Problem is Neglibigle or Nonexistent	No Opinion	No Response
U of M	96	12.5	50.0	32.3	3.1	2.1
MSU	97	16.5	47.4	26.8	6.2	3.1
WSU	43	14.0	51.2	32.6	2.3	-
WMU	42	11.9	35.7	45.2	7.1	-
MTU	35	2.9	25.7	48.6	17.1	5.7
CMU	46	13.0	23.9	17.4	30.4	15.2
EMU	38	15.8	26.3	44.7	10.5	2.6
NMU	27	0.0	37.0	40.7	22.2	-
OU	27	22.2	51.9	22.2	3.7	-
FSC	29	20.7	20.7	31.0	27.6	-
GVSC	39	15.4	23.1	23.1	25.6	12.8

*Reference to pp. 92-93 of the Report

Table 3-9.1S*

Funds Awarded for Sponsored Research and Development Through Grant or Contract, Michigan Public Institutions**, 1965-1966 by Area of Science and Source of Funds
(in Thousands of Dollars)

Institution	Engineering Grant	Engineering Contract	Physical Sciences Grant	Physical Sciences Contract	Life Sciences Grant	Life Sciences Contract	Social Sciences Grant	Social Sciences Contract	Other Sciences incl. Psychology Grant	Other Sciences incl. Psychology Contract
MSU										
Federal Funds	272	35	1,766	447	1,606	2,896	156	-	77	41
NonFed. Funds	16	100	182	-	701	299	22	106	6	7
Total	288	135	1,948	447	2,307	3,195	178	106	83	48
WSU										
Federal Funds	5	83	652	32	1,267	279	4		62	32
NonFed. Funds	(NonFed. data not available at this time)									
Total	5	83	652	32	1,267	279	4		62	32
MTU										
Federal Funds	37	155	2	46	38	-				
NonFed. Funds	30	60	2	252	11	21				
Total	67	215	4	298	49	21				
WMU										
Federal Funds		11	86				24		31	
NonFed. Funds		40	24				-		7	
Total		51	110				24		38	
CMU										
Federal Funds			87		41				10	
NonFed. Funds			-		-				-	
Total			87		41				10	
NMU										
Federal Funds			6		7		17			
NonFed. Funds			-		-		-			
Total			6		7		17			

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(continued)

Table 3-9.1S * (continued)

	Engineering		Physical Sciences		Life Sciences		Social Sciences		Other Sciences incl. Psychology	
Institution	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract
OU										
Federal Funds			24		7	51	6			4
NonFed. Funds			32		-	-	-			-
Total			56		7	51	6			4
FSC										
Federal Funds			1		-		3			1
NonFed. Funds			-		2		-			-
Total			1		2		3			1

*Reference to p. 93f of the report
**Institutions not listed either did not have applicable data or did not have data available at this time.

Table 3-9.2S*

Federal Sources of Funds Awarded for Sponsored Research and Development Through Grant or Contract, Michigan Public Institutions**, 1965-1966
(in Thousands of Dollars)

Federal Sources	MSU		WSU		MTU		WMU		CMU	
	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract	Grant	Contract
A. Department of Defense										
1. Air Force	43	39	58	13	22					
2. Army		22	30	2		81				
3. Navy		174		19						
4. Other										
B. Atomic Energy Commission		1,998		96		69				
C. Department of Health, Education and Welfare										
1. Nat'l Instit. of Health	1,317	569	1,633	189			107		10	
2. Public Health Service other than NIH	26									
3. Office of Education		41		43			9		128	
D. Department of Agriculture	35	350			5	22		11		
E. Department of Interior		141								
F. Department of Labor	122									
G. National Science Foundation	2,326		269	32	25		25			
H. National Aeronautics and Space Administration		85			8					
I. All Other Federal Agencies	8			32		46				
Totals (sum of A through I)	3,877	3,419	1,990	426	60	218	141	11	138	

(continued)

*Reference to p. 93 f. of the report
**Institutions not listed either did not have applicable data or did not have data available at this time.

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Table 3-9.2S * (continued)

Federal Sources	NMU Grant	NMU Contract	OU Grant	OU Contract	FSC Grant	FSC Contract
A. Department of Defense						
1. Air Force						
2. Army						
3. Navy						
4. Other						
B. Atomic Energy Commission				30		
C. Department of Health, Education and Welfare						
1. Nat'l Instit. of Health						
2. Public Health Service other than NIH				25		
3. Office of Education					3	
D. Department of Agriculture						
E. Department of Interior						
F. Department of Labor						
G. National Science Foundation	30		37		1	1
H. National Aeronautics and Space Administration						
I. All Other Federal Agencies						
Totals (sum of A through I)	30		37	55	4	1

*Reference to p. 93 f. of the report
**Institutions not listed either did not have applicable data or did not have data available at this time.

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Table 3-9.3S*

Funds for Specially Organized Projects for the Support or Improvement of Science Education by Institutions**, Year, and Source of Funds

(in Thousands of Dollars)

Institution	1961-62	1962-63	1963-64	1964-65	1965-66
U of M					
Federal Funds	314	458	735	852	870
NonFed. Funds	6	6	28	12	9
Total	320	464	763	864	879
MSU					
Federal Funds	586	521	564	531	449
NonFed. Funds	-	-	-	-	-
Total	586	521	564	531	449
WMU					
Federal Funds				213	394
NonFed. Funds				-	-
Total				213	394
CMU					
Federal Funds			139	117	119
NonFed. Funds			-	-	-
Total			139	117	119
NMU					
Federal Funds	62	52	183	119	147
NonFed. Funds	-	-	-	-	-
Total	62	52	183	119	147
OU					
Federal Funds	23	3			5
NonFed. Funds	-	-			-
Total	23	3			5
FSC					
Federal Funds			-		-
NonFed. Funds			1		1
Total			1		1

*Reference to p. 129 of report. Funds for Separately Bdugeted Research, Plant and Equipment, and for Fellowships, Assistantships, and Traineeships are excluded.

**Institutions not listed either did not have applicable data or did not have data available at this time.

Table 3-9.4S*

Federal Sources of Funds for Specially Organized Projects for the Support or Improvement of Science Education by Institution** and for the Years 1961-1966 (in Thousands of Dollars)

Federal Sources	U of M	MSU	WMU	CMU	NMU	OU
A. Department of Defense						
1. Air Force						
2. Army						
3. Navy						
4. Other						
B. Atomic Energy Commission	5					
C. Department of Health, Education and Welfare						
1. Nat'l Instit. of Health						
2. Public Health Service other than NIH			34			
3. Office of Education	43					
D. Department of Agriculture						
E. Department of Interior						
F. Department of Labor						
G. National Science Foundation	2,018	2,651	573	375	563	31
H. National Aeronautics and Space Administration						
I. All Other Federal Agencies	1,100					
Totals (sum of A through I)	3,230	2,651	607	375	563	31

*Reference to p. 129 of the report. Funds for Separately Budgeted Research, Plant and Equipment, and for Fellowships, Assistantships, and Traineeships are excluded.

**Institutions not listed either did not have applicable data or did not have data available at this time.

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Table 4-OS*

Number of Science Majors and Credit Hours** Produced, and Graduate Student Percentages By Field of Science and Institution***, 1965-1966

Institutions	Engineering			Physical Science			Life Science			Social Science			Psychology			Other		
	N	% Grad. Students	% Within all Sciences	N	% Grad. Students	% Within all Sciences	N	% Grad. Students	% Within all Sciences	N	% Grad. Students	% Within all Sciences	N	% Grad. Students	% Within all Sciences	N	% Grad. Students	% Within all Sciences
U of M																		
Majors	2,831	44	39	1,292	58	18	1,296	55	18	1,123	35	16	621	47	9	67	99	1
Credit Hours	31,000	26	17	59,554	17	32	44,568	50	24	32,605	28	18	17,449	20	9	460	100	1-
MSU																		
Majors	2,348	11	19	2,241	27	18	4,324	25	35	2,751	21	22	858	20	7	-	-	-
Credit Hours	43,054	13	6	207,890	7	30	163,468	16	23	215,773	8	31	74,755	8	11	-	-	-
[illegible]U																		
Majors	2,091	23	42	859	50	17	859	46	17	752	34	15	376	29	8	-	-	-
Credit Hours	24,613	23	7	121,821	13	32	43,900	14	12	144,166	8	38	41,902	9	11	-	-	-
MTU	(Data for Fall Quarter, 1965, only, for Credit Hours Produced)																	
Majors	2,208	4	75	413	10	14	319	0	11	-	-	-	-	-	-	-	-	-
Credit Hours	14,947	4	34	20,720	2	47	2,635	2	6	5,152	0	12	279	0	1	-	-	-
WMU	(Data on Majors are for Graduate Students only)																	
Majors	-	-	-	83	100	27	41	100	13	70	100	23	115	100	37	-	-	-
Credit Hours	14,671	1	10	33,481	10	23	13,969	4	10	59,239	6	41	22,269	12	15	-	-	-
CMU																		
Majors	-	-	-	688	4	40	493	7	29	332	7	19	194	0	11	-	-	-
Credit Hours	-	-	-	35,064	5	42	11,866	9	14	29,545	3	35	8,091	7	10	-	-	-
EMU	(Data on Majors are for Undergraduates only)																	
Majors	-	-	-	448	0	36	181	0	15	497	0	40	120	0	10	-	-	-
Credit Hours	-	-	-	25,395	8	33	10,237	11	13	32,119	8	42	9,252	14	12	-	-	-

(continued)

Table 4-OS* (continued)

Institution	Engineering			Physical Science			Life Science			Social Science			Psychology			Other		
	N	% Grad. Stu-dents	% Within all Sci-ences	N	% Grad. Stu-dents	% Within all Sci-ences	N	% Grad. Stu-dents	% Within all Sci-ences	N	% Grad. Stu-dents	% Within all Sci-ences	N	% Grad. Stu-dents	% Within all Sci-ences	N	% Grad. Stu-dents	% Within all Sci-ences
OU																		
Majors	157	0	19	249	2	31	68	0	8	216	0	27	124	0	15	-	-	-
Credit Hours	1,175	0	4	10,858	4	39	2,448	0	9	8,369	0	30	5,156	0	18	-	-	-
FSC	(No Graduate enrollments)																	
Majors	-	-	-	28	0	5	503	0	95	-	-	-	-	-	-	-	-	-
Credit Hours	-	-	-	10,337	0	33	9,514	0	31	9,160	0	30	1,941	0	6	-	-	-
GVSC	(No Graduate enrollments)																	
Majors	-	-	-	96	0	23	78	0	19	177	0	43	60	0	16	-	-	-
Credit Hours	-	-	-	9,641	0	35	3,630	0	13	11,282	0	41	2,835	0	10	-	-	-
--																		

*Reference to pp. 97-104 of the Report
**Semester credit hours are entered for U of M, CMU, EMU, WMU, and OU.
Term or quarter credit hours are entered for MSU, WSU, MTU, FSC and GVSC.
***There were no data currently available for NMU or SVSC.

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Table 4-1S

Expenditures for Equipment by Michigan Public Institutions*
from Funds for Separately Budgeted Research
By Area of Science and Federal and NonFederal Sources, 1964-65 and 1965-66

(In Thousands of Dollars)

	1964-1965						1965-1966					
	Federal		NonFederal		Total		Federal		NonFederal		Total	
Area of Science	Amount	% from Source	Amount	% from Source	Amount	%	Amount	% from Source	Amount	% from Source	Amount	%
Engineering	604	86.9	91	13.1	695	100.0	427	87.1	63	12.9	490	100.0
Life Sciences	1,592	77.8	453	22.2	2,045	100.0	1,516	82.5	321	17.5	1,837	100.0
Physical Sciences	1,295	94.6	74	5.4	1,369	100.0	1,059	95.8	46	4.2	1,105	100.0
Social Sciences	124	69.7	54	30.3	178	100.0	16	32.0	34	68.0	50	100.0
Other Sciences	115	58.7	81	41.3	196	100.0	93	60.8	60	39.2	153	100.0
Total	3,730	83.2	753	16.8	4,483	100.0	3,111	85.6	524	14.4	3,635	100.0

*Data for 1964-65 reported and included from U of M, MSU, WSU, MTU, CMU, NMU, WMU, OU, FSC; for 1965-66 from U of M, MSU, MTU, CMU, NMU, WMU, OU, and FSC.

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Table 4-1.1S

Equipment Expenditures at the University of Michigan
for Science Research and Education
by Source, 1965-66
(in Thousands of Dollars)

Sources	Totals		% of Source
Funds from Separately Budgeted R & D			
Federal	1,884		89.6
Institution's Own Funds	97		4.6
Other Non-Federal	122		5.8
Total	2,103		100.0
% of All Sources		81.8	
Funds from Institution's Instruction and Department Research Fund	466		100.0
% of All Sources		18.1	
Funds from Federal Science Education Grants	2		100.0
% of All Sources		.1	
Total	2,571		

Table 4-2S

Capital Expenditures in Michigan Public Institutions*, on Science Plant and Equipment** for R and D and Graduate Instruction and for Undergraduate Instruction, 1956-1966 By Source of Funds and By Area of Science

(In Thousands of Dollars)

Area of Science and Type of Expenditure	Federal Funds Amount	%	State Legislative Appropriations Amount	%	Institution's Own Funds Amount	%	Other Funds Amount	%	All Sources Total Amount	Total %
Engineering										
R&D and Grad. Instruction	321	4.4	6,587	89.5	438	6.0	11	.1	7,357	100.0
Undergrad.Instruct.	865	7.8	8,687	78.7	1,325	12.0	167	1.5	11,044	100.0
Total	1,186	6.4	15,274	83.0	1,763	9.6	178	1.0	18,401	100.0
Physical Sciences										
R&D and Grad. Instruction	2,363	25.3	5,733	61.3	1,179	12.6	79	.8	9,354	100.0
Undergrad. Instruct.	58	.4	11,705	88.3	1,380	10.4	111	.9	13,254	100.0
Total	2,421	10.7	17,438	77.1	2,559	11.3	190	.8	22,608	100.0
Life Sciences										
R&D and Grad. Instruction	7,720	25.8	9,819	32.8	10,129	33.9	2,249	7.5	29,917	100.0
Undergrad.Instruct.	1,297	17.4	4,166	55.9	1,558	20.9	431	5.8	7,452	100.0
Total	9,017	24.1	13,985	37.4	11,687	31.3	2,680	7.2	37,369	100.0
Social Sciences										
R&D and Grad. Instruction	560	19.5	959	33.3	1,066	37.0	295	10.2	2,880	100.0
Undergrad.Instruct.	-		3,924	70.1	1,566	28.0	104	1.9	5,594	100.0
Total	560	6.6	4,883	57.6	2,632	31.1	399	4.7	8,474	100.0
Psychology										
R&D and Grad. Instruction	304	34.0	-		590	65.9	1	.1	895	100.0
Undergrad.Instruct.	-		637	36.2	1,104	62.7	19	1.1	1,760	100.0
Total	304	11.4	637	24.0	1,694	63.8	20	.8	2,655	100.0

(continued)

Table 4-2.S (continued)

Area of Science and Type of Expenditure	Amounts and Proportions from Sources									
	Federal Funds		State Legislative Appropriations		Institution's Own Funds		Other Funds		All Sources	
	Amount	%	Amount	%	Amount	%	Amount	%	Total Amount	Total %
Other Sciences										
R&D and Grad. Instruction	-		217	100.0	-		-		217	100.0
Undergrad. Instruct.	-		-		-		-		-	
Total	-		217	100.0	-		-		217	100.0

*Data available and included from U of M, MSU, MTU, OU, CMU, and FSC. Data included from WMU for 1964-66 only.

**Equipment expenditures from the Institutions' funds for Instruction and Departmental Research and from Special Funds for the Support or Improvement of Science Education are excluded. See Table 4-1 of the Report.

Table 4-8.1S

Type of Financial Assistance Received by Ph.D. Candidates According to Source (Federal, University, and Other) and Institution (U of M, MSU, WSU, MTU, and WMU)

	Genrl Duty Assistant		Teaching Assistant		Research Assistant		Fellowship		Scholarship		Traineeship		Other	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Federal Assistance														
U of M	2	0.9	3	1.3	75	33.0	50	22.0	4	1.8	83	36.6	10	4.4
MSU	1	2.1	2	4.2	22	45.8	10	20.8	-	-	9	18.7	4	8.3
WSU	-	-	1	6.7	4	26.7	4	26.7	-	-	5	33.3	1	6.7
MTU	-	-	-	-	1	11.1	1	11.1	-	-	7	77.8	-	-
WMU	-	-	-	-	-	-	3	75.0	-	-	1	25.0	-	-
University														
U of M	1	0.8	69	52.7	25	19.1	17	13.0	5	3.8	8	6.1	6	4.6
MSU	6	11.5	27	51.9	13	25.0	2	3.8	-	-	2	3.8	2	3.8
WSU	-	-	7	70.0	1	10.0	1	10.0	-	-	-	-	1	10.0
MTU	-	-	1	100.0	-	-	-	-	-	-	-	-	-	-
WMU	1	33.3	2	66.7	-	-	-	-	-	-	-	-	-	-
Other														
U of M	1	1.9	-	-	12	22.6	27	50.9	5	9.4	2	3.8	6	11.3
MSU	-	-	1	7.1	6	42.8	6	42.8	-	-	1	7.1	-	-
WSU	-	-	-	-	1	50.0	-	-	-	-	-	-	1	50.0
MTU	-	-	-	-	-	-	-	-	-	-	1	100.0	-	-
WMU	-	-	-	-	-	-	-	-	-	-	1	100.0	-	-

Table 4-8.2S

Type of Financial Assistance Received By Masters Candidates According to Source (Federal, University, and Other) and Institution (U of M, MSU, WSU, MTU, and WMU)

	Genrl Duty Assistant		Teaching Assistant		Research Assistant		Fellowship		Scholarship		Traineeship		Other	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Federal Assistance														
U of M	-	-	-	-	10	11.5	20	23.0	1	1.1	38	43.7	18	20.7
MSU	1	8.3	1	8.3	2	16.6	4	33.3	1	8.3	2	16.6	1	8.3
WSU	-	-	1	12.5	1	12.5	2	25.0	-	-	1	12.5	3	37.5
MTU	-	-	1	16.7	1	16.7	1	16.7	-	-	2	33.4	1	16.7
WMU	-	-	1	3.6	5	17.8	8	28.6	3	10.7	3	10.7	8	28.6
University														
U of M	5	8.5	20	33.9	7	11.9	11	18.6	8	13.5	5	8.5	3	5.1
MSU	2	7.7	20	76.9	4	15.4	-	-	-	-	-	-	-	-
WSU	-	-	5	50.0	-	-	1	10.0	4	40.0	-	-	-	-
MTU	3	10.0	25	83.3	-	-	1	3.3	-	-	-	-	1	3.3
WMU	7	13.7	32	62.7	3	5.9	6	11.8	-	-	2	3.9	1	2.0
Other														
U of M	-	-	-	-	3	6.8	15	34.1	4	9.1	4	9.1	18	40.9
MSU	-	-	2	22.2	2	22.2	1	11.1	2	22.2	-	-	2	22.2
WSU	-	-	1	7.1	-	-	-	-	-	-	1	7.1	12	85.7
MTU	-	-	-	-	1	20.0	2	40.0	1	20.0	-	-	1	20.0
WMU	1	12.5	-	-	-	-	-	-	2	25.0	2	25.0	3	37.5

Table 4-8.3S

Identifiable Types* of Financial Assistance from Six Federal Agencies** Received by a Sample of Ph.D. and Masters Candidates in Five Michigan Institutions (U of M, MSU, WSU, MTU, WMU), 1966-1967

Source of Assistance	Total N from Source	Genrl Duty Assistant. N	%	Teaching Assistant. N	%	Research Assistant. N	%	Fellowship N	%	Scholarship N	%	Traineeship N	%
		Number and Percent of Each Type of Assistance - Ph.D. Candidates											
NIH	83	1	1.2	0	0.0	19	22.9	24	28.9	2	2.4	37	44.6
DOD	27	0	0.0	0	0.0	24	88.9	2	7.4	1	3.7	0	0.0
AEC	19	0	0.0	0	0.0	11	51.9	8	42.1	0	0.0	0	0.0
NASA	29	0	0.0	0	0.0	10	34.5	1	3.4	0	0.0	18	62.1
NSF	70	0	0.0	3	4.3	22	31.4	16	22.9	0	0.0	29	41.4
OE	23	2	8.7	2	8.7	3	13.0	13	56.5	0	0.0	3	13.0

Source of Assistance	Total N from Source	Genrl Duty Assistant. N	%	Teaching Assistant. N	%	Research Assistant. N	%	Fellowship N	%	Scholarship N	%	Traineeship N	%
		Number and Percent of Each Type of Assistance - Masters Candidates											
NIH	16	0	0.0	0	0.0	6	37.5	2	12.5	0	0.0	8	50.0
DOD	8	0	0.0	0	0.0	6	75.0	1	12.5	0	0.0	1	12.5
AEC	5	0	0.0	0	0.0	0	0.0	5	100.0	0	0.0	0	0.0
NASA	5	0	0.0	1	20.0	1	20.0	1	20.0	0	0.0	2	40.0
NSF	42	1	2.4	2	4.8	3	7.1	8	19.0	2	4.8	26	61.9
OE	10	0	0.0	1	10.0	0	0.0	7	70.0	1	10.0	1	10.0

*Category of "Other" non-loan assistance is excluded.
**Category of "Other" Federal agencies is excluded.

Table 4-9.1S

FTE Faculty**, By Field of Science and Institution, 1965-1966

Institution	Engineering		Physical Science		Life Science		Social Science		Psychology		Other	
	N	% Within Science Fields	N	% Within Science Fields	N	% Within Science Fields	N	% Within Science Fields	N	% Within Science Fields	N	% Within Science Fields
U of M	190.75	16.1	217.10	25.9	293.54	35.0	81.74	9.7	52.16	6.2	3.11	.4
MSU	126.9	13.6	278.1	29.7	309.6	33.1	179.2	19.2	41.6	4.4	-	-
WSU	60.5	11.4	163.6	30.8	179.0	33.7	95.2	18.0	32.5	6.1	-	-
MTU	96.5	48.6	76.0	38.3	18.5	9.3	7.25	3.7	.25	.1	-	-
WMU	30.9	14.9	60.5	29.1	25.8	12.4	68.2	32.8	18.0	8.6	4.6	2.2
CMU	-	-	49.0	49.5	16.0	16.1	27.0	27.3	7.0	7.1	-	-
EMU	-	-	44.0	34.4	25.0	19.5	50.0	39.1	9.0	7.0	-	-
NMU	-	-	23.66	39.2	9.0	14.9	27.75	45.9	-	-	-	-
OU	5.0	10.9	17.3	37.8	4.0	8.7	13.5	29.5	6.0	13.1	-	-
FSC	-	-	25.0	36.8	23.0	33.8	17.0	25.0	3.0	4.4	-	-
GVSC	-	-	8.5	35.4	5.0	20.8	7.5	31.3	3.0	12.5		

*Ref

*Reference for pp. 123-125 of the Report.

**Percentages of FTE Faculty holding appointments as Lecturer, Assistant Instructor, or Graduate Teaching Assistant or Fellow are listed in Table 4-9 of the Report except for the area of "Other" sciences. At U of M, 3.2% of the FTE Faculty teaching in this area hold such appointments, and at WMU 0.0%.

Table 4-9.2S

Evaluation by a Sample of Students** in Five Michigan Institutions (U of M, MSU, WSU, MTU, WMU) of the Quality of Teaching by Graduate Teaching Assistants and Fellows

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Evaluation of Graduate Courses Taught by Graduate Assistants and Fellows

		Percent of Student Responses			
Category of Students	N	Very Satisfactory	Generally Satisfactory	Generally Unsatisfactory	Very Unsatisfactory
All grad. students	418	12.9	57.9	21.5	7.7
Ph.D. candidates	236	14.8	55.9	20.8	8.5
Masters candidates	182	10.4	60.4	22.5	6.6

Evaluation of Undergraduate Courses Taught by Graduate Assistants and Fellows

		Percent of Student Responses			
Category of Students	N	Very Satisfactory	Generally Satisfactory	Generally Unsatisfactory	Very Unsatisfactory
All grad. students	725	11.3	66.1	18.3	4.3
Ph.D. candidates	356	12.4	67.1	17.4	3.1
Masters candidates	369	10.3	65.0	19.2	5.4
Undergraduate seniors	416	7.1	59.4	26.4	7.1

*Reference to pp. 123-125 of the Report

**Students indicating that they had not been taught by graduate assistants or fellows are excluded from the N's in the tables. 62 percent of the Ph.D. candidates and 67 percent of the masters candidates had not been in graduate classes taught by graduate assistants or fellows. 42 percent of the Ph.D. candidates, 34 percent of the masters candidates, and 7 percent of the undergraduate seniors had not been in undergraduate

Table 4-9.3S*

Estimates by Ph.D., Masters, and Senior Science Majors of the Impact of Different Types of Financial Assistance on the Time Needed by a Bachelors Degree Holder to Acquire a Ph.D. or Masters Degree

Respondents** According to Degree Being Pursued	Number of Respondents and Median Response as to Years Required for a Ph.D. Degree With Various Types of Assistance Received									
	Scholarship or Fellowship		Teaching Assist.		Genrl. Duty Assist.		Research Assist.		Not Employed or Assisted	
	N	Med. Years	N	Med. Years	N	Med. Years	N	Med. Years	N	Med. Years
All Graduate Students	827	3.72	825	4.69	810	4.64	817	4.57	821	3.78
Ph.D. Candidates	622	3.74	621	4.71	605	4.66	614	4.58	615	3.81
Masters Candidates	205	3.65	204	4.59	205	4.64	203	4.52	206	3.72
Bachelors Candidates	90	3.57	92	4.54	91	4.55	91	4.55	92	3.60

Respondents** According to Degree Being Pursued	Number of Respondents and Median Response as to Years Required for a Masters Degree With Various Types of Assistance Received									
	Scholarship or Fellowship		Teaching Assist.		Genrl. Duty Assist.		Research Assist.		Not Employed or Assisted	
	N	Med. Years	N	Med. Years	N	Med. Years	N	Med. Years	N	Med. Years
All Graduate Students	1184	1.39	1180	1.89	1161	1.83	1164	1.82	1177	1.38
Ph.D. Candidates	614	1.38	612	1.86	600	1.80	606	1.78	609	1.39
Masters Candidates	510	1.39	568	1.92	561	1.86	558	1.87	568	1.36
Bachelors Candidates	202	1.45	203	2.09	199	1.99	197	2.10	198	1.41

*Reference to pp. 125-126 of the Report.
**Total possible respondents (those who returned usable questionnaires were 634 Ph.D. candidates, 581 Masters candidates, and 505 Bachelors candidates.

Table 4-9.4S*

Evaluation by Graduate Teaching, Research, and General Duty Assistants** Pursuing Ph. D. and Masters Degrees of the Procedures of Supervision Over Their Work by Faculty or Research Directors

Categories of Students	N	Percent of Students Indicating Satisfactory or Unsatisfactory Procedures of Supervision				
		Very Satisfactory	Generally Satisfactory	Uncertain	Generally Unsatisfactory	Very Unsatisfactory
Graduate Students	466	24.5	44.8	14.2	13.5	3.0
Ph.D. Candidates	298	26.2	46.6	10.4	13.8	3.8
Masters Candidates	168	21.4	41.7	20.8	13.1	3.0
Federally Aided	130	26.9	46.9	7.7	16.9	1.5
University Aided	289	23.2	43.9	17.0	12.5	3.5

*Reference to p. 127 of the Report
**Only students with these kinds of assistant duties responded to this item.

Table 4-9.5S*

Opinion of a Sample of Graduate Assistants and Teaching Fellows (at U of M, MSU, WSU, MTU, WMU) as to Whether Their Assistantship Duties Were Important as Part of Their Professional Training

Category of Students	N	Percent of Student Responses: All of the Time	Most of the Time	Some of the Time	Never
All grad. students	464	23.3	48.5	26.3	1.9
Ph.D. candidates	297	24.9	48.8	25.3	1.0
Masters candidates	167	20.4	47.9	28.1	3.6
Federally aided students	129	28.7	55.0	15.5	0.8
University aided students	287	17.8	46.0	33.4	2.8

*Reference to pp. 127-128 of the Report

Table 4-9.6S*

Opinion of a Sample of Graduate Assistants and Teaching Fellows (at U of M, MSU, WSU, MTU, WMU) as to Whether Their Assistantship Duties Made Reasonable Use of Their Abilities

		Percent of Student Responses			
Category of Students	N	All of the Time	Most of the Time	Some of the Time	Never
All grad. students	462	18.0	53.2	27.1	1.7
Ph.D. candidates	296	20.9	53.0	25.0	1.0
Masters candidates	166	12.7	52.6	30.7	3.0
Federally aided students	127	22.0	58.3	18.9	0.8
University aided students	287	13.6	52.3	32.1	2.1

* Reference to pp. 127-128 of the Report

Table 4-9.7S*

Career Plans of a Sample of Graduate Students at U of M, MSU, WSU, MTU, WMU

Category of Students	N	Percent of Student Response: Pursue Another Degree	University Research Without Pursuit of Degree	University Teaching or Research	Elementary or Secondary Teaching or Research	Business and Industry Service or Research	Government Service or Research	Become Self-Employed	Other
All Ph.D. candidates	624	1.4	1.8	62.8	0.5	22.6	5.8	0.6	4.5
All Masters candidates	554	31.6	0.7	10.5	7.3	34.1	11.0	0.5	3.8
Federally** Aided									
Students	362	12.2	2.2	48.1	4.7	20.7	8.8	0.6	2.8
Ph.D. candidates	259	2.3	2.3	62.5	0.8	31.3	6.9	0.4	3.5
Masters candidates	103	36.9	1.9	11.6	14.6	19.4	13.6	1.0	1.0
University Aided									
Students	360	18.9	0.8	45.0	3.1	22.8	5.6	0.0	3.9
Ph.D. candidates	197	0.5	1.5	70.1	0.5	19.8	3.0	0.0	4.6
Masters candidates	163	41.1	0.0	14.7	6.1	26.4	8.6	0.0	3.1
Business and Industry									
Aided Students	81	4.9	1.2	9.9	1.2	79.0	1.2	1.2	1.2
Ph.D. candidates	29	0.0	3.4	24.1	0.0	69.0	0.0	3.4	0.0
Masters candidates	52	7.7	0.0	1.9	1.9	84.6	1.9	0.0	1.9

*Reference to p. 128 of the Report
**Includes NIH, DOD, AEC, NASA, NSF, OE.

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Part 4

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