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ABSTRACT

An examination of the findings of three national surveys reveals that several statistical academic science resource indicators reflected a period of growth during the mid-seventies. While this trend is expected to continue through the end of the seventies, the 9 percent increase in federal research and development (R&D) funding to universities proposed in the President's 1981 budget is seen to permit little if any real growth in the early eighties. These highlights are presented: in dollars, one-tenth of the R&D was spent by universities in 1979, as well as one-half of the basic research. Although annual growth in R&D expenditures averaged 9 percent between 1972 and 1977, real growth was only 1 to 2 percent. During this period the life science dominated academic science and engineering (S/E) resource increased. Graduate institutions increased their employment of S/E personnel by 3 to 6 percent. Overall in academe, part-time S/E personnel increased 35 percent, and full-time personnel increased 11 percent. S/E employees in R&D increased at a full-time-equivalent rate of 22 percent; those in teaching increased 14 percent. In addition, the mid-seventies was a period of increased participation by women in acdemic science programs. Despite an overall decrease in graduate level enrollments in 1974-77, graduate enrollment in S/E rose, with part-time enrollment rising faster than full-time, and with women's and foreign student enrollment rising faster than the average. Data are presented in narrative and tabular form, with survey forms and instructions for fiscal year 1977 appended. (MSE)

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foreword

The allocation of university resources is becoming increasingly complex because of some unusual current and prospective difficulties. Enrollment growth has been reduced and could actually become negative as a result of demographic factors that have already affected elementary and secondary school populations. The resulting lowered demand for faculty, coupled with the reduced number of new tenured positions, is creating in some fields a staffing problem that is likely to be aggravated during the next decade. Other fields, especially engineering and computer sciences, have problems in attracting faculty. Expansion of graduate programs has already begun to taper off, but there have been increases in part-time study, changes in the age-mix of students, and increased interest in continuing education in nontraditional modes. Inflation, as well as the changes in enrollment, have placed increased burdens on university budgets. All of these trends are likely to continue, at least into the near future, and will affect most aspects of academic endeavor, including those dealing with science and technology. Trade-offs between research, instruction, and public service will have to be considered more carefully by most institutions. The difficult decisions that will have to be made can be put on a firmer basis if sufficient background information is available. This report is designed to provide such information.

This publication is the first in a series of consolidated biennial analyses of academic R&D expenditures, the utilization of scientists and engineers, and the characteristics of the graduate science student population. Data from three NSF academic surveys provide the basis for most of this study. In prior years, information from each of these surveys was analyzed and published separately. The new publication integrates results from all three and analyzes trends in more detail. Suggestions and comments on this new publication are most welcome.

Charles E. Falk
Director, Division of Science
Resources Studies
National Science Foundation

June 1980

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notes

The term "science" as used in the institutional surveys on which this report is based is understood to include engineering. The abbreviation "S/E" refers to "science and engineering."

Unless constant dollars are specified, data for research and development and capital expenditures are shown in this report in current dollars. When constant dollars are discussed, they represent an adjustment to the 1972 level and are converted to a fiscal-year basis. The gross national product (GNP) implicit price deflator prepared by the Department of Commerce is used as the basis for the conversion.

Data in part 1 cover fiscal years; data in part 2 are collected as of January in each year; data in part 3 are collected as of fall in each year.

Appendix tables at the end of this report are designed to provide the detailed data shown in the charts.

Details shown in appendix tables may not add to totals because of rounding.

For longer term and more detailed analyses, refer to data tabulated and illustrated in the publications listed on cover 2 of this report.

For information on the availability of data tapes, contact Moshman Associates, Inc., 6400 Goldsboro Road, Washington, D.C. 20034, or telephone 301-229-3000.

acknowledgments

This report was prepared in the Universities and Nonprofit Institutions Studies Group of the Division of Science Resources Studies by Penny D. Foster, under the direction of Richard M. Berry, Study Director. William L. Stewart, Head of the R&D Economic Studies Section, and Charles E. Falk, Director, Division of Science Resources Studies provided general guidance and review. The report could not have been prepared without the excellent cooperation of the university and college officials who responded to the three annual NSF statistical surveys of academic science.

contents

highlights

overall trend

• An examination of the findings of three national surveys reveals that several statistical academic science resource indicators—R&D expenditures, employment of scientists and engineers, and graduate enrollment in science and engineering (S/E) programs—reflected a period of growth during the midseventies. While this trend is expected to continue through the end of the seventies, the 9-percent increase in Federal R&D funding to universities proposed in the President's 1981 budget will permit little if any real growth in the early eighties.

r&d expenditures

• Of the $54 billion estimated to have been spent nationwide in 1979 for research and development, about one out of every ten R&D dollars was spent by universities and colleges. One-half of the $7 billion devoted to basic research was performed in academia.

• Between fiscal years 1972 and 1977, growth in academic R&D performance averaged 9 percent annually in current dollars, most of which occurred after fiscal year 1974. However, inflation reduced this growth to an average of 1 percent per year in real terms over the five years reported in this publication and at 2 percent per year beginning in fiscal year 1975. A rise in academic employment of scientists and engineers accompanied this growth in R&D expenditures, increasing at a yearly rate of 3 percent.

• During 1972-77 the life sciences dominated academic S/E resource increases. R&D expenditures in the life sciences accounted for 65 percent of the fiscal years 1972-77 net growth. Federal funding of the life sciences in the same period accounted for 66 percent of the growth in all federally financed R&D expenditures. The largest absolute increase in postdoctoral utilization between 1974 and 1977 was attributable to life science fields, where 80 percent of the net growth was concentrated. Over one-half of the rise in the number of academic scientists and engineers employed between January 1973 and January 1978 also occurred in the life sciences, as did growth in full-time graduate S/E enrollment, particularly students holding research assistantships.

academic s/e personnel

• Doctorate-granting institutions increased their employment of scientists and engineers by 3 percent per year between January 1973 and January 1978. An even higher rate of growth occurred in master's-granting institutions, up an average of over 6 percent per year

• Nearly 17,000 more part-timers were employed in 1978 in universities and colleges than in 1973, an increase of 35 percent: an even higher number of full-timers was added, 24,700, but their growth rate was considerably slower, up 11 percent in five years. The surge in part-time employment suggests an increasing institutional dependence on short-term and relatively transient appointments and a slowing down in the hiring of full-time staff, particularly by 2-year institutions.

• On a full-time-equivalent (FTE) basis, the number of scientists and engineers employed in R&D activities increased 22 percent in five years: those in teaching rose by 14 percent. The rise in R&D involvement was consistent with the concurrent increase in R&D expenditures and utilization of postdoctorates and graduate research assistants.

• The midseventies marked a period of increased participation rates of women in academic science programs, both in employment and in graduate enrollment. The rate of growth in numbers of women employed full time as scientists and engineers averaged 6 percent per year, while employment of men grew much slower, at an average of 2 percent per year. In 1978 women represented 16 percent of the scientists and engineers employed full time in universities and colleges.

graduate s/e students

• While overall enrollment at the graduate level decreased between 1974 and 1977, doctorate institutions reported a 15-percent rise in graduate S/E enrollment, raising the share flowing into graduate science and engineering from 22 percent to 28 percent.

• Enrollment on a part-time basis in graduate S/E programs rose at a faster pace than full-time enrollment, 26 percent compared to 11 percent. This accelerated growth pattern brought the part-time share up from 26 percent of the graduate S/E enrollment total in 1974 to 29 percent in 1977. The life sciences accounted for 40 percent of the net growth in part-time enrollment and engineering fields for another 35 percent.

• Women represented 29 percent of the full-time graduate S/E enrollment total, and the proportion of women enrolled was on the rise. Between 1974 and 1977 their number increased 37 percent while the number of men enrolled full time increased only 4 percent.

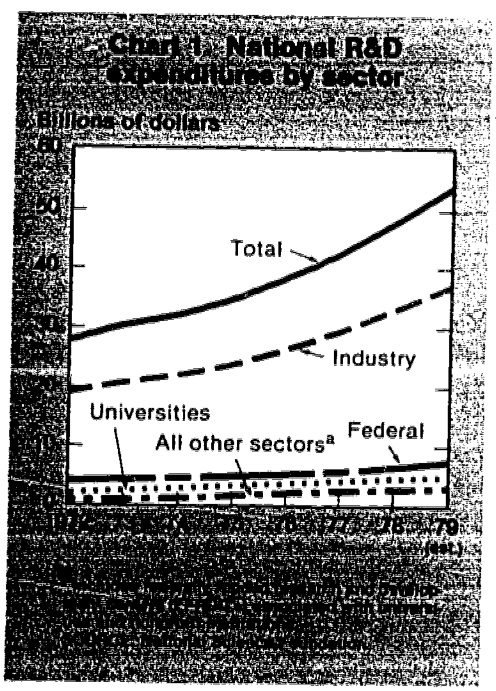
• While foreign students constituted 17 percent of the full-time S/E graduate enrollment total in 1977, their 1974-77 rate of growth (16 percent) exceeded that of U.S. citizens studying full time (10 percent).

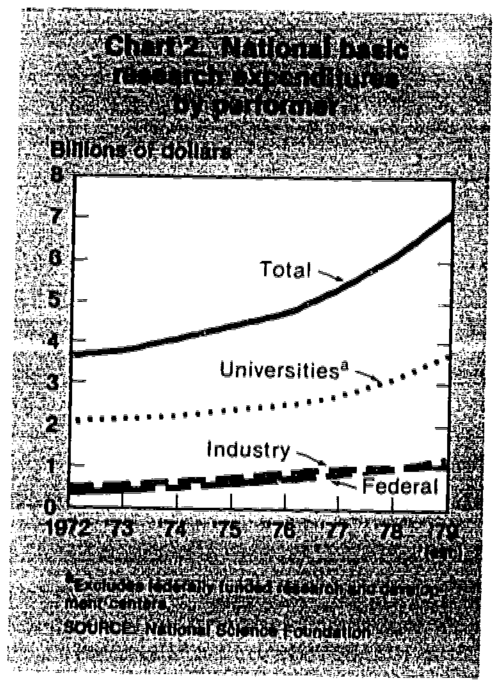
part 1.

trends in academic r&d expenditures

general characteristics, 1972-79

Academic survey data analyzed in this report cover the fiscal years 1972 through 1977; estimates for 1979 have been calculated for presentation in the National Science Foundation's (NSF) recurring publication series that analyzes national patterns of R&D resources.[1] These estimates indicate that the academic sector's role in the performance of research and development accounted for less than one out of every ten R&D dollars spent in the United States in 1979. Of the $54 billion estimated to have been spent nationwide in 1979, only about $5 billion represented R&D activity performed in universities and colleges (appendix table B-1 and chart 1). To view the volume of university R&D performance in terms of the total U.S. level, however, tends to obscure the academic sector's substantial contribution to basic research. To gain a better perspective, one should focus on the dollars spent in academia for basic research performance alone. Just over one-half of the estimated U.S. total of $7 billion committed to basic research in 1979 was performed in the academic sector (appendix table B-2 and chart 2). When the amount devoted to basic research conducted in federally funded research and development centers (FFRDC's) associated with universities is added to this total, the proportion becomes even higher—three-fifths of the national basic research total. The universities' R&D totals discussed here are actually understated; they represent separately budgeted research activity only. The amount of departmental research performed in university facilities cannot be reported by institutions through current accounting procedures since it cannot be separated reliably from the resources devoted to instruction.





[1] National Science Foundation, *National Patterns of Science and Technology Resources, 1980* (NSF 80-308) (Washington, D.C.: U.S. Government Printing Office, 1980).

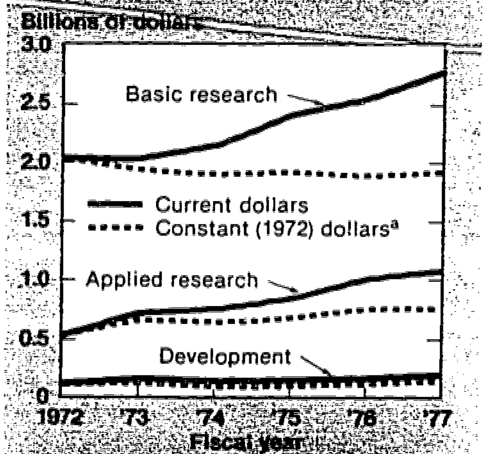
detailed characteristics, 1972-77

In the 5-year period, 1972-77, examined in detail in this report, current-dollar volume of university basic research expenditures rose by 38 percent, but this apparent growth was not sufficient to overcome the effects of inflation, and, in fact, a 3-percent erosion in the real-dollar level actually occurred.[2] This downturn in academic basic research performance over the entire five years took place at the same time that applied research activities in university laboratories were growing in real dollars.[3] However, the relative level of applied research funding is still small (appendix table B-3 and chart 3). The surge in university expenditures for applied research raised the total from $544 million in 1972 to $1,067 million in 1977, nearly doubling in current dollars and up 38 percent in constant dollars. Although the real rate of growth averaged 6.6 percent per year during 1972-77, the total academic expenditures devoted to applied research amounted to only one-tenth of the national applied research total by 1977.[4] When compared to universities' major role in the conduct of basic research, this small fraction devoted to applied research by universities is placed in better perspective.

the federal role

The symbiotic re[illegible]nship that exists today between the Federal Government and the university research community had its roots in Presidential initiatives at the end of World War II and culminated in the creation of the Office of Naval Research in 1946 and NSF in 1950. This was the beginning of large-scale Federal efforts to channel Federal resources into university research laboratories, thereby strengthening basic research through the use of public funds. In 1953 when the first NSF national data collection effort began, universities reported the expenditure of $110 million for basic research, of which $73 million, or 66 percent, came from Federal sources. In 1977 the Federal Government disbursed $2.0 billion to universities, or 71 percent of their $2.8 billion basic research funding. For a discussion of institutional and Federal agency reporting concepts, refer to the technical notes on page 24.

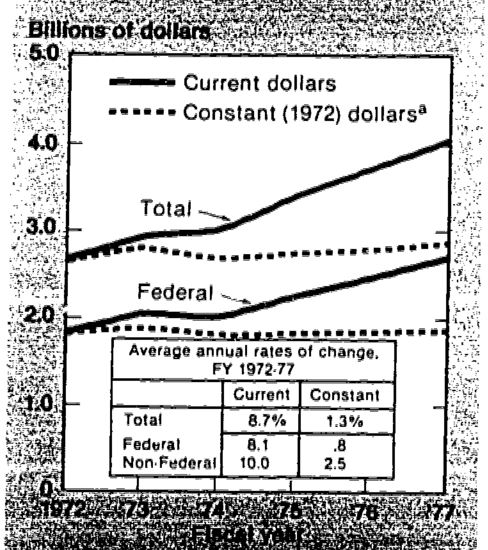
Chart 3. R&D expenditures at universities and colleges by character of work



^a Based on GNP implicit price deflator.
SOURCE: National Science Foundation

Federal funding of all academic R&D activities grew modestly between 1972 and 1977 in real-dollar terms, up only 4 percent overall, for an average of less than 1 percent per year (appendix table B-4 and chart 4). During this period, the proportion funded by Federal sources changed little, ranging between 67 percent and 69 percent (appendix table B-5). In the midsixties, however, the Federal role was more substantial; agencies supported over 73 percent of all academic R&D activities.[5] The lowered Federal share in the seventies was accompanied by a rising contribution from all other sectors. Non-Federal support levels for R&D activities rose at about twice the annual rate of Federal funding in real-dollar terms between 1972 and 1977. Support from the institutions themselves constituted the largest component (38 percent), with State and local governments providing the next largest portion (28 percent). Foundations and industrial firms together accounted for another 25 percent in 1977. Industrial R&D support to universities rose at the fastest pace of all non-Federal supporters of research and development, followed closely by growth in institutional support. Because of the rising support levels from other-than-Federal sources real net growth in total academic R&D expenditures during 1972-77 amounted to almost 7 percent, or more than 1 percent per year.

Chart 4. R&D expenditures at universities and colleges by source



^a Based on GNP implicit price deflator.
SOURCE: National Science Foundation

fields of science

Both total and federally financed R&D expenditures grew in every major area of science between 1972 and 1977 except for the interdisciplinary category, "other sciences, n.e.c." Both the life and environmental sciences showed the same R&D growth pattern; both fields expanded in current-dollar terms

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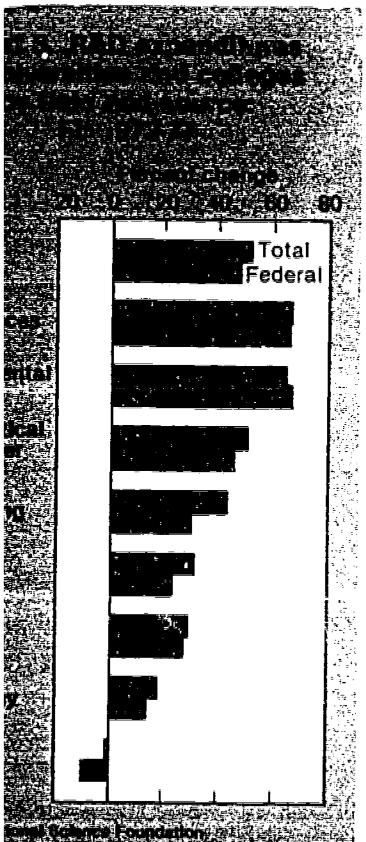
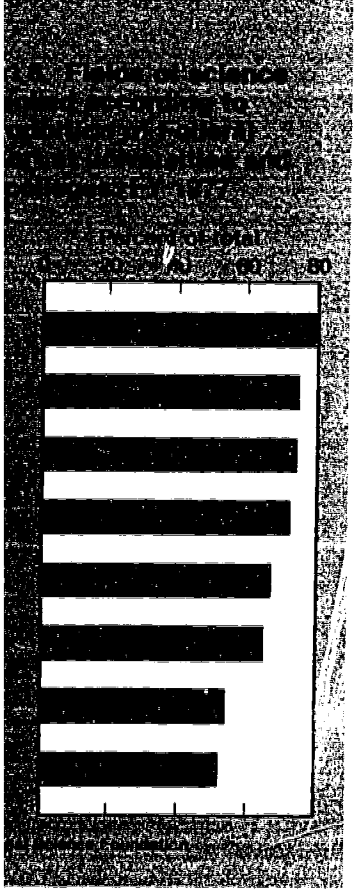
[2] Based on the National Science Foundation's Survey of Scientific and Engineering Expenditures at Universities and Colleges, annual series.

[3] In the absence of a reliable R&D cost index, the gross national product (GNP) implicit price deflator was used to convert current dollars into constant 1972 dollars. The GNP deflator can only indicate approximate changes in costs of R&D performance.

[4] National Science Foundation, *National Patterns of R&D Resources: Funds & Personnel in the United States, 1953—1978-79* (NSF 78-313) (Washington, D.C.: U.S. Government Printing Office, 1979), table B-2, p. 30.

[5] National Science Foundation, *Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1977 (Detailed Statistical Tables)* (NSF 78-311) (Washington, D.C. 20550, 1978), table B-3, p. 2.





by two-thirds between 1972 and 1977, prompted by similar expansion in Federal support (appendix tables B-5 and B-6 and chart 5). The share of R&D activities devoted to the life sciences, where the bulk of R&D performance took place in universities, rose from 51 percent in 1972 to 56 percent of the funds in 1977, up to a total of $2.3 billion. The next-ranked fields, engineering and the physical sciences, received only 12 percent and 11 percent, respectively, of the 1977 R&D funds, and the lowest share went to psychology, only 2 percent.

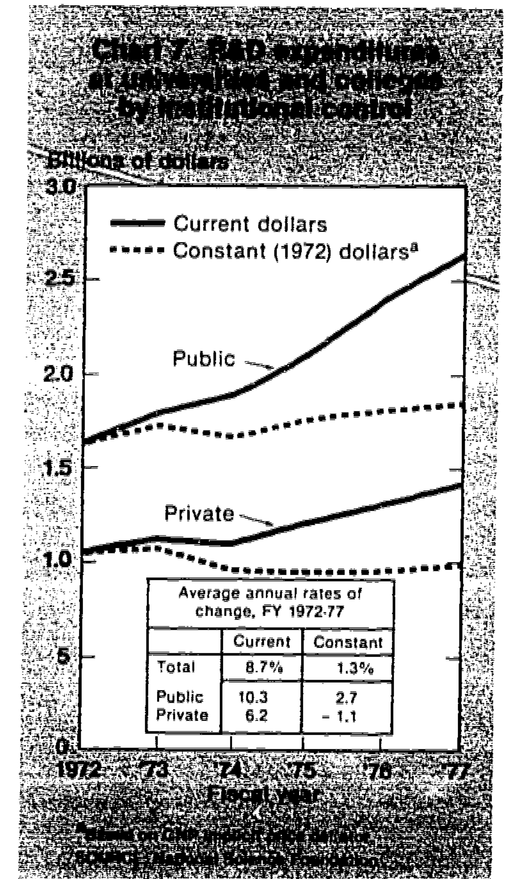
In 1977 the physical sciences ranked first in terms of the percentage of Federal support received, and the social sciences last (chart 6).

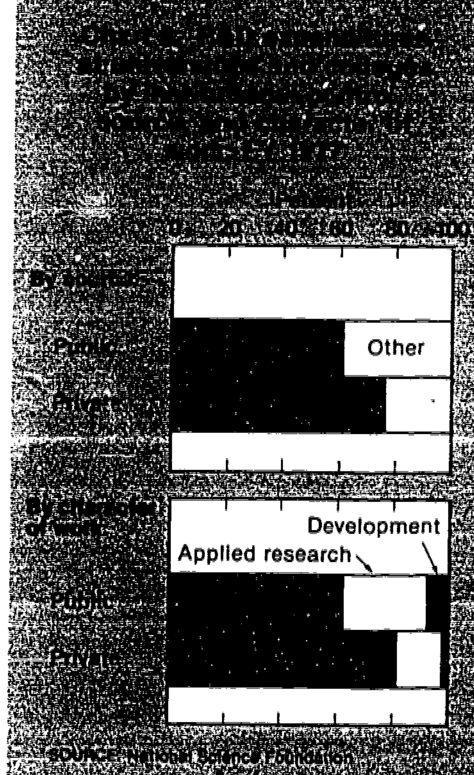
Institutional control

Although both public and private institutions increased their R&D spending in terms of current dollars between 1972 and 1977, privately controlled institutions lagged behind in real-dollar outlays (appendix table B-7 and chart 7). The 1-percent per year average decline contrasted with the annual gain of 3 percent per year by public institutions. The relative magnitude of public institution R&D spending also rose, from 61 percent of the total in 1972 to 65 percent in 1977.

In spite of this increase in the proportion of research and development performed in publicly controlled institutions, the Federal role was less visible there than in private ones. In 1977 Federal agencies contributed a higher proportion of R&D funding to private institutions (78 percent) than they did to public institutions (61 percent), a consistent pattern in the five years studied (appendix table B-8 and chart 8). Also, private institutions performed a higher proportion of basic research (81 percent) than did those institutions under public control (62 percent).

While the relative emphasis placed on R&D expenditures in each field of science was similar in both public and private institutions, the proportion spent on agricultural sciences was considerably higher in public institutions (17 percent compared to 2 percent) because of the influence of agricultural experiment stations affiliated with





land-grant colleges. In contrast, private institutions conducted a higher percentage of biological and medical sciences research than did those under public control.

geographical distribution

In 1977 every geographical division in the United States expanded its academic R&D level over the 1972 total (charts 9 and 10). The Pacific States moved from second place in 1972 to first in 1977, spending nearly $300 million more (appendix table B-9). In relative terms, the highest growth rate occurred in the West and East South Central Divisions and the lowest in New England. In spite of their low growth rate, the New England States reported the highest percentage of Federal R&D support to their institutions of higher education (appendix table B-10). Pacific States ranked next in the share of Federal funds received.

California and New York together accounted for about one-fourth of the Nation's academic R&D spending in 1977, about the same fraction as in 1972. These two States also accounted for one-fourth of the Federal dollars. R&D expenditures by institutions in Texas nearly doubled in five years, the highest growth rate of any of the 10 leading States.

impact of federal policies on institutional concentration

The effects of Federal R&D funding policies that were inaugurated in the midsixties have been analyzed in a recently completed NSF sponsored study.[6] A 1965 Presidential directive to agency heads called for "... the maintenance of outstanding quality in science and engineering education in those universities where it exists ...", while acknowledging at the same time that "... too few institutions in too few areas of the country ..." receive such funds.[7] The NSF study showed that in

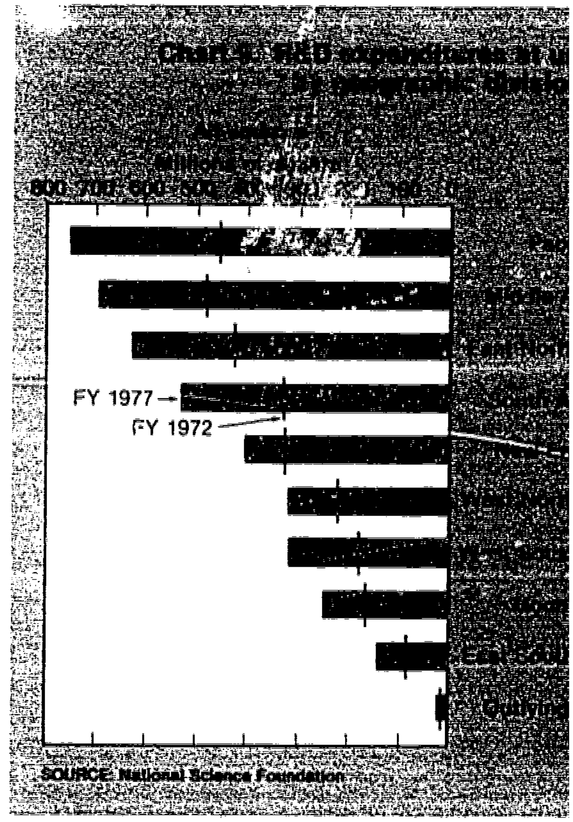
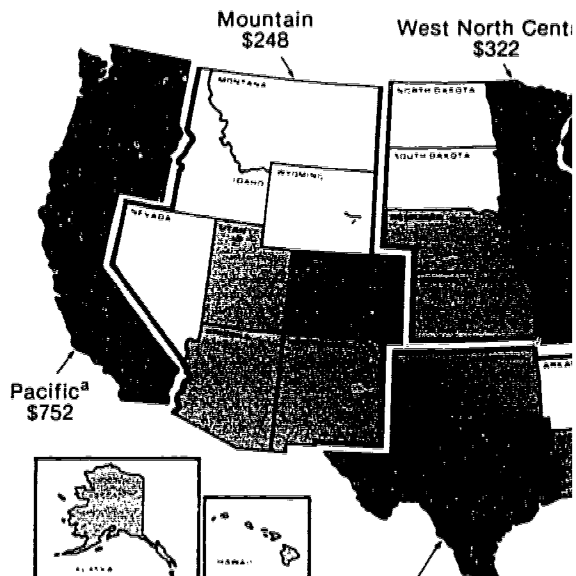


Chart 10. R&D expenditures by State

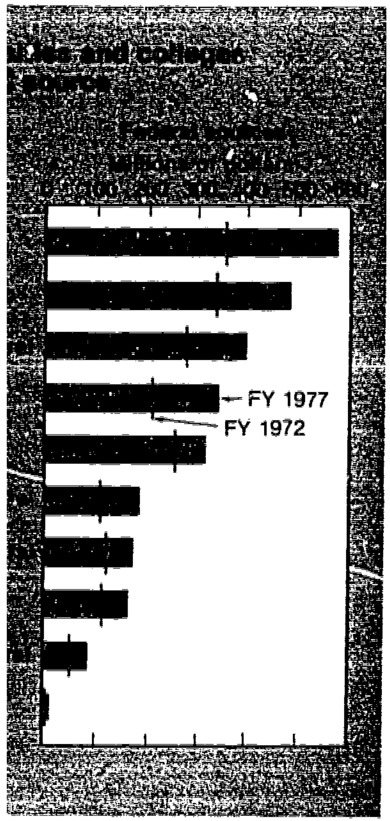
(Millions



[a]Includes Alaska and Hawaii
SOURCE: National Science Foundation

[6]George J. Nozicka, "Federally Funded Research and Development at Universities and Colleges, A Distributional Analysis," NSF grant number SRS 77-20867 (Washington, D.C.: Moshman Associates, Inc., 1979.)

[7]President Lyndon B. Johnson, directive entitled, "Strengthening the Academic Capability for Science Throughout the Nation," 1965.



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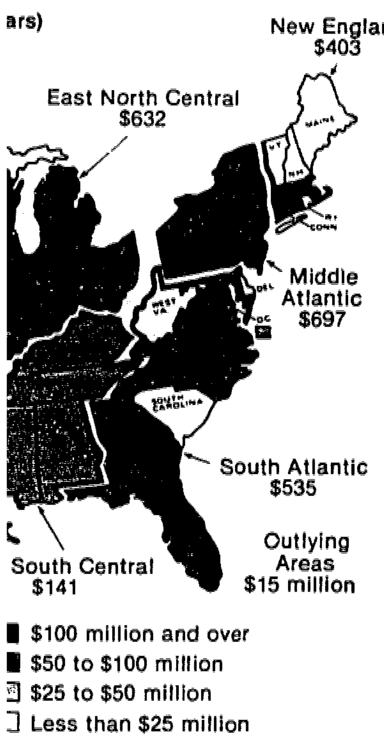
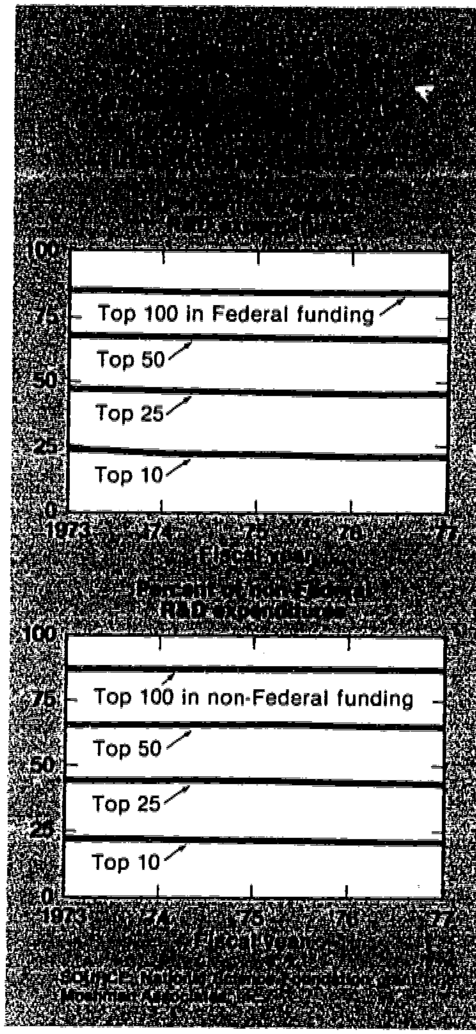
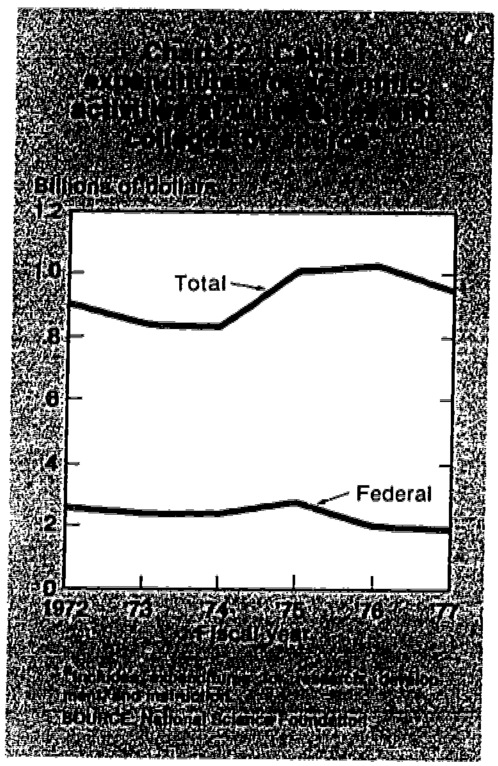


1950 one-half of all Federal academic research funding was concentrated in only 11 universities; by 1977 the number had increased to 30 institutions.[8]

The growth in Federal science funding of the sixties provided the favorable climate needed for adhering to these two simultaneous distributional objectives—maintaining excellence of major research performing institutions and wider geographic dispersion. In the seventies, however, a period of curtailed growth in Federal support of academic R&D activities made tradeoffs necessary between hard choices of decentralization and continued support of centers of research excellence.

Empirical evidence derived from data reported from 1973 through 1977 by 274 doctorate-granting institutions on NSF's survey of R&D expenditures confirmed the stability of distributional patterns for both federally funded and nonfederally funded R&D expenditures[9] (chart 11). Between 1973 and 1977, the period examined by this special study, the 10 leading institutions in terms of Federal R&D funding received about the same proportion of funds each year, ranging between 24 percent and 26 percent (appendix table B-11). Together, the leading 100 institutions received just over 86 percent each year. Non-Federal funding paralleled the distributional pattern of Federal funding. The study also found that no significant differences exist between fields where research is usually capital intensive and those where it is not. This high degree of stability indicates that the primary goal of Federal agencies to maintain support for leading research performers was met during 1973-77, as the relative amount of federally funded R&D expenditures remained virtually unchanged in real dollars.





capital expenditures for research, development, and instruction

In 1977, universities invested over $960 million in facilities and large items of equipment devoted to research, development, and instruction (appendix table B-12 and chart 12). In addition to this amount, purchases for research instrumentation and smaller items of scientific equipment are often made out of current R&D accounts related to specific projects rather than from capital funds. Findings from a recent NSF survey of the Higher Education Panel estimated that Ph.D.-granting institutions spent about $247 million for scientific research equipment out of their current R&D project funds in fiscal year 1978 and approximately $33 million from R&D plant funds.[10] Other Federal efforts at determining the amount of funds invested in research equipment have begun through the addition of an "optional" data item that has been added to the Survey of Scientific and Engineering Expenditures at Universities and Colleges, FY 1979. This survey is designed to provide NSF with the beginnings of a data system to measure, for the first time, the level of annual outlays by universities for research equipment paid for out of current fund accounts.

The 1972-77 period was marked by considerable fluctuations in the amount of capital investment by universities and colleges from year to year. The period closed at only a slightly higher level than five years earlier. The effects of inflation in the seventies nullified this nominal growth.

Although Federal agencies have established a prominent role in the support of current R&D expenditures within universities, they have exhibited a much lower profile in the financing of capital outlays. Federally financed expenditures for new construction and modernization of existing instruction and R&D facilities amounted to only $195 million in 1977, down from $239 million in 1972. The proportion supported by the Federal Government has ranged from its peak (32 percent) in 1968 to its lowest point (20 percent) in 1977.[11]

[8]National Science Foundation, *Expenditures for Scientific Activities at Universities and Colleges*, op. cit., table B-22, p. 42.

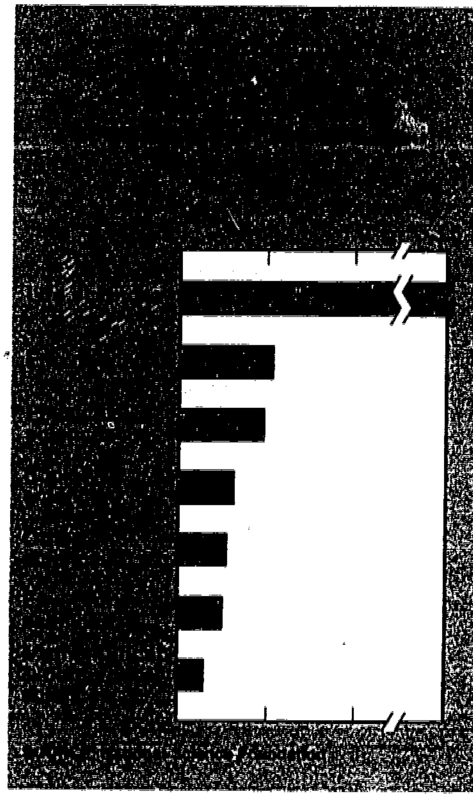
[9]Nozicka, op. cit., tables 14 through 23.

[10]Irene L. Gomberg and Frank J. Atelsek, "Expenditures for Scientific Research Equipment at Ph.D.-Granting Institutions, FY 1978," *Higher Education Panel Report* No. 47 (Washington D.C.: American Council on Education, April 1980.)

[11]Based on National Science Foundation's Survey of Scientific and Engineering Expenditures at Universities and Colleges, annual series.

Recent Federal efforts toward correcting the sliding capital outlays reported by universities have stressed an increased sharing of existing equipment, the encouragement of better methods of determining current inventories, and improved university accounting systems to set aside adequate funds for maintenance and replacement. New regulations instigated by the Office of Management and Budget (OMB) calling for revisions in the method of calculating indirect costs have taken effect in 1980 and could be effective in encouraging these improved management controls.

Of the total outlay for buildings and equipment related to instruction and R&D efforts in 1977, 87 percent was concentrated in 100 of the 539 institutions surveyed, and the 50 leading capital investors accounted for 69 percent of the total. This intense commitment of resources by so few institutions can be more readily illustrated through an examination of the degree of concentration in fields of science. Two-thirds



of the total 1977 investment went for facilities devoted to the life sciences, almost $645 million. Of this amount, $456 million, or 71 percent, was spent by 42 of the 50 leaders, those associated with medical schools and health sciences centers that embarked on extensive building and renewal projects. The heavy capital outlay in the life sciences amounted to over $3.5 billion of the $5.6 billion 5-year total. All other major fields trailed far behind in capital expenditures, with the mathematical and computer sciences receiving the least emphasis (chart 13).

Publicly controlled institutions invested more heavily in capital facilities and equipment than did private institutions, accounting for 71 percent of the total outlay in 1977, slightly less than their 73-percent share in 1972 (appendix table B-13). Federal agencies distributed 61 percent of their capital expenditures support to public institutions in 1977, down from 67 percent five years earlier.

part 2.

trends in scientific and engineering employment

general characteristics, 1973-78

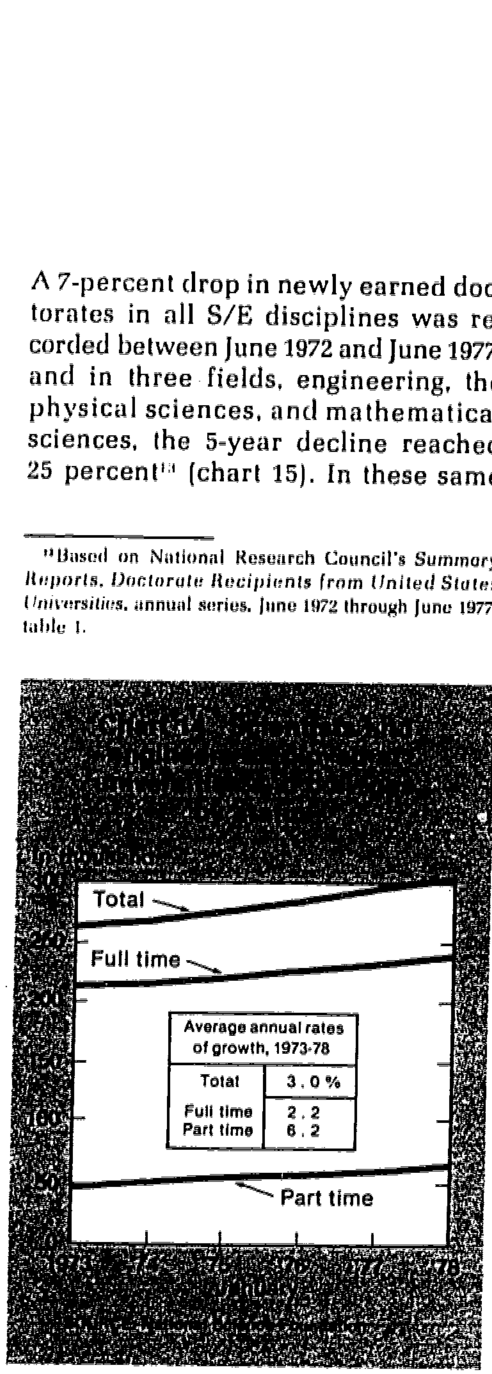
The NSF survey of academic employment of scientists and engineers described in this report defines professional employees of institutions of higher education as those working at a level that requires at least a bachelor's degree. Personnel considered scientists and engineers are faculty members, postdoctorates, and all other professionals working in S/E disciplines, including research administrators.

In the 5-year period analyzed, January 1973 through January 1978, academic institutions have added an average of 3 percent more scientists and engineers to their employment rolls each year.[12] The number of professionals employed full time rose at an average annual rate of 2 percent and part-time employees at three times this annual growth rate (chart 14). This period of expansion came at a time when the number of doctorate recipients in science disciplines, the pool from which many of these academic employees were drawn, was on the wane (appendix table B-14).

[12] Based on National Science Foundation's Survey of Scientific and Engineering Personnel at Universities and Colleges, annual series.

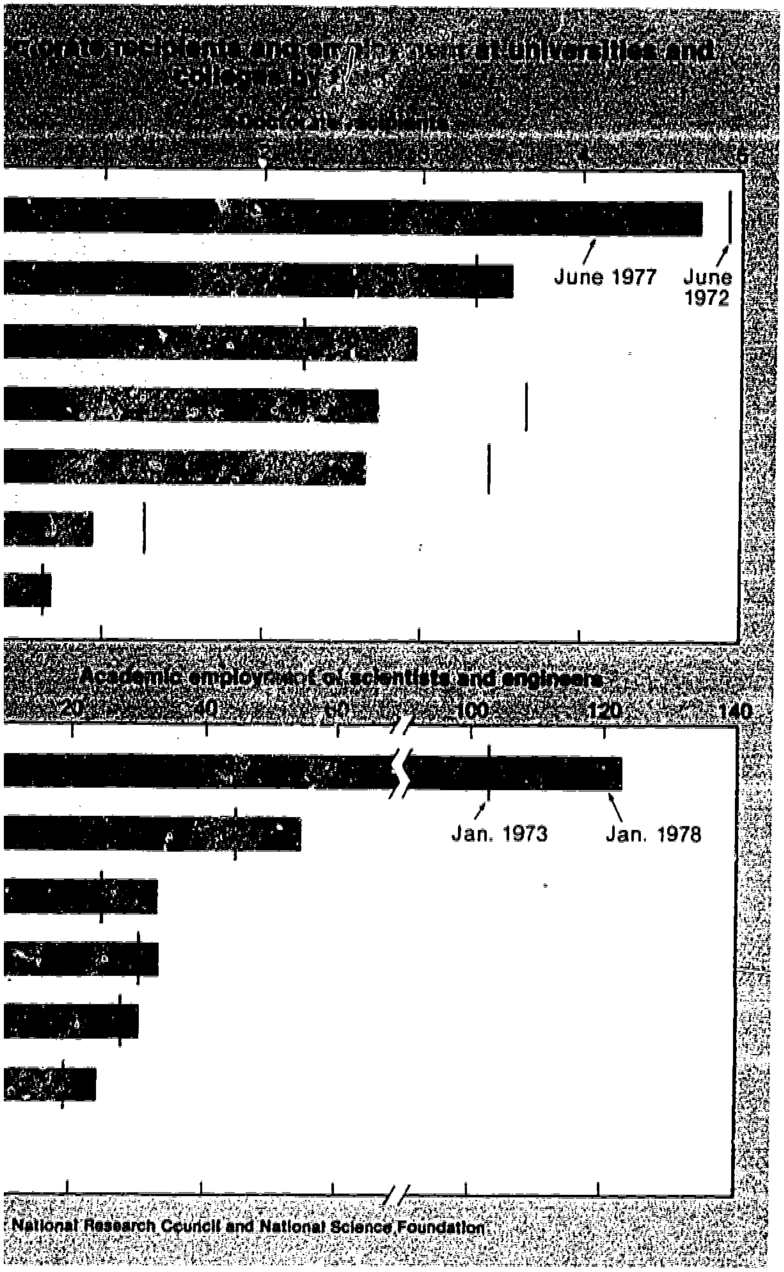
A 7-percent drop in newly earned doctorates in all S/E disciplines was recorded between June 1972 and June 1977, and in three fields, engineering, the physical sciences, and mathematical sciences, the 5-year decline reached 25 percent[13] (chart 15). In these same three fields, however, academic employment grew, an indication that demand for doctorate recipients in these fields has been steady in the higher education sector in spite of a simultaneous reduction in supply. The life sciences employed the greatest number of scientists in academic institutions in 1978 and was the field most often chosen by 1977 doctorate recipients. The social sciences ranked second in both employment and field of doctorate received. Psychology ranked third in numbers of Ph.D.-holders but sixth in employment size; environmentalists ranked lowest in both measures.

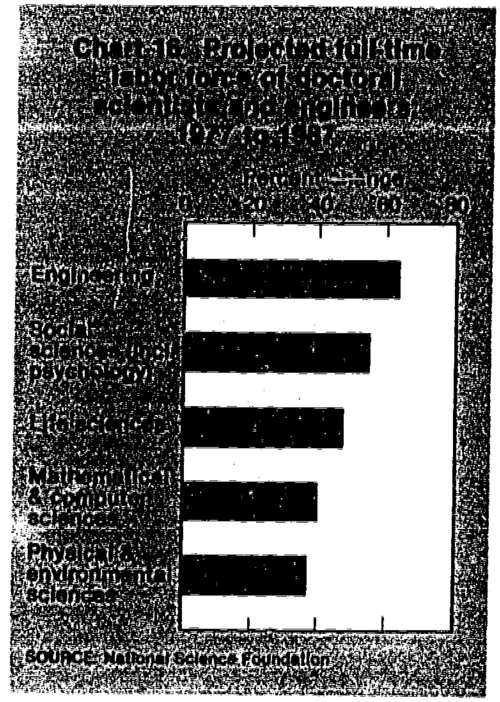
[13] Based on National Research Council's *Summary Reports, Doctorate Recipients from United States Universities*, annual series, June 1972 through June 1977, table 1.



The life sciences and social sciences each accounted for nearly one-fourth of the total net growth of 41,600 academic scientists and engineers during 1973-78. Mathematical and computer scientists represented another one-fifth of the total growth. Expansion on a national scale in the doctoral labor force in these same three broad fields was projected by NSF through 1987 to a total of 47 percent (life sciences), 55 percent (social sciences), and 40 percent (mathematical and computer sciences)[14]

[14] National Science Foundation, *Projections of Science and Engineering Doctorate Supply and Utilization, 1982 and 1987* (NSF 79-303) (Washington, D.C.: U.S. Government Printing Office), table 3, p. 5.





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was considerably slower, up 11 percent during 1973-78. This employment pattern of professional scientists and engineers followed closely that of instructional staff in all institutions of higher education in all fields—the number of full-time instructors or above was projected by the National Center for Education Statistics to rise by 16 percent between 1973 and 1978, while part-time instructional staff was projected to rise by 56 percent.[15]

Scientists and engineers employed on a full-time basis represented 79 percent of the academic employment total in 1978, down from 82 percent in 1973 (appendix table B-16 and chart 17). This slight shift away from full-time into part-time status occurred in every field of science except the life sciences, where the ratio remained the same in both years. The pervasive nature of this movement into part-time employment may indicate that some institutions were gradually reducing the ratio of full- to part-time employees in order to effect economies in salary payments and fringe benefits, such as retirement and health insurance plans, and in anticipation of future reductions in both undergraduate and graduate S/E enrollment. A recent study of the overall academic labor market revealed that "... the supply of part-timers is probably larger than that of full-timers, both because academic employers can draw on persons with full-time jobs to teach an occasional evening or off-hours course, and because part-timers can be hired with a lesser degree or with less experience than full-timers. . ."[16]

The number of Ph.D.-holders employed by universities and colleges went up 21 percent between 1973 and 1978, and master's degree-holders rose by

[15] Department of Health, Education, and Welfare, National Center for Education Statistics, *Projections of Education Statistics to 1986-87* (Washington, D.C.: U.S. Government Printing Office), table 22, p. 67.

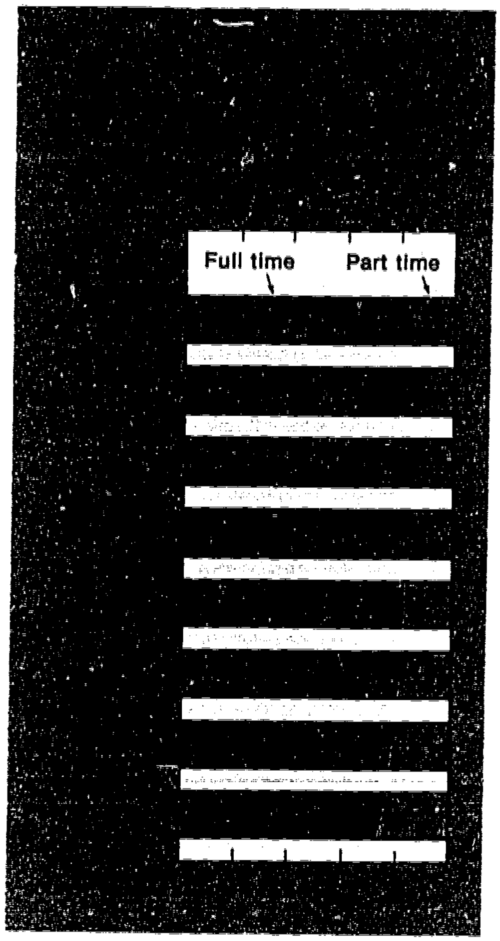
[16] Howard Tuckman, Jaime Caldwell, and William Vogler, "Part-timers and the Academic Labor Market of the Eighties," *The American Sociologist*, Vol. 13 (Nov. 1978), pp. 184-195.

almost the same percentage, up 20 percent. The distribution of this growth differed, however, when employment status was examined. Ph.D.-holders made up 83 percent of the net growth in full-time employment, and master's degree-holders made up 59 percent of the part-time growth. Bachelor's-degree recipients made up only 3 percent of the 1973-78 employment growth, with full-timers showing a net loss of over 2,000, offset by an increase of 3,400 part-timers.

type of activity

Two different collection methods have been employed by NSF to measure the change in level of academic employment of staff holding teaching and research appointments. To measure the amount of effort devoted to these activities the NSF personnel survey has used both a "primarily employed" and a "full-time-equivalent" (FTE) concept during the period studied. The former method requires institutional respondents to classify their professional staff according to how they spent the *major* portion of their time, i.e., whether in teaching, research and development, or any other S/E activity. The alternate method using FTE scientists and engineers converts the headcount data into the approximate time or effort spent in *each* of the three functions. On a "primarily employed" basis, both teaching and research staff increased at about the same percentage between 1973 and 1978—18 percent and 17 percent, respectively (appendix table B-17). By moving to an FTE basis for measuring time spent in these activities, however, institutions reported that the number of FTE scientists and engineers involved in R&D efforts rose at a faster rate than did those in teaching, up 22 percent compared to 14 percent. This finding is supported by data provided from a biennial NSF sample survey to determine the characteristics of doctoral scientists and engineers. Individuals surveyed reported a higher growth rate in their R&D involvement, up 38 percent between 1973 and 1977, compared to their teaching activity, up 13 percent (appendix table B-18).

The increase in R&D activity noted above is directly related to the rise in



academic R&D expenditure levels discussed earlier. This trend toward heavier emphasis on R&D spending by universities has been shown to affect the type of appointments being made. In a recent study of the causes underlying the 3-percent per year growth pattern of all academic scientists and engineers, NSF staff visited 14 public and 9 private doctorate-granting universities to examine the nature of this employment expansion.[17] Among its other findings, the study determined that growth in sponsored research funding is beginning to influence academic recruitment practices. A shift was noted to an increasing use of doctoral research staff and short-term appointees that were hired for specific research projects, especially in major research universities. The ability of these scientists and engineers to obtain outside support was found to be the major determinant in the hiring of such researchers.

Another study conducted by the National Research Council (NRC) in 1978 determined the characteristics of nonfaculty doctoral staff, and it concluded that this group, while an important segment of the academic community, represented only 3 percent of all doctoral scientists and engineers employed in academia in 1977 and that more than one-half were employed in the biosciences and physics.[18] This relatively small component of the academic staff may become more significant as the research enterprise grows in complexity. The study noted that ". . . The large, complex research projects . . . require long-term staff with specialized skills who can devote their full-time energies to specific tasks . . ." without the distraction of teaching responsibilities. If academic R&D expenditures continue to maintain the momentum exhibited during the 1972-77 period, doctoral research staff without faculty rank will provide an invaluable resource for R&D performance. In addition, postdoctoral utilization will probably continue to increase even though these research appointments are usually considered to be temporary. The number of postdoctorates grew at twice the rate of increase observed for all other types of academic S/E employees between 1974 and 1977.

These findings are reinforced by several other studies—one funded by NSF and conducted by NRC and another at Harvard University. NRC assessed the nature and magnitude of future declines in openings in *all* universities for new faculty and found that ". . . in the absence of . . . policy intervention, there will be a substantial and sustained decline in openings for new faculty in a number of science and engineering fields. This decline stems from two key forces: (1) An absence of growth in total faculty size, resulting from low present growth and projected decreases in college and university enrollments and a comparatively steady level of research funding; and (2) low rates of retirement of present tenured faculty, resulting from low rates of faculty growth during the 1940's and 1950's compared to the 1960's, and from changed laws affecting

[17] National Science Foundation, *Employment Patterns of Academic Scientists and Engineers, 1973-78*, (NSF 80-314) in press.

[18] National Research Council, Commission on Human Resources, "Nonfaculty Doctoral Research Staff in Science and Engineering in United States Universities" (Washington, D.C., 1978.)

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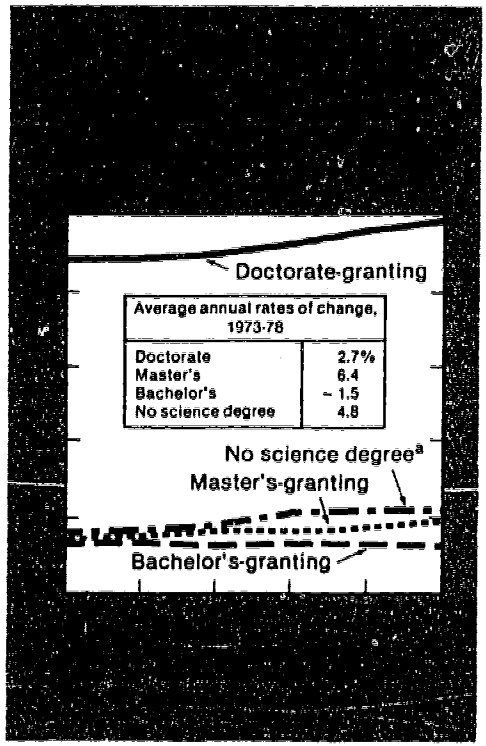
retirement policies . . ."[19] These same factors were also cited in the Harvard study, which also found a decided difference in the effects demography will have on major research universities "which tend to have strong student markets relative to the rest of higher education . . ." and concluded that "major research producers will not be among the worst affected by the impending decline, but the impact that some of them will feel is likely to be significant . . ."[20]

type of institution

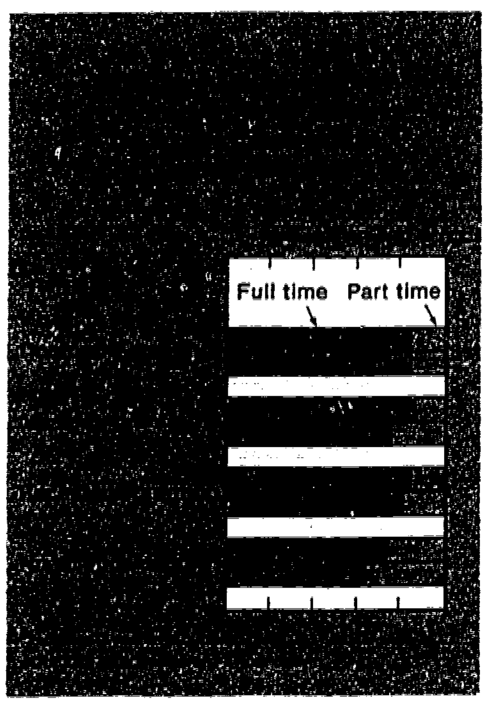
Of the net growth of 41,600 scientists and engineers employed in the academic sector during 1973-78, nearly three-fifths joined doctorate-level institutions, which showed a 2.7-percent annual rate of growth (appendix table B-16 and chart 18). The key role played by doctorate institutions in the overall employment growth pattern can be traced to their ability to continue to draw support from State legislatures or to have ready access to large endowment funds. Also, student demand is likely to remain strong in major established universities, both public and private, where the reputation for quality has been strong over the years. The heavy concentration of research in doctorate institutions also explains their prominence in the growth of academic employment. They accounted for 22,500 of the 31,200 FTE scientists and engineers added between 1973 and 1978 (72 percent). And those FTE's employed in doctorate institutions in R&D activities accounted for 45 percent of the total FTE growth during 1973-78.

An even higher rate of employment growth occurred in master's institutions than in doctorates, up an average of 6.4 percent per year during 1973-78. These institutions accounted for 25 percent of the net growth during this period, employing a total of 39,200 scientists and engineers by 1978. Another 21 percent



of the net addition to academic employment occurred in 2-year and nonscience-degree-granting institutions together, growing at the rate of 4.8 percent per year. Only the bachelor's-level institutions recorded a dropoff in employment, averaging 1.5 percent per year.

The employment "mix" of full- to part-time scientists and engineers changed considerably between 1973 and 1978 in master's-granting institutions and those



granting 2-year and nonscience degrees (appendix table B-16 and chart 19). The rise in proportion of part-timers in these institutions suggests a sharper curtailment in hiring of permanent employees and an increasing dependence on short-term and transient appointments. A variety of reasons behind this increased utilization of part-timers in all institutions of higher education has surfaced in recent studies of this aspect of the academic labor market. The high rate of growth in S/E employment at 2-year institutions particularly was confirmed in studies of salary differentials between full- and part-time employees in all fields. One such study found that "... A larger proportion of part-timers are hired at two-year institutions than at any other institutions of higher education. Stringent pressures to keep tuition costs low for the relatively low income clients which these institutions serve and limited State and private funding make the hiring of less costly faculty an attractive option; increasing enrollments and fairly high turnover rates provide these institutions with the opportunity to increase the number of part-timers without causing substantial dislocations of full-timers. . ."[21] A warning signal has been raised about the future in another study that concluded that ". . . In the absence of a set of well-defined skill levels for part-timers, those institutions which employ part-timers without an appropriate system of incentives may experience a lessening in the quality of their educational offerings. . ."[22]

sex of full-time scientists and engineers, 1974-78

In 1978, men represented 84 percent of the full-time scientists and engineers employed in universities and colleges; in 1974, when data on sex were first collected in this series, they accounted for 85 percent, an almost imperceptible difference. This percentage, however, was considerably higher than their

[19] National Research Council, Commission on Human Resources, *Research Excellence Through the Year 2000: The Importance of Maintaining a Flow of New Faculty Into Academic Research* (Washington, D.C., 1979), p. i.

[20] Robert E. Klitgaard, "The Decline of the Best?" *An Analysis of the Relationship Between Declining Enrollments, Ph.D. Productions, and Research* (Cambridge, Mass.: Harvard Univ., May 1979.)

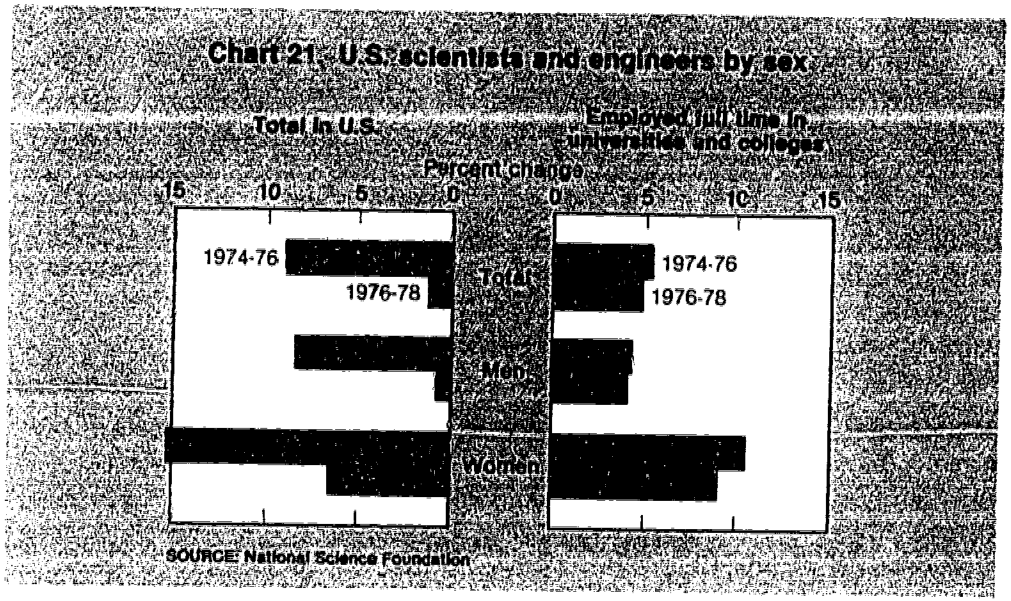
[21] Barbara Tuckman and Howard P. Tuckman, "Sex Discrimination Among Part-Timers at Two-Year Institutions of Higher Education," paper funded by the Ford Foundation under a grant to the American Association of University Professors, 1979.

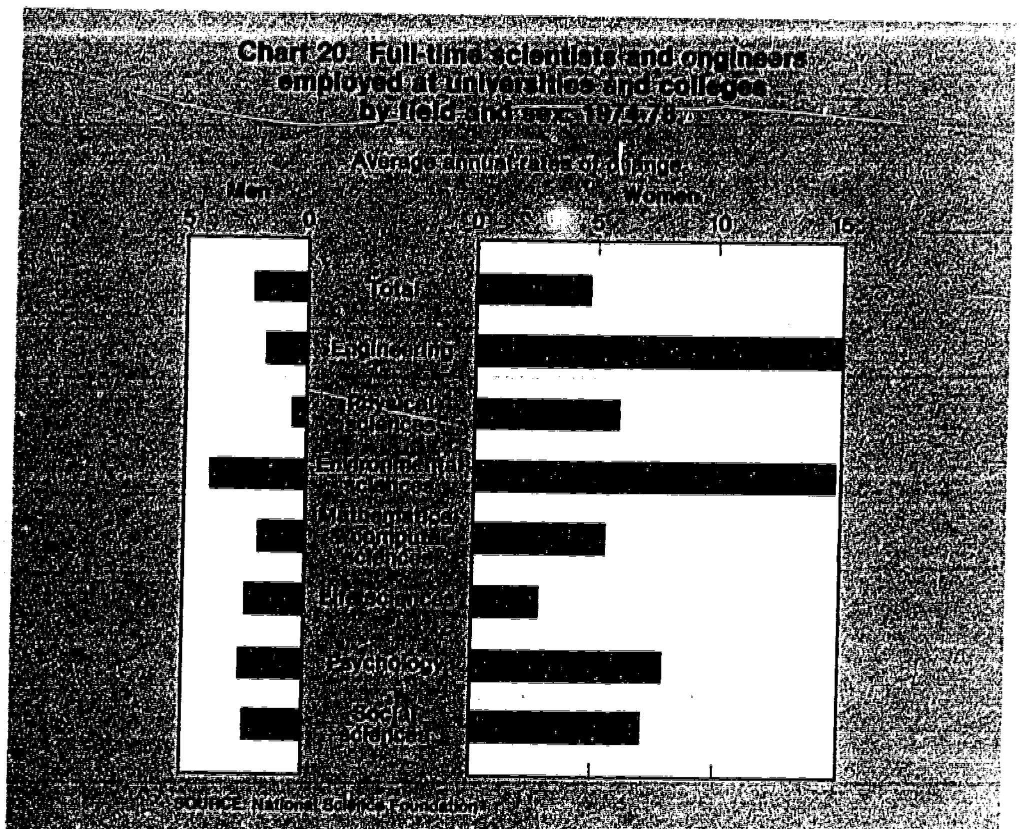
[22] Howard P. Tuckman and Jaime Caldwell, "The Reward Structure for Part-Timers in Academe," paper funded by the Ford Foundation under a grant to the American Association of University Professors, 1979.

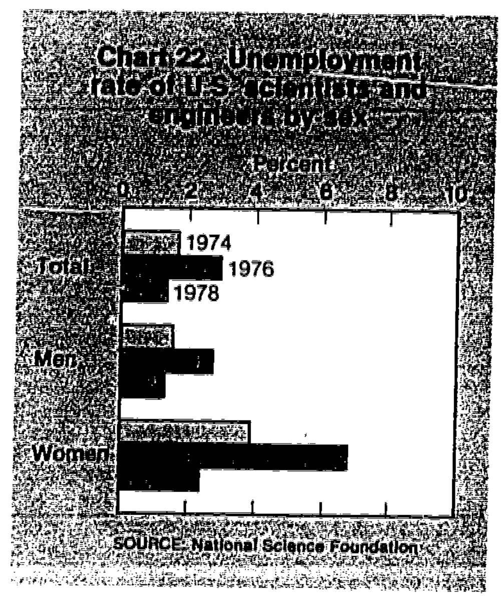
75-percent representation in all full-time instructional faculty positions in academic year 1977-78.[23]

In spite of the relatively insignificant change in the proportion of women employed full time as scientists and engineers between 1974 and 1978, they accounted for 29 percent of the net growth of all full-time S/E employment. Also, an examination of the increase in the number of male scientists and engineers employed full time in academia between 1974 and 1978 showed their annual rate of growth to be slower than that of women, 2 percent per year compared to 5 percent per year, which was evident in every major field (appendix table B-19 and chart 20). In the entire national pool of scientists and engineers, this pattern also prevailed—the rate of growth in the U.S. total of women scientists and engineers outstripped the growth rate of men between 1974 and 1978[24] (appendix table B-20 and chart 21). In contrast, men's unemployment rate was lower than that of women scientists and engineers in each of the years 1974, 1976, and 1978 (appendix table B-21 and chart 22).

The pattern of increased participation of women employed full time in science and engineering in academia as described here does not reflect all of the realities of the job market. Salary differentials between men and women exist in all sectors of the economy and in some fields the gap is widening. In any discussion of comparative salary levels, however, it is important to look at the difference between entry level and experienced level salaries separately, rather than at median annual salaries alone, which are not as sensitive an indicator of differentials. Also, any analyses of salary differentials related to sex, to be meaningful, should take into account as many of the factors as possible that affect this dollar spread between men and women: (1) The field of science in which the comparison is made; (2) the level of education attained; (3) the age bracket; (4) the number of years in the labor force, or years after the degree is earned; (5) geographic area, whether urban or rural; (6) eco-







[23]Department of Health, Education, and Welfare, National Center for Education Statistics, Survey of Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty in Institutions of Higher Education, annual series.

[24]National Science Foundation, *U.S. Scientists and Engineers: 1978* (Detailed Statistical Tables) (NSF 80-304) (Washington, D.C., 1980.)

nomic sector of employment, such as Government, business, educational, or nonprofit institutions, etc.; (7) type of work activity in which engaged, such as teaching, research and development, management of research and development, or other activity; and (8) full- or part-time status; and probably many more relevant factors. Some of these characteristics have been examined in a current NSF study of sex and ethnic differences in the Federal Government's employment of scientists and engineers that may help explain salary differences in the academic sector.[25]

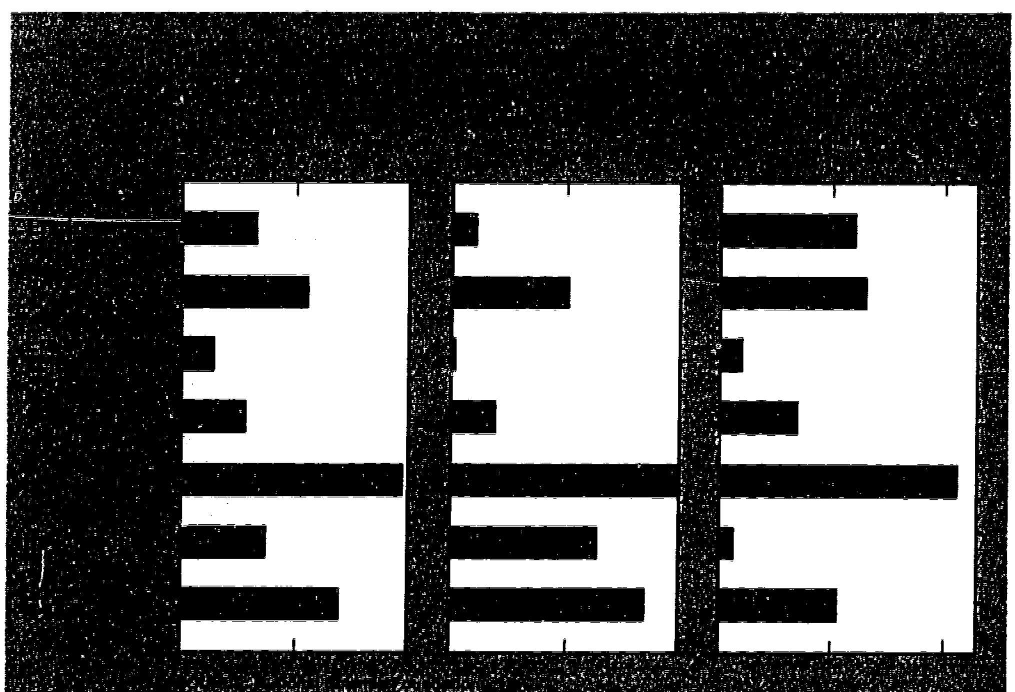
As part of a recent NRC study of salary differentials, special tabulations from the Survey of Doctorate Recipients showed that at the full-professor level, the dollar gap between men and women actually widened between 1973 and 1977 in three fields: chemistry, medical sciences, and psychology.[26] At the assistant-professor level, however, all of the fields studied showed an improvement in the equalization of salaries between men and women doctorate-holders during 1973-77, although men's salaries were still slightly higher in 1977. Overall, the average salaries of male doctorate-holders in all sectors of S/E employment, including academia, averaged $5,400 higher than their female counterparts, up from $3,600 higher in 1973.[27]

An NSF-sponsored study assessed job access, positions, promotion practices, and salaries of women holding higher education appointments through a series of site visits to nine typical institutions. The NSF graduate enrollment and employment surveys were used as the primary data sources.[28] The NSF-sponsored study noted that "the absolute numbers of women scientists/engineers may be increasing in some cases, but the percentages are small and women are still found in the lower ranks and untenured positions of academe." The campus interviews also revealed that competition for women scientists is increasing from private industry, as are the salary levels offered, and the number of national research opportunities are growing. Industrial jobs are becoming more plentiful, even for bachelor's and master's degree-holders, so that the pipeline that is providing a larger pool of women could well be directed away from the university setting and into business and industry, if such demand continues.[29]

minorities, 1973-77

The biennial Survey of Doctorate Recipients conducted for NSF by the NRC provides some perspective on the minority employment picture of doctoral scientists and engineers in the Nation as well as in academic institutions.[30] Results from this sample survey show that the total number of Asian doctorate-holders employed in S/E fields in all economic sectors rose between 1973 and 1977 by an estimated 63 percent (appendix table B-22). This high rate of growth had very little impact, however, on Asian representation in the national totals of all doctoral scientists and engineers. The 15,700 Asians holding Ph.D.'s in science and engineering in 1977 represented only 5 percent of the total, up only slightly from their 4-percent share reported four years earlier. The number of blacks holding S/E Ph.D.'s grew at about the same rate as whites, 27 percent and 25 percent, respectively, but black representation was lower than that of Asians, less than 1 percent of all S/E doctorate recipients in both 1973 and 1977 (about 2,800 of the 303,300 total).

The academic sector employed less than one-half of the Asian doctorate recipients as scientists or engineers in 1977, nearly two-thirds of the black Ph.D.-holders, and over one-half of the white doctorates. Considerable variance was observed among whites, blacks, and Asians in their field of academic employment. Only in the life sciences did they exhibit equal representation—about 30 percent of whites and blacks and 32 percent of Asians were employed in life science disciplines in universities and colleges (appendix table B-23 and chart 23). Engineering attracted a higher percentage of Asians than blacks or



[25] National Science Foundation, "Sex and Ethnic Differentials in Employment and Salaries Among Federal Scientists and Engineers," *Reviews of Data on Science Resources*, No. 34 (NSF 79-323) (Washington, D.C.: U.S. Government Printing Office, Dec. 1979.)

[26] National Research Council, Committee on the Education and Employment of Women in Science and Engineering, *Climbing the Academic Ladder: Doctoral Women Scientists in Academe* (Washington, D.C., 1979), pp. 88-94.

[27] National Science Foundation, *Characteristics of Doctoral Scientists and Engineers in the United States: 1977* (Detailed Statistical Tables) (NSF 79-306) (Washington, D.C., 1979), p. 4.

[28] Clare Rose, "The Study of the Academic Employment and Graduate Enrollment Patterns for Women in Science and Engineering" under NSF grant numbers SRS 76-82705 and SRS 77-16927 (Los Angeles, Calif.: Evaluation and Training Institute, Dec. 1978.)

[29] The National Science Foundation estimated that the total number of Ph.D.'s in the labor force that is expected to work in industrial R&D positions will rise 39 percent between 1977 and 1987, while those in faculty positions will grow by only 11 percent. See National Science Foundation, *Projections of Science and Engineering Doctorate Supply and Utilization*, op. cit., p. viii.

[30] National Science Foundation, *Characteristics of Doctoral Scientists and Engineers in the United States*, op. cit., table B-6 and revised data for 1973.

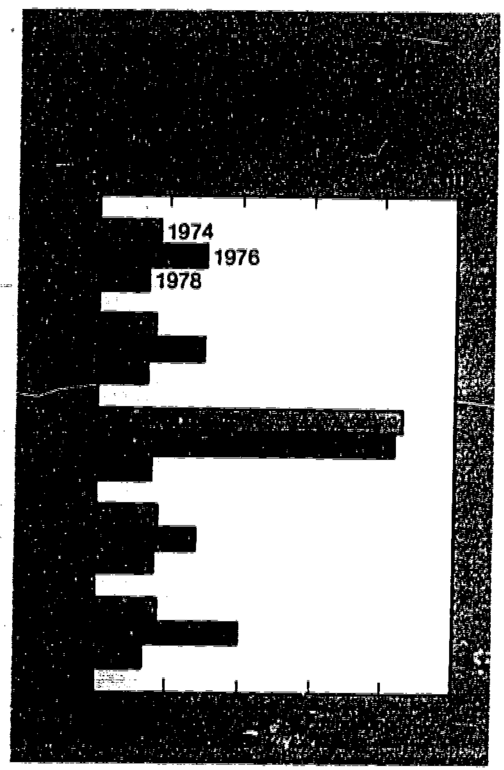
whites; the social sciences and psychology employed a higher percentage of blacks than whites or Asians. These 1977 distributional patterns were about the same as in 1973.

This same survey of doctorate recipients provides data on median annual salaries of doctoral scientists and engineers employed in the United States according to race. In 1973 there was little measurable difference in salaries among white, black, and Asian doctorate-holders. By 1977 a discernible gap had developed—whites received about 8 percent or $1,800 more per year on the average than did blacks or Asians.

Another source of data on minorities concerns the entire U.S. labor force of scientists and engineers and shows a decided growth pattern between 1974 and 1978, the years for which data are collected through the Scientific and Technical Personnel Characteristics System (STPCS) developed by NSF from three separate data bases.[11] The national estimate of S/E employment patterns show that the 114,100 minority scientists and engineers in the U.S. labor force in 1978 represented a 15-percent increase over the 1974 total. In spite of this rise, their representation in the entire S/E labor force remained at about the same level in 1978 as in 1974—just over 4 percent (appendix table B-24).

The unemployment rate estimated for blacks in S/E fields in 1978 showed a decided improvement over the rates estimated in 1974 and 1976 and matched that of white scientists and engineers at about 1.5 percent. Asians and other minorities also exhibited lower unemployment rates in 1978 compared to 1976 (appendix table B-25 and chart 24).

[11] National Science Foundation, *U.S. Scientists and Engineers*, op. cit.



postdoctoral utilization, 1974-77

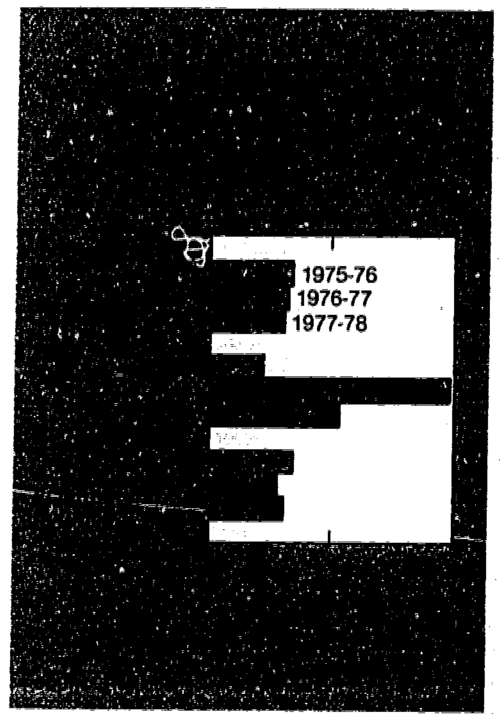
While data on S/E postdoctoral appointees are not separately identifiable on the NSF Survey of Scientific and Engineering Personnel Employed at Universities and Colleges, their characteristics and support patterns can be derived from another data source, the NSF Survey of Graduate Science Student Support and Postdoctorals. This departmental survey of graduate S/E programs has provided postdoctoral data from doctorate-granting institutions for the period fall 1974 through fall 1977, which is considered equivalent to the January 1975 through January 1978 collection period of S/E employment survey statistics.

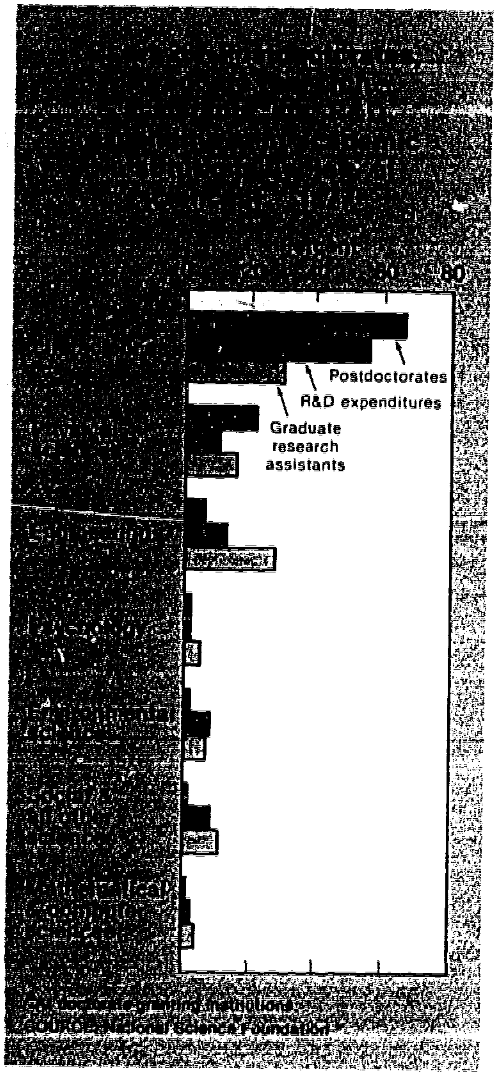
Findings from the postdoctoral survey indicate that the total number of personnel holding these appointments grew at twice the rate shown by the total academic S/E employment population in comparable years (appendix table B-25 and chart 25). While the total number of postdoctorates in fall 1977—19,700—represented only 6 percent of the 306,500 scientists and engineers reported as employed in the academic sector in January 1978, the size of the postdoctoral pool grew a total of 18 percent in four years while all other academic employees grew at only one-half this rate. The highest rate of postdoctoral growth occurred between 1976 and 1977.

Postdoctoral employment rates should be compared not only with those of other academic scientists and engineers but with utilization patterns of both graduate research assistants and new S/E doctorate recipients. In 1977, for instance, the ratio of full-time students holding research assistantships to postdoctoral appointees in doctorate institutions was over 2 to 1 at the total level. This pattern varied considerably, however, by field of science. For example, the social sciences utilized research assistants at the highest ratio of any field—14 students to 1 postdoctorate. This minimum usage of postdoctorates matched the relatively low standing of the social and other interdisciplinary sciences in terms of academic R&D expenditures in fiscal year 1977—only 9 percent of the R&D funds of doctorate institutions was devoted to these fields (chart 26). Employment plans expressed by new doctorate recipients in social sciences disciplines in 1977, as reported on the NRC Survey of Earned Doctorates, indicated that only 6 percent desired postdoctoral study in these fields on graduation; the majority expected some other form of employment within education institutions.[12] In contrast, newly graduating doctorate recipients in the life sciences indicated a much stronger preference for postdoctoral study, 47 percent, than for other types of employment. These fields had the highest proportion of academic R&D expenditures, about 56 percent in fiscal year 1977, and the lowest ratio of research assistants to postdoctorates, about 1 to 1.

In a related 1975 study that concentrated on changes in the environment of graduate education between 1968 and 1973, the National Board on Graduate Education

[12] National Research Council, *Summary Reports*, op. cit., table 2.



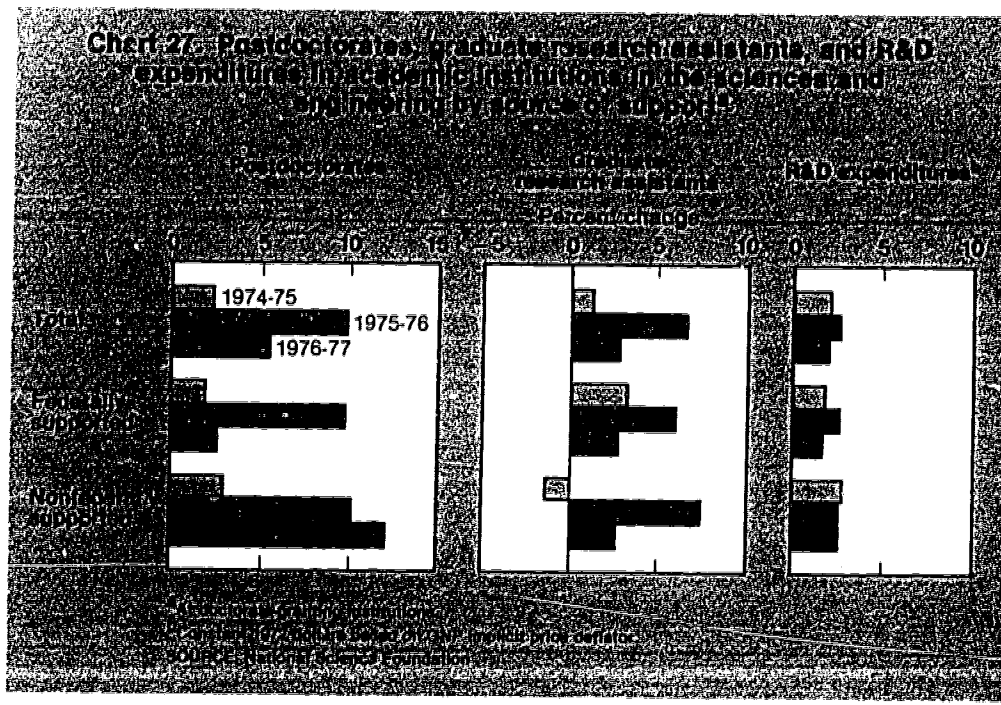


created profiles of 14 fields of graduate study, including both S/E and humanities disciplines, in order to look at the effects of rapid shifts in public policy toward graduate education.[33] As part of this report, employment plans of new Ph.D.'s from the NRC Survey of Earned Doctorates were analyzed and several disciplines were compared in conjunction with site visits. For example, almost one-half of the new doctorate-holders in chemistry chose postdoctoral positions in academic institutions in 1973, up from 28 percent in 1968. This type of appointment was found to be almost mandatory for students expecting faculty positions in chemistry. In contrast, industrial jobs in chemistry were listed far less frequently in 1973 than in 1968 as first position preference—21 percent compared to 38 percent. In describing the trade off between predoctoral and postdoctoral employment by institutions, the report stated that "... Many professors ... shifted support in their project grants from predoctoral research assistants to full-time postdoctoral students, thereby expanding the number of postdoctoral positions...." In addition, some departments were able to combine several teaching assistantship salaries into one and change the position to accomodate a postdoctoral student instead. The report found that "... the postdoctoral appointment has become very diverse, ranging from highly coveted opportunities to work under eminent scientists to thinly disguised and poorly paid teaching appointments . . ."—a conclusion applicable to most disciplines. In 1977 these same characteristics appear to be ingrained in the hiring practices of universities, and the continued utilization of postdoctorates, especially in fields where R&D expenditures are accelerating, seems to be assured.

Postdoctorates receiving some form of Federal support accounted for 69 percent of the 1977 total, down slightly from 71 percent in 1974. The number receiving Federal fellowships or traineeships, or working on Federal research projects, grew by 15 percent during the 1974-77 period, while those receiving other forms of support grew by a total of 27 percent. Between 1976 and 1977 a decided shift in the growth pattern occurred that could account for this difference. The rate of increase in federally supported postdoctorates dropped sharply, while the rate accelerated for those depending on other forms of support (appendix table B-27 and chart 27).

The working relationship that develops in a university research community can be illustrated further by an examination of the growth trends in postdoctoral appointments, graduate research assistants, and academic R&D expenditures in terms of the sources of support received. The 15-percent overall growth in postdoctorates receiving Federal support between 1974 and 1977 occurred simultaneously with a 13-percent overall rise in federally supported graduate research assistants and a constant-dollar rise of 6 percent in Federal R&D funding to doctorate-granting institutions. For each of these indicators of Federal research support, the rate of growth decelerated between 1976 and 1977, but not enough to affect the overall expansion pattern markedly.

The extent of the influence of foreign postdoctorates on the academic employment scene has not been measured comprehensively since 1967, when the NRC conducted a survey of the characteristics of postdoctorates on a national scale.[14] The 1967 study revealed that 81



[33] David W. Breneman, *Graduate School Adjustments to the "New Depression" in Higher Education*, Technical Report No. 3 (Washington, D.C.: National Board on Graduate Education, Feb. 1975.)

[14] National Research Coucil, *The Invisible University* (Washington, D.C., 1969), tables 5 and 27.

percent of all postdoctorates in the United States held academic appointments; the remaining 19 percent were distributed among nonprofit institutions, the Federal Government, and private industry. In academic institutions, 49 percent of the postdoctoral appointees in 1967 were from foreign countries. In 1977, when NSF collected data on foreign postdoctorates for the first time, the proportion employed in graduate S/E disciplines of doctorate-granting institutions amounted to only 32 percent. Of the 6,200 foreigners employed as postdoctorates in universities in fall 1977, over 3,500, or 57 percent, were assigned to life sciences departments, considerably below the U.S. citizen percentage of 70 percent in these same departments. In contrast, in engineering and the physical sciences postdoctorates from abroad constituted a higher percentage than did U.S. citizens (appendix table B-28).

While the number of postdoctoral positions in science and engineering has risen 18 percent in universities between 1974 and 1977, along with professional S/E employment at all levels in academic institutions, there are indications of a shrinking personnel pool from which these new postdoctoral appointments are coming, as discussed earlier. The number of doctorate recipients in science and engineering dropped from 19,500 in June 1972 to 18,300 in June 1977, or by nearly 7 percent.[35]

[35] National Research Council, *Summary Reports*, op. cit., table 1.

part 3.

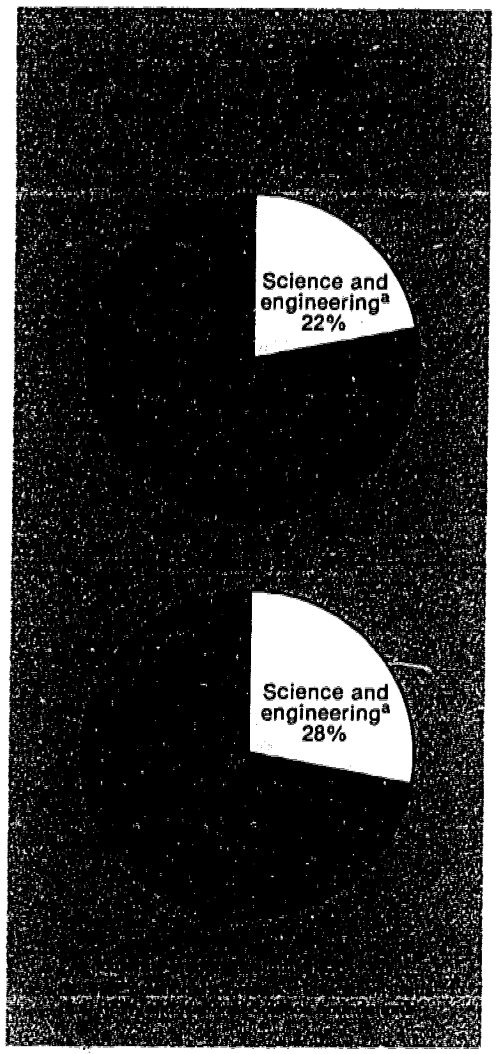
trends in graduate science enrollment

general characteristics, 1974-77

Paralleling the growth pattern of current expenditures for academic research and development and employment of scientists and engineers, enrollment of graduate students in S/E programs also rose in the period 1974-77. This section presents a statistical portrait demonstrating the factors at work that influenced the size of the graduate science student pool during the years for which the data from a compatible data base exist.[36] The two previous sections examined six years in the midseventies; the following analysis concentrates on only four years, 1974 through 1977, because of the limiting features of data on the earlier years' population, as described in the technical notes.

The cyclical patterns of growth and retrenchment in graduate science enrollment that have characterized this population since the sixties are influenced by complex interacting forces; no single element is responsible for the many directional shifts that take place and no causal relationship can be traced to any one factor. Job market conditions, the economy in general, affirmative action efforts, tuition costs, the draft, demographics, personal taste—all play a role in individual, institutional, and governmental decisionmaking. The size of the S/E enrollment pool at the graduate level is thus difficult to predict or explain. This section will present descriptors of the characteristics of this group and some of the factors that determine the size of the supply from which the Nation's scientists are drawn.

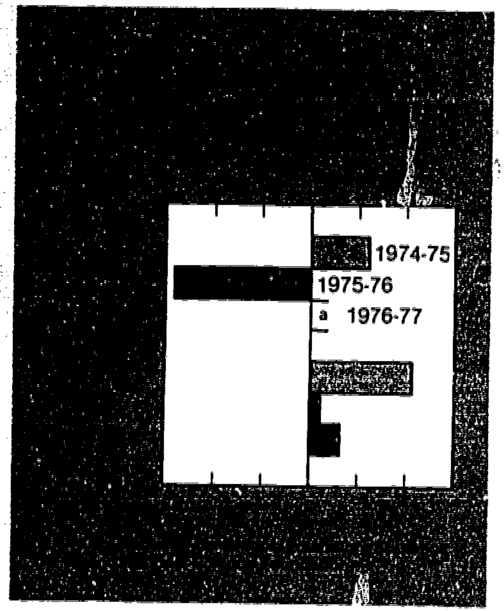
Since doctorate-granting institutions enrolled about 85 percent of the graduate science student population, accounted for 98 percent of the R&D expenditures of institutions of higher education, and employed 68 percent of the scientists and engineers, this section will concentrate on the characteristics of these institutions.



enrollment and degree patterns

The "mix" of science-to-nonscience enrollment at the graduate level changed somewhat between 1974 and 1977 (appendix table B-29 and chart 28). In the earlier year, S/E graduate students

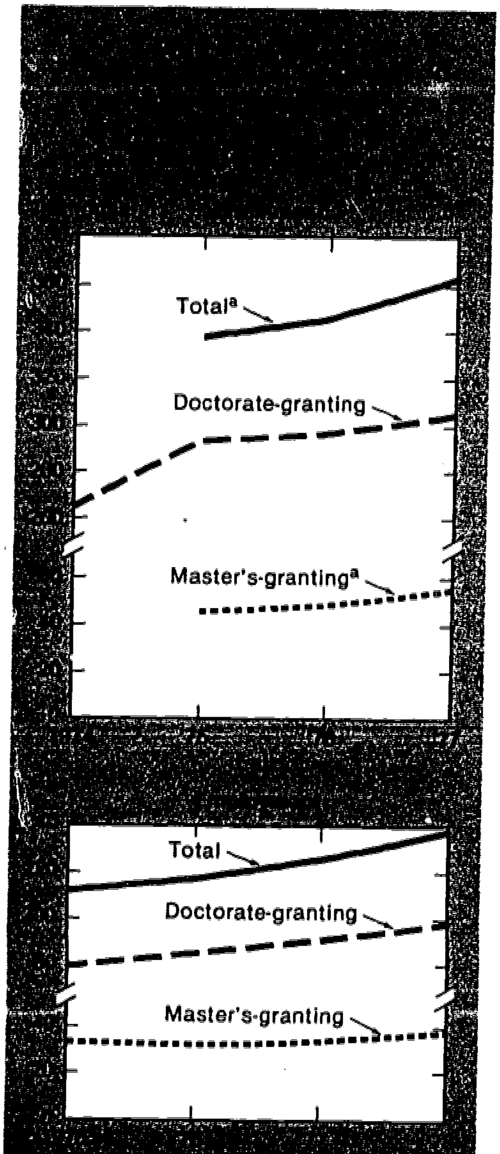
[36] Based on National Science Foundation's Survey of Graduate Science Student Support and Postdoctorals, annual series beginning in 1974.



accounted for 22 percent of all graduate enrollment; by 1977, their share had risen to 28 percent. During this time, graduate enrollment in all fields declined by 9 percent, so that in 1977 it represented less than 10 percent of all resident and extension enrollment, down from 12 percent in 1974[37] (chart 29).

During a general period of graduate S/E enrollment growth, academic employment of scientists and engineers in graduate institutions rose also. Master's institutions added over 5,100 scientists and engineers to their employment roles (up 15 percent in four years), and doctorate institutions added 18,900 (up 10 percent) (appendix table B-30 and chart 30).

Even though undergraduate enrollment grew in all fields between 1974 and 1977, the total number of baccalaureates and first-professional degrees awarded dropped slightly; undergraduate S/E degrees also dropped by 5 percent (appendix table B-31 and chart 31). If the addition of over 21,000 health science degrees, however, were combined with the loss of over 16,500 S/E degrees, the net effect would be a 1-percent growth in the 1974-77 period in bachelor's and first-professional degrees in science-related fields. The same would be true of master's degrees—over 13,000 master's degrees in health were awarded in 1977, 3,300 more than in 1974. When coupled



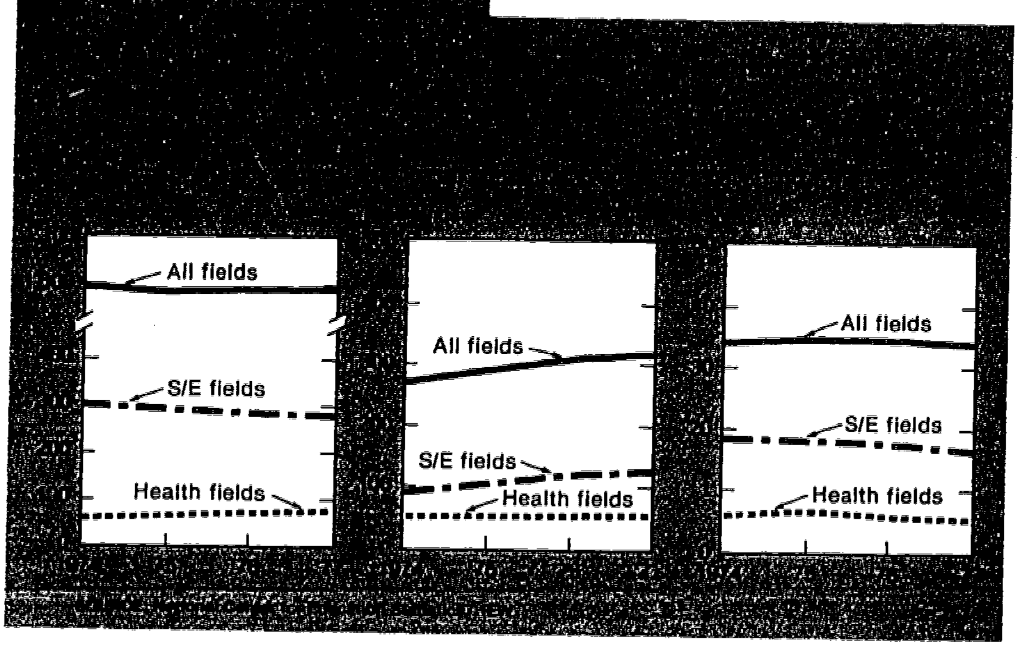
with the 2,500 more S/E degrees awarded, overall growth in master's degree awards in science-related fields amounted to 9 percent. Only the number of doctorates awarded declined in science, engineering, and health fields, a slowdown that began a year earlier.

full-time graduate science enrollment in doctorate-granting institutions

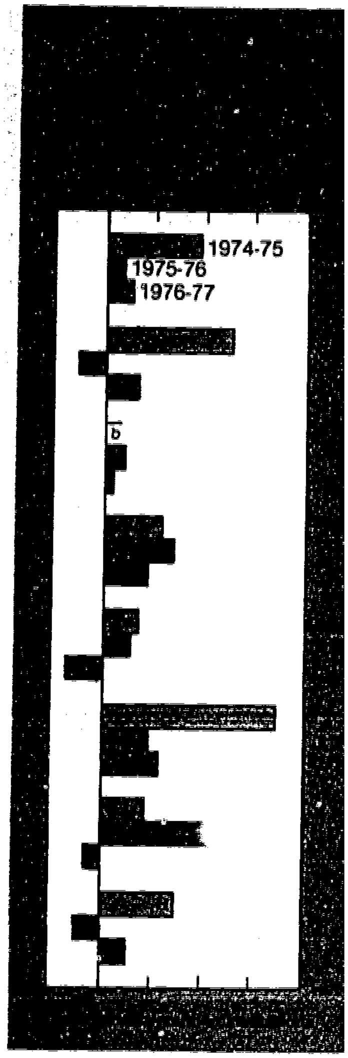
In the 1974-77 period, full-time enrollment in graduate S/E fields rose a total of 11 percent, a surge that took place almost entirely between 1974 and 1975; the growth rate decelerated to an average of 2 percent in each succeeding year. Other signs of change were evident in the relative share of those studying full time, dropping from 74 percent of graduate S/E enrollment to 71 percent. In every major field, growth either slowed markedly by 1977 or actually reversed (appendix table B-32 and chart 32). To better understand this "flattening out" tendency, it is important to examine the sources of support relied upon by full-time students to discern an emerging pattern.

federal support patterns

Federal initiatives to increase the Nation's supply of needed scientists and engineers began to wane in the early seventies with the realization that at least a balance between demand and



[37] Department of Health, Education, and Welfare, National Center for Higher Education, Survey of Opening Fall Enrollment in Higher Education, annual series.



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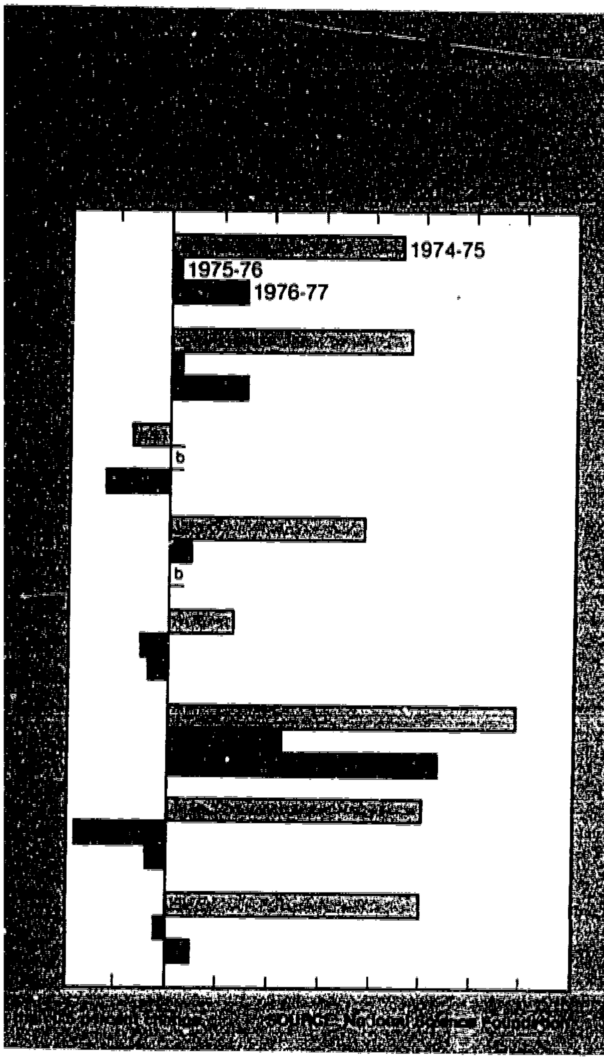

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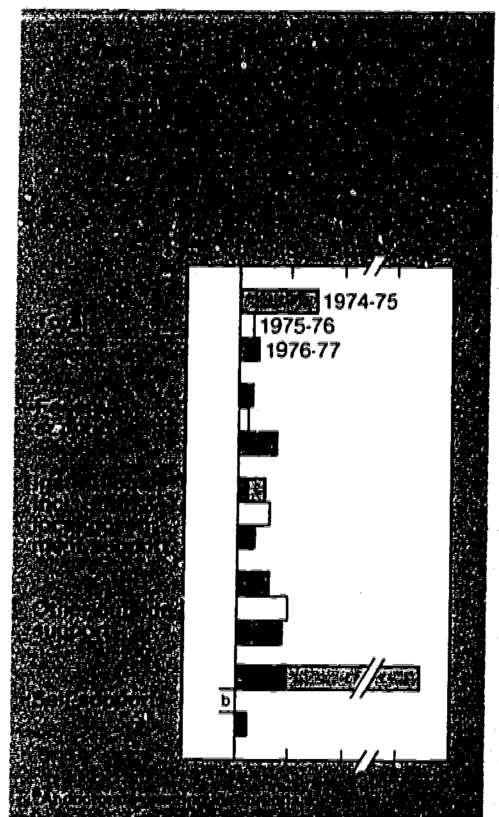
B-33). The actual dropoff was even greater in real terms. Two factors probably accounted for the downturn in real dollars—the erosive nature of inflation and the funding lag between the time the funds were obligated and the time the funds were spent.

Thus, toward the end of the seventies direct student aid from Federal agencies played an increasingly minor role in the support of graduate S/E students. Earlier, in 1967, the height of Federal visibility in terms of the relative share of graduate S/E fellowships and traineeships supported, 73 percent of full-time S/E graduate fellows-trainees depended on Federal support.[39] By 1977, only 50 percent of these students received such financial aid through fellowships and traineeships.

During the same period when Federal dollars for direct graduate student aid diminished (1971 to 1977), agencies increased their indirect assistance to students through the growth in funding of academic research and development, as shown in part I (appendix table B-6 and chart 4). Federally financed R&D expenditures at universities and colleges rose an average of almost 1 percent per year above the rate of inflation between fiscal years 1972 and 1977, contributing to the creation of a growing number of federally supported research assistantships. Because of this trade off between direct and indirect support of graduate science students, the net effect was a turnaround in the total number of federally supported students between 1974 and 1977. Doctorate-granting institutions reported accelerating rates of growth in each of these years, for an overall rise in federally supported students of 5 percent over 1974 totals (appendix table B-34 and chart 33). Thus, the number of graduate S/E students receiving some form of Federal support reached 50,300 in 1977, or 23 percent of the full-



[39] Based on data provided on National Science Foundation's Graduate Traineeship Applications for fall 1967, as reported in *Graduate Science Student Support and Manpower Resources in Graduate Science Education, Fall 1969* (NSF 70-40). (Washington, D.C.: U.S. Government Printing Office) and unpublished data from fall 1967 Graduate Traineeship Applications.

time total. Even though R&D financing by Federal agencies spurred such growth, the Federal share of student support in 1977 was still below that of 1971, when 31 percent received Federal aid to pursue graduate work full time.[40]

The shift to federally supported research assistantships has been gradual. In 1971, this form of aid was available to 42 percent of those receiving some form of Federal assistance; by 1977, the proportion had risen to 50 percent. Concurrently, the use of fellowships and traineeships by Federal agencies for the support of graduate students dropped from a 51-percent share of those receiving Federal assistance in 1971 to 39 percent in 1977.

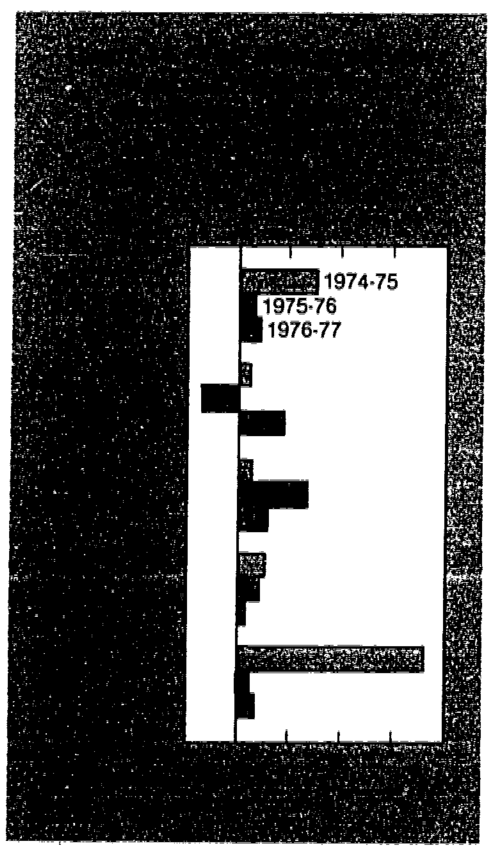
Past Federal policies toward student aid were aimed at the direct support of graduate S/E students, while current academic R&D funding policies affect them indirectly. New student assistance programs that took effect in fiscal year 1974 were designed instead to strengthen undergraduate education in all fields through loans and grants programs allocated on the basis of student and family financial need. In particular, the educational opportunity grants of the Office of Education have resulted in a wide dispersion of Federal obligations to about 2,700 institutions of higher education and reached nearly 2.9 million students in 1977.[41] These publicly funded assistance programs have been budgeted to reach over 3.2 million undergraduates by 1981 at a cost of over $2.7 billion that year.

other sources of support

The 5-percent rise in federally supported students mentioned above, while significant, was overshadowed by the 14-percent increase in students receiving financial aid from all other sources during 1974-77. Both institutional and State and local government support rose, reaching 80,500 students in 1977, or 37 percent of the full-time student total. An even larger gain in both absolute and relative terms occurred in the number of students relying on their own and their families' resources for graduate training. Nearly 13,000 more self-supported students attended doctorate-granting institutions in 1977 than in 1974, for an overall percentage gain of 23 percent that brought their total to nearly 69,000. With rising tuition and living costs, as well as increasing interest rates on educational and personal loans, this high rate of growth in numbers of students dependent on self-support showed signs o[illegible]ering off.

mechanisms of support

In 1977 about 61 percent of the S/E students enrolled full time received some form of graduate assistantships, either fellowships, traineeships, research, or teaching assistantships, an increase of 6 percent over the number in 1974. Those students receiving all other types of support, primarily self-support, grew by 21 percent. Of all mechanisms of support, fellowship and traineeship-holders grew at the lowest rate (only 2 percent), while research assistantship-holders rose by 11 percent, fueled by the rise in academic R&D spending discussed earlier (appendix table B-35 and chart 34). Teaching assistantships were available to 5 percent more students in 1977 than in 1974.



women in graduate science programs

The increase in the number of women preparing for careers in science and engineering by enrolling full time in graduate S/E programs has been rapid between 1974 and 1977, up 37 percent to a total of 63,700. Nearly 17,000 more women attended graduate schools of doctorate-granting institutions in 1977 than three years earlier. In contrast, the net growth in the number of men was up only 4 percent to 154,500.

In 1976 and 1977, men registered slight losses, with a decline in graduate study in engineering and the life and social sciences between 1975 and 1976 and another decline in psychology and the mathematical and social sciences the following year. Only the environmental sciences showed an increase in male graduate enrollment for three successive years. For women, only one field, mathematical and computer sciences, showed a downturn between 1976 and 1977, but its effect on the total number was slight (appendix table B-36 and chart 35).

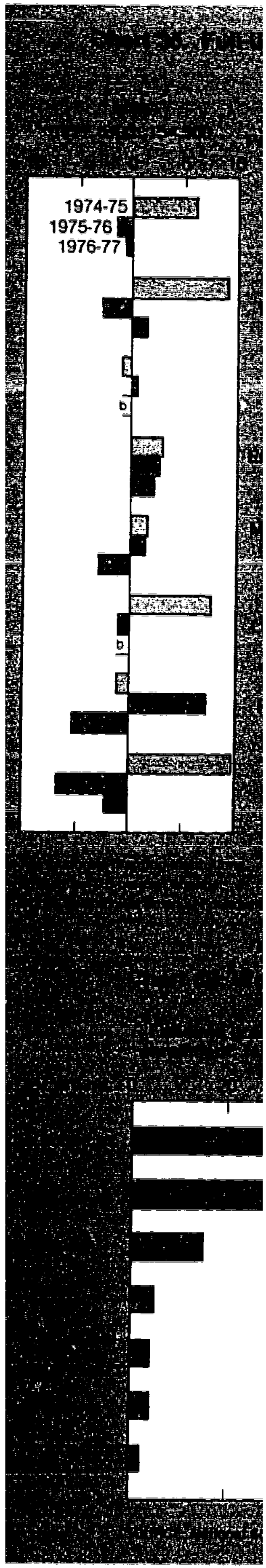
Women's strong interest in science and engineering was demonstrated further by the growth in the number of S/E doctorates they received between 1974 and 1977[42] (appendix table B-37.) The number granted to women rose from 14 percent of the total S/E doctorates to 18 percent in a few short years, and every field of science enrolled a larger share of women in 1977 than in 1974. In two areas, the environmental and social sciences, doctorate awards dropped between 1976 and 1977, but the net loss was not enough to affect the total rise.

In parallel with this strong advance in both graduate science training and in doctorate-holders between 1974 and 1977, the number of women enrolled in undergraduate programs in all fields increased significantly, from 2.3 million to 2.9 million, or by 26 percent. The number of men rose at the undergraduate level also but at a slower pace, up from

[40] National Science Foundation, *Graduate Student Support and Manpower Resources in Graduate Science Education, Fall 1971* (NSF 73-304) (Washington, D.C.: U.S. Government Printing Office.), p. 82.

[41] Office of Management and Budget, *Appendix to the Budget of the United States Government, Fiscal Year 1977*, p. 350, and *Fiscal Year 1979*, p. 428, (Washington, D.C.: U.S. Government Printing Office.)

[42] National Research Council, *Summary Reports*, op. cit., June 1974-June 1977, table 1.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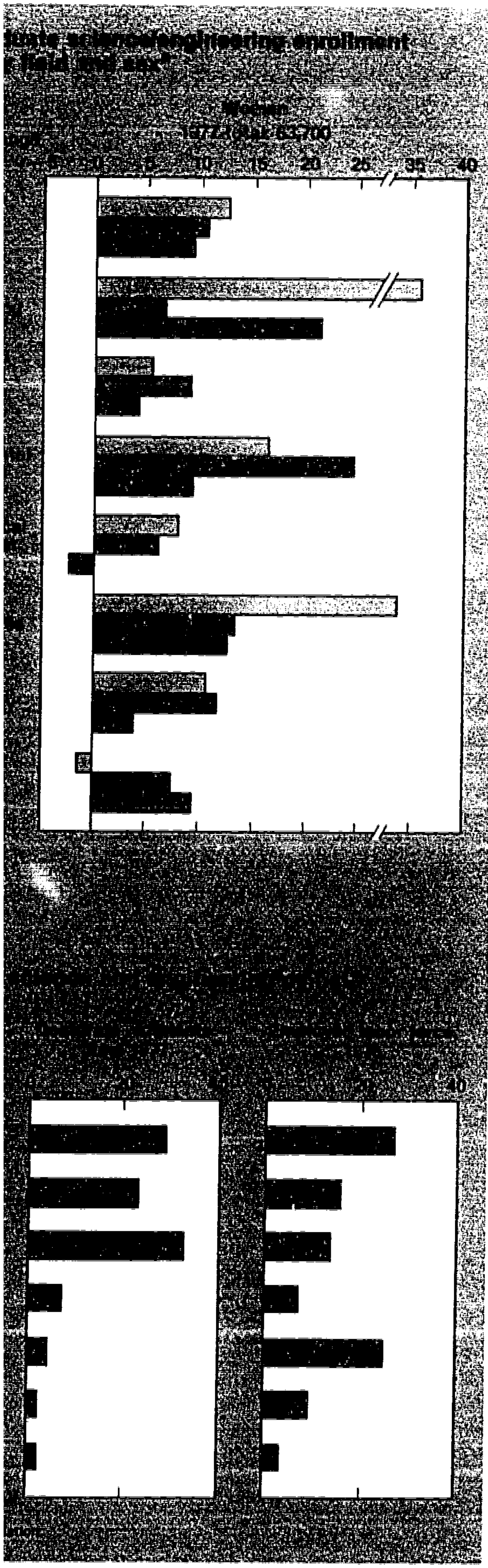


2.8 million to 3.1 million, or by 11 percent.[43]

In 1977 the life sciences drew the highest proportion of women into graduate study and the social sciences ranked next. In terms of doctorate degrees awarded to women, more were awarded in 1977 in psychology than in any other field; the life and social sciences were next in order. In the 1978 labor force the life sciences ranked first in the number of women employed, followed by the mathematical and computer sciences (appendix table B-38 and chart 36).

foreign students

Although students from foreign countries represented only 2 percent (235,500) of the 11.4 million students enrolled in all U.S. institutions of higher education in 1977, their numbers have grown by 52 percent since 1974.[44] In graduate S/E programs, foreign students enrolled full time increased 16 percent in the same period to a total of 37,000. In spite of this rise, foreign students accounted for only 17 percent of the 1977 full-time graduate science student total, about the same proportion reported by doctorate-granting institutions 10 years earlier.[45]

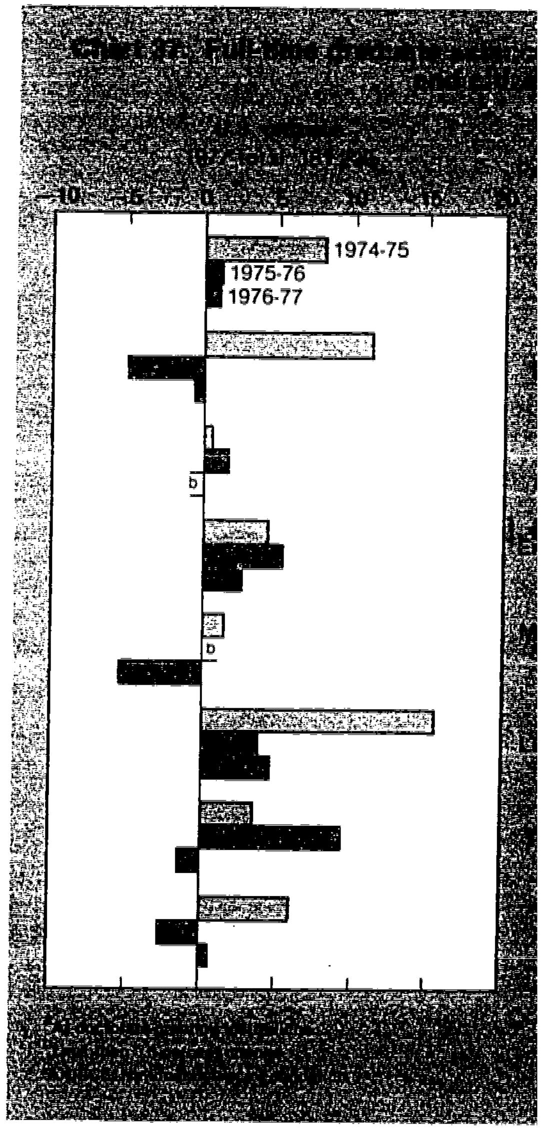
Engineering ranked first in S/E enrollment choice by foreign graduate students in 1977, as it did in each of the three preceding years. For U.S. citizens, engineering ranked third, behind the life and social sciences. In every major S/E field, institutions reported foreign student growth, so that the total number increased each year of the period. Growth in U.S. citizen enrollment slowed markedly in both 1976 and 1977 after a 1974-75 surge, so that total percentage growth between 1974 and 1977 was 11 percent, raising the 1977 total of U.S. citizens to 181,200 (appendix table B-39 and chart 37).

Enrollment data recently made available on all nonresident aliens as reported by institutions of higher education to NCES showed an increase of 15 per-

[43] Department of Health, Education, and Welfare, National Center for Higher Education, Survey of Opening Fall Enrollment in Higher Education, annual series.

[44] Institute of International Education, *Open Doors 1977/78, A Report on International Educational Exchange* (New York, N.Y., 1979), table 1, p. 2.

[45] Based on unpublished data from National Science Foundation's Graduate Traineeship Applications for Fall 1967.



cent between 1976 and 1978.[46] The impact of these students was greater at the graduate than the undergraduate level, and because of this trend, NCES predicts that colleges having graduate programs may be in a better position to adjust to the estimated declines in U.S. citizen enrollment expected in the eighties. Engineering fields drew nearly 20 percent of the national enrollment total of all nonresident aliens, up slightly from 18 percent in 1976, and was the area in which the highest proportion of bachelor's, master's, and doctorate degrees was awarded in academic years 1975 and 1976.

Publicly controlled institutions enrolled

[46] Department of Health, Education, and Welfare, National Center for Education Statistics, bulletin entitled, "Nonresident Alien Enrollments and Degrees are Increasing," (NCES 80-B05), March 19, 1980, based on fall enrollment and compliance report of institutions of higher education, 1976 and 1978.

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[47] Institute of International Ec
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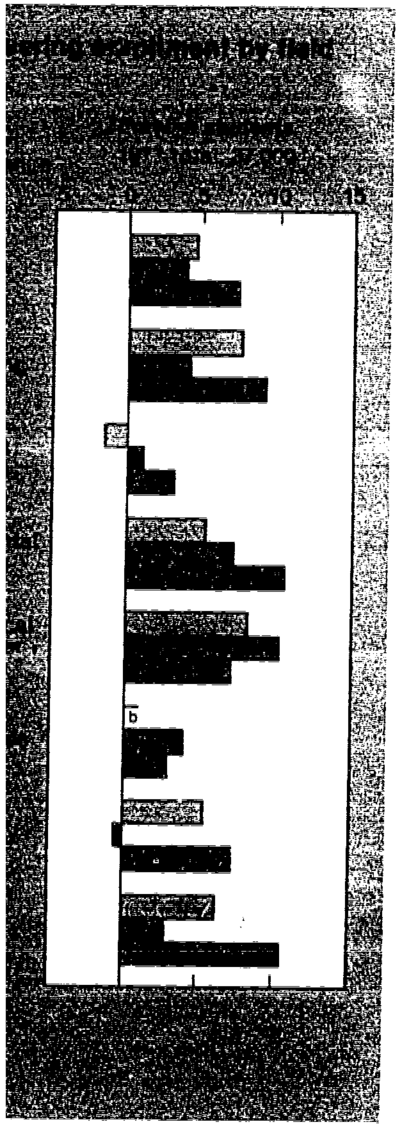

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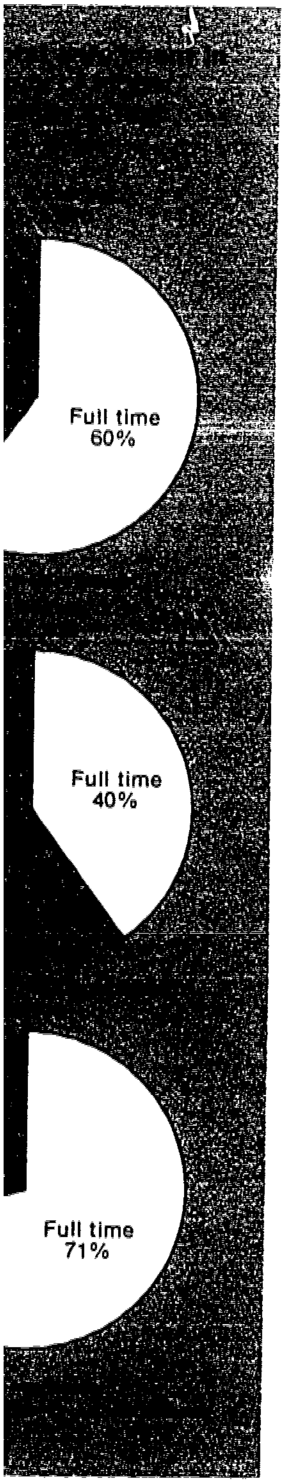
S/E students, institutions reported that only 22 percent of foreign S/E students relied on their own resources for support; the institutions and Federal agencies supported about 60 percent.[48]

part-time graduate science enrollment in doctoral-granting institutions

In 1977 the part-time component of enrollment at all levels of higher education amounted to 40 percent; at the graduate level, it amounted to a much higher proportion, over 60 percent.[49] In the S/E

[48] National Science Foundation, *Graduate Science Education: Student Support and Postdoctorals, Fall 1973* (NSF 74-318) (Washington, D.C.: U.S. Government Printing Office), p. 57.

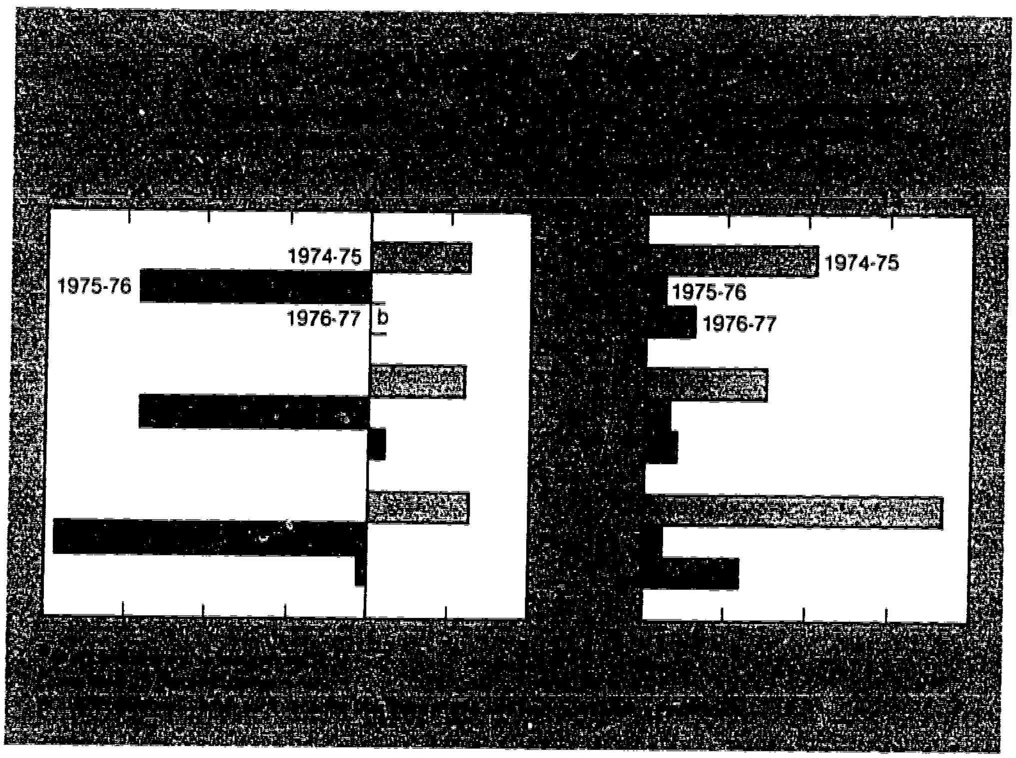
[49] Department of Health, Education, and Welfare, National Center for Education Statistics, Survey of Opening Fall Enrollment in Higher Education, annual series.



disciplines, however, only 29 percent were enrolled in graduate departments on a part-time basis, or about one-half the share typicai of the graduate level in all fields (appendix table B-40 and chart 38).

Further differences were evident in the rates of change between part-time graduate enrollment totals and the number in S/E programs. Although part-timers in all graduate fields declined in 1976 and 1977 and showed an overall loss of 15 percent, those in S/E programs rose for three successive years for a gain of 26 percent, reaching a total of 88,500 students by 1977 (appendix table B-41 and chart 39).

The life sciences accounted for 40 percent of this net growth, adding nearly 7,300 part-timers between 1974 and 1977. Much of this incremental growth occurred in the health sciences, primarily in nursing and preventive medicine. Students employed full time in such health science occupations frequently enroll for advanced degrees on a part-time basis in order to upgrade their credentials and attain higher levels of certification. Engineering fields accounted for 35 percent of the 1974-77 net growth in part-timers, with industrial engineering showing the largest gain. Several fields showed signs of a cutback between 1976 and 1977, particularly the physical sciences, down 5 percent, and psychology and the mathematical sciences, down 2 percent each.



appendixes

A. Technical Notes
B. Statistical Tables
C. Survey Forms and Instructions

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appendix a

technical notes

This report presents data that were collected in three NSF annual surveys of academic science resources covering the following time periods:

1. Scientific and Engineering Expenditures at Universities and Colleges, FY 1972 through FY 1977
2. Scientific and Engineering Personnel Employed at Universities and Colleges, January 1973 through January 1978
3. Graduate Science Student Support and Postdoctorals, Fall 1974 through Fall 1977

In terms of the reporti... riod of respondents in these surveys, each differs according to NSF survey concepts and institutional recordkeeping practices. The R&D expenditure data are reported according to established institutional financial accounting practices. In most instances, records are maintained on the basis of the institution's fiscal year (i.e., the year ending in July or in October) or of calendar years. The survey of scientific and engineering (S/E) personnel is mailed to respondents in January, but the date that institutions use to supply data differs, depending again on established practices. For many public institutions with State reporting requirements, the NSF data are based on personnel files compiled the preceding fall. Others report as of January or whenever they "lock in" their personnel files for annual administrative reporting purposes. The graduate student and postdoctoral headcounts are based on data compiled at the opening of the fall semester.

Data collected through the institutional survey system instituted by NSF have been integrated into a common-coded computerized data base to permit greater accessiblity and subsequent dissemination. A compatible coding structure allows the data user to make institutional and field-of-science comparability studies not usually possible from other data sources.

As part of its continuing effort to reduce respondent reporting burden, NSF converted its data collection efforts from an annual to a biennial cycle beginning in fiscal year 1977. A full-scale survey format using a "long" form is mailed in odd-numbered years to all institutions having S/E programs, while in alternate years only key data elements printed on "short" forms are collected from doctorate-granting institutions. The current consolidated report analyzes the results from the three above-named surveys in their 1977 long-form cycles and will be produced in the future on a biennial basis.

survey of scientific and engineering expenditures at universities and colleges, fy 1977

On December 2, 1977, survey questionnaires were mailed to 539 universities and colleges and 21 university-administered federally funded research and development centers (FFRDC's). Essentially the same criteria in 1977 were used in establishing the survey universe that were employed for the fiscal year 1975 and 1976 surveys. The universe included all academic institutions granting graduate degrees in the sciences or engineering, and all other universities and colleges with over $50,000 in R&D expenditures. The 21 university-administered FFRDC's were surveyed separately.

The R&D expenditures reported by this survey's 539 universities and colleges are estimated to account for over 99 percent of all academic R&D spending. Information gathered from the 1972 survey, when over 1,600 additional universities and colleges were surveyed, indicated that all other institutions of higher education accounted for less than 1 percent of total R&D spending.

Five and one-fourth months after the mailout (May 10, 1978), 96 percent of the institutions, including the 100 leading R&D performers in the academic sector, had responded with usable data. This excellent response rate, achieved in part by improvements in data processing techniques, facilitated publication of the final data tabulations in *Scientific and Engineering Expenditures at Universities and Colleges, Fiscal Year 1977* (Detailed Statistical Tables) (NSF 78-311) by August 1978, 8 months from the initial mailout of the questionnaire.

imputation for nonresponse

Twenty-three institutions failed to respond to the survey questionnaire and a machine imputation program was developed to provide estimates for these institutions. The imputation program for nonrespondents was based on detailed summary data according to respondent institution characteristics

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(level of degree granted and type of control) to determine inflation or deflation factors. These factors were applied to the previous years' responses to create estimates for nonrespondents. R&D estimates for nonrespondents totaled $79 million, or 1.9 percent of the $4.0 billion universe total. Only 8 doctorate-granting, 10 master's-granting, and 5 bachelor's-granting institutions failed to respond to the FY 1977 survey.

A detailed account of the imputation results is given in table A-1, which combines both machine-imputed totals and those estimated by NSF. Previously, this table did not incorporate NSF estimates for some nonrespondent institutions. Generally, these NSF estimates were used to distribute R&D spending by character of work.

response analysis and data quality

NSF has identified certain areas in which efforts have been undertaken to enhance the quality of statistics. One particular area is the reporting of the institutional contribution toward organized research activities. The category "institutional funds," a source of R&D support item, is comprised of several elements. These include separately budgeted expenditures funded from such sources as unrestricted endowment income and unrecovered indirect costs and cost sharing of R&D projects sponsored by outside agencies. While most institutions can report from their accounts expenditures from such sources as endowment income, estimates are usually required for data on unrecovered indirect costs and cost sharing. As a result, NSF has redesigned its survey forms and instructions and taken other steps to upgrade the quality and consistency of reporting of the "institutional funds" data.

The reporting of basic research is one of the most important components of the expenditure survey. These data are of particular interest to Federal planners since over one-half of the total U.S. basic research performance occurs in academe. Nevertheless, relatively few universities have recordkeeping systems which can reveal precise data on the character of research. As a result, many institutions are forced to estimate this item. More precision may be possible in the future, however, as a number of large research performers have made provisions to have principal investigators code their projects at the time of award as either basic or applied research.

When referring to Federal funding of academic research and development, it is well to keep in mind that a university's perspective may differ from that of a Federal agency in terms of how R&D projects should be categorized. In NSF's survey of separately budgeted R&D expenditures, the institution is asked to distribute R&D funds according to the performer's intent as to character of work, i.e., whether basic, applied, or development. From the institution's point of view, a project could be classified as basic research based on the NSF definition, while the same project could be considered applied by the sponsor, whose purpose may be dictated by issues related to its own mission. In the NSF annual Survey of Federal Funds for Research and Development, agencies classified just over one-half of their 1977 academic R&D obligations as basic, while the performers responding to the institutional survey labeled three-fourths of their 1977 federally financed R&D expenditures as basic research, as illustrated in table A-2.

Additional questions regarding the findings from the Survey of Scientific and Engineering Expenditures at Universities and Colleges should be addressed to James B. Hoehn or Marge Machen, Universities and Nonprofit Institutions Studies Group, Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550 (202-634-4673). Data tapes for FY 1977 and prior years may be purchased from:

Moshman Associates, Inc.
6400 Goldsboro Road
Washington, D.C. 20034
(301) 229-3000

survey of scientific and engineering personnel at universities and colleges, january 1978

Survey questionnaires were mailed in mid-February 1978 to more than 2,200 institutions of higher education and 21 university-administered FFRDC's. The survey universe included all institutions of higher education, including 2-year institutions, that were identified by NSF as offering degree-credit courses in either the sciences or engineering.

Table A-1. Academic R&D expenditures survey response rates by type of institution: FY 1977

Type of institution	Number surveyed	Number of respondents	Percent of total
Total	539	516	95.7
Doctorate	287	279	97.2
Master's	177	167	94.4
Bachelor's and no science degree	75	70	93.3

Source: National Science Foundation.

Table A-2. Distribution of Federal academic R&D support by character of work and survey respondent: FY 1977

(Dollars in millions)

Character of work	Institutional responses to the Survey of Scientific and Engineering Expenditures at Universities and Colleges: Amount	Percent distribution	Agency obligations reported to Survey of Federal Funds for Research and Development: Amount	Percent distribution
Federal academic R&D support, total	$2,717	100.0	$2,905	100.0
Basic research	1,992	73.3	1,547	53.2
Applied research	605	22.3	1,042	35.9
Development	120	4.4	316	10.9

Source: National Science Foundation.

At the survey closeout date in late August 1978, the survey population included 2,228 universities and colleges and 21 university-associated FFRDC's. This adjustment reflected curriculum modifications (i.e., openings or closing of courses in science or engineering) as well as changes in the institutional population. Of this total, 1,763 (79 percent) responded, compared with an 87-percent response rate for the previous year. General expressions of concern about "paperwork burden" and increased workloads of academic support staff appear to have contributed to the decline in the response rate. While several items were added to the 1978 survey form which increased its complexity, NSF has reduced the size and complexity of forms in subsequent surveys.

The majority of nonrespondents were small institutions, primarily 2-year institutions. Among the approximately 300 Ph.D.-granting institutions that accounted for virtually all academic research as well as nearly two-thirds of all academic scientists and engineers, only 36 were nonrespondents. Response rates are shown in table A-3.

estimates for nonresponse

Estimates were made for institutions that failed to respond to the survey in order to provide overall national totals of academic employment of scientists and engineers. These "imputations" for nonrespondents were based primarily on key item totals reported (or estimated) in the prior survey year. Totals for these institutions were inflated or deflated according to overall rates of change for data supplied by respondents at the same degree level and the same type of governance (public or private). Detailed imputations were then made on the basis of the distribution computed for similar institutions.

The largest imputation rates were for data collected on an item introduced to the 1978 survey which covered FTE scientists and engineers employed in separately budgeted R&D activities. For instance, the imputation rate was 35 percent for the FTE distribution of headcount data on scientists and engineers involved in R&D activities. Since questions on FTE involvement in R&D activities by detailed discipline were newly added to the form in 1978, a number of institutions had not yet designed or developed information systems to supply these estimates. Also, some may have found it difficult to separate departmental research from separately budgeted activities. As Federal and State reporting requirements for research involvement of faculty are broadened, it is expected that the quality of data on FTE's in research and development will improve in subsequent survey years.

Table A-3. Scientific and engineering personnel survey response rates by type of institution: January 1978

Type of institution	Number surveyed	Number of respondents	Percent of total
Total	2,228	1,763	79.1
Doctorate	308	272	88.3
Master's	297	261	87.9
Bachelor's and no science degree	1,623	1,230	75.8

Source: National Science Foundation.

response analysis and data quality

The data systems used to complete the NSF personnel survey are becoming more centralized and more automated. A postenumeration study of 45 institutions conducted in 1978 found that three-fifths of a sample of large research universities used computerized payroll or management information systems to complete this form compared with only 40 percent in an NSF evaluation study done in 1973.[1] It was found in the 1978 study that nearly one-half of the sampled institutions used multiple sources to supply data for all questionnaire items. These various record sources inevitably lead to some inconsistencies among institutional responses.

The principal area of reporting variance occurs in the request for universities to classify the extent of professional involvement in R&D activities. Because centralized records usually do not carry entries of R&D involvement, various decentralized reporting practices are common. Among them are estimates made by research administrators, graduate deans, department chairpersons, or surveys of faculty. Some institutions use time and effort data obtained from internal surveys of faculty while other institutions base their estimates on the relation between income from organized research and faculty salary structures.

Requests for additional information concerning the personnel survey findings should be addressed to Mr. James Hoehn or Mrs. Esther Gist, Universities and Nonprofit Institutions Studies Group, Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550. (202) 634-4673. Data tapes for January 1978 and prior years may be purchased from:

Moshman Associates, Inc.
6400 Goldsboro Road
Washington, D.C. 20034
(301) 229-3000

survey of graduate science student support and postdoctorals, fall 1977

Mailout of the fall 1977 survey was completed on December 5, 1977, to 371 reporting units or schools at all S/E doctorate-granting institutions and 328 S/E master's institutions. The survey was closed out on June 22, 1978, with a near 100-percent institutional response rate among doctorate-granting institutions. Only one institution failed to respond. Among the master's institutions, three were unable to participate in the survey during 1977, nor did they respond in 1976.

imputation for nonresponse

Missing data were imputed based on the previous year's response for the 33 departments at the one nonrespondent doctorate institution. In addition, another 11 departments required full imputation, and 9 received partial imputation. Only three departments not responding to the 1977 survey were also nonrespondent in 1976 and thus were not included in the tabulations.

At master's institutions, 10 departments were fully imputed based on their

[1] National Science Foundation, *Evaluation of the Survey of Scientific Activities of Institutions of Higher Education*, by Robert R. Wright (Washington, D.C., 1973)

Table A-4. Graduate science students and postdoctoral survey response rates by type of institution and department: Fall 1977

Type of institution	Institutions			Departments		
	Number surveyed	Number of respondents	Percent of total	Number surveyed	Number of respondents	Percent of total
Total	699	695	99.4	9,513	9,281	97.6
Doctorate	371	[1]370	99.7	7,951	7,898	99.3
Master's	328	325	99.1	1,562	1,383	88.5

[1] Branch campuses and medical schools were considered separate reporting units for some institutions.

Source: National Science Foundation

previous year's response and another 169 departments required partial imputation to complete the data items requesting a breakout on major sources of support or sex of students. Response rates are shown in table A-4.

response analysis and data quality

Two national studies have been conducted to determine reporting practices and data quality of the Survey of Graduate Science Student Support and Postdoctorals. One was conducted in 1974 and involved personal visits and structured interviews at a sample of 30 institutions and 120 S/E departments.[2] The second was undertaken in 1978 and covered campus interviews at a sample of 45 major research universities.[3]

The results from the two national studies corresponded closely. Among the findings was that the Survey of Graduate Science Student Support and Postdoctorals is much more decentralized in reporting practices than the other two annual surveys of academic institutions covering R&D expenditures and S/E personnel. In the graduate student survey, one form is sent to NSF by each graduate department that is designated as a "science and engineering" program. Typically, when these forms are sent to institutions at the beginning of a survey, the NSF coordinator in the office of the graduate dean sends each form to specific departments for accumulation of data and completion. All of the institutions in the response analysis studies used this reporting procedure in one way or another—either to obtain data on numbers of graduate students, their enrollment, demographics, and income characteristics, or to acquire similar statistics for postdoctorates.

Departmental respondents use varying methods to assemble the NSF graduate student and postdoctoral data. The most prevalent procedure is to prepare lists of individual graduate students and postdoctorates with associated data on funding sources and enrollment characteristics. Other departments may use existing information from the university's centralized management information system or from fellowship and traineeship applications, letters of intent, payroll forms, application and admission forms, etc. Many of them base their reports on "personal knowledge" of the person filling out the form, especially in departments with small enrollment. Since most departments have to compile their own data base, the degree of accuracy probably depends largely upon their understanding of the importance of these national statistics for policy and planning.

The reason for the highly decentralized reporting procedures used in the NSF graduate student survey are both traditional and conceptual. Originally, the departmental forms were designed to obtain basic data as part of the NSF Graduate Traineeship Program. Departments were required to submit reports to NSF to qualify for these traineeships. When the NSF Graduate Traineeship Program was largely abolished in 1971, the data continued to be collected as part of a statistical survey and most institutions continued to compile them on the same basis as before. Conceptually, some of the data requested by NSF can only be reported at the level of departments with any degree of accuracy. Although central records contain most of the data in many institutions, only departments know about sources of graduate student support that do not go through payroll records or other administrative units of the university (i.e., stipends such as company support, private foundation awards, and family support of individual students). In addition, central records of many institutions are extremely weak in terms of their ability to report data on postdoctorates with reasonable reliability.

Requests for additional information concerning the graduate student survey findings should be addressed to Mrs. Susan G. Broyles, Universities and Nonprofit Institutions Studies Group, Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550 (202-634-4673). Data tapes for fall 1977 and prior years may be purchased from:

Moshman Associates, Inc.
6400 Goldsboro Road
Washington, D.C. 20034
(301) 229-3000

data user guide

To introduce the potential user to the common-coded data base developed by the Universities and Nonprofit Institutions Studies Group, Moshman Associates, Inc. produces on a periodic basis a "Data User Guide." The January 1980 issue, Version 3, reflects the addition of FY 1978 survey data to the integrated data base and documents major changes to data structures that have occurred since FY 1977.

Copies of the "Data User Guide" may be obtained without charge from:

Universities and Nonprofit
Institutions Studies Group
National Science Foundation
Room L-602
Washington, D.C. 20550

[2] Westat, Inc., "Assessment of Coverage, Consistency of Reporting and Methodology of the 1973 Graduate Science Student Support Survey: A Reliability and Validity Study." (Rockville, Md., 1975.)

[3] Richard M. Berry, *NSF Academic Science Statistics Postenumeration Study*, supported by Intergovernmental Personnel Act, Agreement No. SRS-7719419, July 18, 1977, National Science Foundation (Boulder, Colo.: National Center for Higher Education Management Systems, 1978.)

appendix b

statistical tables

R&D Expenditures

Page

Science and Engineering Personnel

Graduate Enrollment

Table B–1. National R&D expenditures by sector: 1972–79 (est.)

(Dollars in millions)

Year	Total	Federal	Industry	Nonprofit institutions	Academic sector: Universities and colleges	Academic sector: Associated FFRDC's[1]
1972	$28,413	$4,482	$19,539	$ 952	$2,677	$ 764
1973	30,615	4,619	21,233	1,006	2,940	817
1974	32,734	4,815	22,867	1,164	3,023	865
1975	35,200	5,397	24,164	1,243	3,409	987
1976	38,848	5,710	26,938	1,323	3,730	1,147
1977	42,940	6,142	29,933	1,417	4,064	1,384
1978	48,140	6,882	33,406	1,520	4,615	1,717
1979 (est.)	54,152	7,522	37,700	1,750	5,340	1,840

[1] Federally funded research and development centers.
SOURCE: National Science Foundation

Table B–2. National basic research expenditures by performer: 1972–79 (est.)

(Dollars in millions)

Year	Total	Federal	Industry	Universities and colleges [1]	All other
1972	$3,748	$ 538	$ 593	$2,022	$ 595
1973	3,877	537	631	2,055	654
1974	4,144	611	699	2,153	681
1975	4,527	682	719	2,410	716
1976	4,881	719	817	2,547	798
1977	5,444	866	910	2,787	881
1978	6,292	1,047	1,040	3,185	1,020
1979 (est.)	7,257	1,157	1,190	3,745	1,165

[1] Excludes federally funded research and development centers (FFRDC's).
SOURCE: National Science Foundation

Table B–3. R&D expenditures at universities and colleges by character of work: FY 1972–77

(Dollars in millions)

Fiscal year	Basic research		Applied research		Development	
	Current	Constant[1]	Current	Constant[1]	Current	Constant[1]
1972	$2,022	$2,022	$ 544	$544	$110	$110
1973	2,054	1,967	717	687	168	161
1974	2,153	1,914	737	655	133	118
1975	2,408	1,933	852	684	149	120
1976	2,547	1,911	1,015	761	168	126
1977	2,788	1,959	1,067	750	209	147

[1] Based on GNP implicit price deflator in 1972 dollars.
SOURCE: National Science Foundation

Table B–4. R&D expenditures at universities and colleges by source: FY 1972–77

(Dollars in millions)

Fiscal year	Total		Federal		Non-Federal	
	Current	Constant[1]	Current	Constant[1]	Current	Constant[1]
1972	$2,677	$2,677	$1,839	$1,839	$ 838	$838
1973	2,940	2,816	2,038	1,952	902	864
1974	3,023	2,687	2,032	1,806	991	881
1975	3,409	2,736	2,288	1,836	1,121	900
1976	3,730	2,798	2,501	1,876	1,229	922
1977	4,064	2,856	2,717	1,909	1,347	947

[1] Based on GNP implicit price deflator in 1972 dollars.
SOURCE: National Science Foundation

Table B–5. R&D expenditures at universities and colleges by source, character of work, and field: FY 1972–77

(Dollars in thousands)

Source, character, and field	1972	1973	1974	1975	1976	1977
Total R&D expenditures	$2,676,511	$2,939,579	$3,023,425	$3,409,194	$3,730,688	$4,064,220
Source of funds:						
Federal Government	1,838,933	2,038,206	2,032,143	2,287,779	2,501,139	2,716,767
State government	257,068	280,880	312,726	336,937	370,549	362,255
Local government	12,850	14,510	14,038	15,428	15,219	13,400
Foundations & voluntary health agencies	128,032	131,168	142,121	167,736	182,709	191,737
Industry	75,270	85,240	96,033	113,256	123,519	139,149
Institutional funds	305,520	319,247	350,575	397,746	435,272	517,681
All other outside sources	58,838	70,328	75,789	90,312	102,281	123,231
Character of work:						
Basic research	2,022,185	2,054,044	2,152,668	2,408,057	2,547,494	2,787,546
Applied research	544,178	717,041	737,360	852,048	1,014,893	1,067,421
Development	110,148	168,494	133,397	149,089	168,301	209,253
Field of science:						
Engineering	347,341	383,556	347,970	382,176	432,961	498,606
Physical sciences	329,900	330,431	333,851	350,745	379,123	426,689
Astronomy	21,974	24,114	24,427	26,611	26,271	32,336
Chemistry	110,015	114,133	116,026	120,976	140,041	163,522
Physics	161,853	167,801	169,359	173,651	182,903	200,908
Other, n.e.c.	36,058	24,383	24,039	29,507	29,908	29,923
Environmental sciences	192,331	209,645	235,186	255,301	286,532	317,035
Mathematical and computer sciences	70,536	74,692	76,832	85,466	86,805	106,329
Mathematics	NA	36,954	37,642	39,861	42,367	51,183
Computer sciences	NA	37,738	39,190	45,605	44,438	55,146
Life sciences	1,352,601	1,529,285	1,631,574	1,900,486	2,098,913	2,256,782
Biological sciences	451,239	557,493	511,311	631,363	710,444	769,097
Agricultural sciences	[1] 231,057	[1] 275,552	346,209	382,120	411,265	464,428
Medical sciences	604,987	645,687	716,080	811,545	896,262	948,273
Other, n.e.c.	65,318	50,553	57,974	75,458	80,942	74,984
Psychology	70,400	73,856	74,392	79,942	77,166	83,014
Social sciences	206,344	232,180	241,141	256,633	266,855	269,481
Economics	46,586	47,806	47,961	56,245	65,592	70,206
Political science	21,771	25,523	27,123	29,500	28,389	32,496
Sociology	59,475	61,521	63,575	68,798	66,079	61,258
Other, n.e.c.	78,512	97,330	102,482	102,090	106,795	105,521
Other sciences, n.e.c.	107,058	105,934	82,479	98,445	102,333	106,284

[1] Estimated, based on data collected in 1974.
NA—Not available
SOURCE: National Science Foundation

Table B–6. Federally financed R&D expenditures at universities and colleges by character of work and field: FY 1972–77

(Dollars in thousands)

Character and field	1972	1973	1974	1975	1976	1977
Total	$1,838,933	$2,038,206	$2,032,143	$2,287,779	$2,501,139	$2,716,767
Character of work:						
Basic research	1,420,198	1,455,441	1,521,841	1,693,644	1,827,085	1,992,135
Applied research	338,425	462,437	439,198	516,062	580,638	604,783
Development	80,310	120,328	71,104	78,073	93,416	119,849
Field of science:						
Engineering	259,058	287,094	240,063	260,154	290,689	336,211
Physical sciences	267,392	270,383	270,190	285,002	303,868	340,724
Astronomy	16,854	17,697	17,101	19,524	18,251	23,133
Chemistry	84,582	86,861	88,692	92,706	107,216	124,323
Physics	139,629	146,224	146,515	149,879	155,348	171,118
Other, n.e.c.	26,327	19,601	17,882	22,893	23,053	22,150
Environmental sciences	142,110	157,627	168,434	180,676	210,286	236,830
Mathematical and computer sciences	53,207	55,487	58,103	65,100	65,205	77,378
Mathematics	NA	28,557	29,405	31,221	32,334	39,900
Computer sciences	NA	26,930	28,698	33,879	32,871	37,478
Life sciences	884,212	1,014,279	1,052,663	1,237,655	1,373,928	1,466,629
Biological sciences	319,625	398,924	366,021	457,471	520,216	572,338
Agricultural sciences	[1] 80,228	[1] 93,854	100,952	112,175	121,654	134,236
Medical sciences	448,805	485,962	543,663	613,798	673,305	706,147
Other, n.e.c.	35,554	35,539	42,027	54,211	58,753	53,908
Psychology	54,865	58,649	58,554	61,193	58,317	62,313
Social sciences	113,935	132,470	136,731	141,452	139,613	139,285
Economics	20,940	22,776	22,292	27,081	29,081	31,021
Political science	8,592	10,362	11,902	12,287	11,984	14,929
Sociology	35,694	40,486	41,295	45,000	40,355	37,289
Other, n.e.c.	48,709	58,846	61,242	57,084	58,193	56,046
Other sciences, n.e.c.	64,154	62,217	47,405	56,547	59,233	57,397

[1] Estimated, based on data collected in 1974.
SOURCE: National Science Foundation

Table B–7. R&D expenditures at universities and colleges by institutional control: FY 1972–77

(Dollars in millions)

Fiscal year	Public		Private	
	Current	Constant[1]	Current	Constant[1]
972	$1,621	$1,621	$1,055	$1,055
973	1,805	1,729	1,135	1,087
974	1,912	1,700	1,111	988
975	2,181	1,750	1,228	986
976	2,412	1,810	1,318	989
977	2,641	1,856	1,424	1,000

[1] Based on GNP implicit price deflator in 1972 dollars.
SOURCE: National Science Foundation

Table B–8. R&D expenditures at universities and colleges by source, character of work, and institutional control: FY 1977

(Dollars in millions)

Source and character of work	Total	Public	Private
Total	$4,064	$2,641	$1,424
By source:			
Federal	2,717	1,613	1,103
Non-Federal	1,347	1,028	321
By character of work:			
Basic research	2,788	1,634	1,154
Applied research	1,067	831	237
Development	209	176	33

SOURCE: National Science Foundation

Table B-9. R&D expenditures at universities and colleges by State: FY 1972-77

(Dollars in thousands)

Division and State	1972	1973	1974	1975	1976	1977
United States Total	$2,676,511	$2,935,579	$3,023,425	$3,409,194	$3,730,688	$4,064,220
New England	326,824	334,419	293,229	330,513	361,363	403,153
Connecticut	54,010	53,586	54,482	62,673	71,595	79,348
Maine	5,985	6,688	7,115	8,759	9,632	9,937
Massachusetts	235,054	244,230	202,921	222,699	239,840	265,490
New Hampshire	7,659	8,774	7,273	10,063	11,963	13,705
Rhode Island	17,647	13,869	13,565	15,730	16,166	21,543
Vermont	6,469	7,272	7,873	10,589	12,167	13,130
Middle Atlantic	485,200	530,807	549,495	608,774	650,245	696,880
New Jersey	46,475	49,201	54,453	55,805	54,321	59,040
New York	309,110	348,891	344,506	389,842	408,781	435,799
Pennsylvania	129,615	132,715	150,536	163,127	187,143	202,041
East North Central	428,537	475,258	489,617	546,205	591,295	631,773
Illinois	123,525	133,321	142,145	150,071	162,512	174,328
Indiana	51,160	54,881	57,676	63,947	68,516	69,570
Michigan	97,837	112,375	108,047	127,939	137,823	146,973
Ohio	72,734	77,156	82,153	93,963	108,391	121,230
Wisconsin	83,281	97,525	99,596	110,285	114,053	119,672
West North Central	219,686	219,641	236,760	263,966	292,494	321,789
Iowa	30,690	36,361	40,026	47,069	52,374	60,830
Kansas	28,043	31,310	33,231	30,687	34,334	36,939
Minnesota	49,768	54,577	61,185	70,256	75,590	83,088
Missouri	78,493	65,555	67,391	74,226	81,309	88,176
Nebraska	19,830	18,316	20,687	24,882	28,305	30,820
North Dakota	5,884	6,701	7,506	10,111	12,790	13,526
South Dakota	6,978	6,821	6,734	6,735	7,792	8,410
South Atlantic	322,363	362,635	389,636	447,818	489,892	534,725
Delaware	4,984	5,760	6,333	6,783	7,787	10,443
District of Columbia	25,585	29,489	31,393	35,028	37,248	41,147
Florida	65,468	73,428	76,742	87,590	98,401	105,002
Georgia	49,596	51,755	59,661	68,626	77,691	84,106
Maryland	63,392	70,843	79,045	89,935	93,583	102,599
North Carolina	64,119	78,262	76,076	89,188	92,330	99,380
South Carolina	9,792	11,113	13,901	18,316	19,939	21,813
Virginia	30,470	34,971	39,548	44,825	51,012	58,551
West Virginia	8,957	7,014	6,937	7,527	11,901	11,684
East South Central	82,214	97,699	105,014	123,385	130,820	141,414
Alabama	22,116	27,005	31,066	37,918	37,870	42,340
Kentucky	14,236	16,667	17,334	21,414	22,938	27,620
Mississippi	16,646	19,023	21,999	23,909	26,195	25,445
Tennessee	29,216	35,004	34,615	40,144	43,817	46,009
West South Central	179,837	203,085	219,294	251,131	287,327	318,698
Arkansas	11,414	10,241	11,208	13,817	16,000	16,789
Louisiana	30,267	35,140	35,665	39,218	43,053	45,279
Oklahoma	19,247	20,028	19,106	21,513	23,156	26,289
Texas	118,909	137,676	153,315	176,583	205,118	230,341
Mountain	162,871	178,576	186,367	196,941	221,211	247,972
Arizona	23,911	30,321	31,164	33,539	37,198	41,827
Colorado	59,399	63,997	62,585	65,897	73,308	77,519
Idaho	8,084	8,727	10,600	11,877	13,704	15,215
Montana	6,756	9,771	9,614	10,831	13,254	14,168
Nevada	6,085	6,449	7,537	7,824	9,404	9,043
New Mexico	20,971	16,629	18,075	21,745	24,437	29,386
Utah	32,005	36,004	39,635	37,500	40,789	49,742
Wyoming	5,660	6,678	7,157	7,728	9,117	11,072
Pacific	457,944	525,898	541,387	627,145	691,829	752,459
Alaska	15,524	16,560	19,111	21,139	28,748	35,175
California	323,834	380,220	391,995	458,436	500,756	537,838
Hawaii	23,520	24,846	21,143	24,596	28,049	28,900
Oregon	32,204	34,768	36,557	39,699	47,081	51,530
Washington	62,862	69,504	72,581	83,275	87,195	99,016
Outlying areas	11,035	11,561	12,626	13,316	14,212	15,357

SOURCE: National Science Foundation

Table B–10. Federally financed R&D expenditures at universities and colleges by State: FY 1972–77

(Dollars in thousands)

Division and State	1972	1973	1974	1975	1976	1977
United States Total	$1,838,933	$2,038,206	$2,032,143	$2,287,779	$2,501,139	$2,716,767
New England	259,063	278,521	230,407	255,953	281,627	312,537
Connecticut	38,345	38,913	40,203	45,530	53,780	58,917
Maine	3,206	4,423	4,571	4,046	4,080	4,171
Massachusetts	193,257	210,684	162,620	177,790	191,720	210,723
New Hampshire	6,648	7,347	5,858	7,699	9,038	9,547
Rhode Island	12,852	12,345	11,976	13,608	14,173	19,361
Vermont	4,755	4,809	5,179	7,280	9,036	9,818
Middle Atlantic	336,347	366,996	375,558	417,040	452,574	482,614
New Jersey	27,250	29,567	28,821	32,375	32,553	34,847
New York	220,318	244,365	245,002	275,659	293,667	313,501
Pennsylvania	88,779	93,064	101,735	109,006	126,354	134,266
East North Central	278,674	315,281	315,137	345,137	368,151	392,863
Illinois	83,693	97,765	100,843	106,551	116,558	127,336
Indiana	35,042	39,824	40,329	43,916	45,800	47,353
Michigan	67,276	71,087	67,850	78,622	78,115	84,453
Ohio	49,890	54,828	52,969	60,597	68,179	73,119
Wisconsin	42,773	51,777	53,146	55,451	59,499	60,602
West North Central	123,398	126,730	134,091	148,034	160,279	176,329
Iowa	17,727	20,407	21,768	25,139	26,769	31,334
Kansas	17,433	20,050	20,542	16,762	17,330	18,998
Minnesota	28,504	31,395	35,463	42,065	45,236	48,628
Missouri	46,961	41,947	42,597	47,876	52,097	56,434
Nebraska	7,144	7,380	7,610	8,904	10,853	11,905
North Dakota	2,121	2,541	3,108	4,373	4,791	5,722
South Dakota	3,508	3,010	3,003	2,915	3,201	3,308
South Atlantic	208,886	235,012	244,242	285,023	317,255	340,301
Delaware	3,158	3,500	3,566	3,689	4,625	5,979
District of Columbia	21,600	23,755	24,630	26,284	28,685	30,442
Florida	37,131	41,600	42,370	48,162	56,008	55,836
Georgia	22,983	24,979	24,977	33,072	38,403	43,297
Maryland	47,800	54,959	61,228	69,483	73,666	78,490
North Carolina	46,847	55,079	53,246	62,896	65,335	69,284
South Carolina	4,763	4,922	6,294	7,773	8,958	11,084
Virginia	18,260	21,333	23,594	28,106	33,742	39,437
West Virginia	6,344	4,885	4,337	5,558	7,833	6,452
East South Central	53,670	65,853	67,865	78,236	80,612	84,353
Alabama	15,136	19,655	21,967	26,695	26,515	27,965
Kentucky	8,192	9,045	8,924	11,488	11,059	11,832
Mississippi	7,766	9,029	9,370	9,533	10,381	10,711
Tennessee	22,576	28,124	27,604	30,520	32,657	33,845
West South Central	103,997	112,489	120,792	141,949	161,048	183,327
Arkansas	6,191	4,825	4,346	5,281	6,639	7,807
Louisiana	13,863	14,448	15,820	17,156	18,603	19,460
Oklahoma	10,375	11,186	9,765	11,081	12,952	14,434
Texas	73,568	82,030	90,861	108,431	122,854	141,626
Mountain	115,474	122,406	123,333	135,956	150,355	165,150
Arizona	11,949	15,818	16,038	17,353	20,461	23,017
Colorado	48,081	50,161	47,253	52,149	56,051	57,891
Idaho	3,697	3,868	4,805	5,005	5,834	6,560
Montana	3,058	4,127	4,289	5,059	7,046	7,593
Nevada	3,310	3,560	3,047	2,870	2,851	4,207
New Mexico	18,275	12,919	14,779	18,095	20,218	22,942
Utah	23,594	27,422	28,496	30,356	31,937	35,690
Wyoming	3,510	4,531	4,626	5,069	5,957	7,250
Pacific	355,127	410,426	415,761	474,860	522,446	572,022
Alaska	11,204	11,822	10,718	12,047	18,429	24,664
California	263,314	306,894	311,789	360,398	395,580	423,856
Hawaii	13,725	15,382	14,065	15,540	17,578	17,945
Oregon	21,832	24,007	25,458	27,090	30,930	32,890
Washington	45,052	52,321	53,731	59,785	59,929	72,667
Outlying areas	4,297	4,492	4,957	5,591	6,592	7,271

SOURCE: National Science Foundation

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Table B-11. Relative concentration of R&D expenditures at leading doctorate-granting institutions by source: FY 1973–77

Fiscal year	Percent of total			
	Top 10	Top 25	Top 50	Top 100
Federally financed:				
1973	25.6	47.4	67.6	86.6
1974	24.8	47.4	67.4	86.6
1975	24.5	47.0	66.9	86.8
1976	23.7	46.2	66.7	86.7
1977	23.7	45.6	66.2	86.1
Nonfederally financed:				
1973	23.4	45.4	68.5	88.1
1974	23.4	45.9	68.9	88.9
1975	23.6	45.8	69.1	88.9
1976	23.1	45.0	68.7	88.8
1977	22.5	44.3	68.1	88.3

SOURCE: NSF-sponsored study, "Federally Funded Research and Development at Universities and Colleges," George J. Nozicka, Moshman Associates, Inc., Washington, D.C. 20034, 1979, tables 14 through 23.

Table B-12. Total and federally financed capital expenditures for scientific activities at universities and colleges by field of science: FY 1972–77[1]

(Dollars in thousands)

Field	1972	1973	1974	1975	1976	1977
All sources:						
Total	$914,844	$840,461	$836,412	$1,016,519	$1,041,030	$960,430
Engineering	87,307	57,955	91,784	118,390	81,716	88,233
Physical sciences	68,223	108,868	89,271	80,280	73,521	65,239
Environmental science	96,295	26,624	24,178	35,241	47,791	28,393
Mathematical and computer sciences	24,712	20,016	23,669	15,042	24,677	23,592
Life sciences	517,941	488,630	494,473	668,681	706,844	644,779
Psychology	19,007	39,566	15,511	11,530	9,119	12,737
Social sciences	59,993	61,217	59,346	49,708	44,027	30,997
Other sciences, n.e.c.	41,366	37,535	38,180	37,647	53,335	66,460
Federal Government:						
Total	239,193	226,743	225,511	269,965	206,622	195,496
Engineering	23,439	15,751	42,681	64,026	20,140	17,277
Physical sciences	18,551	24,473	20,619	18,832	19,138	21,894
Environmental sciences	17,827	5,873	7,059	5,884	6,313	9,317
Mathematical and computer sciences	4,341	3,022	4,257	2,584	2,048	1,882
Life sciences	52,328	161,934	139,745	169,412	153,528	137,368
Psychology	3,663	5,101	2,528	2,236	1,955	2,388
Social sciences	10,939	5,371	4,477	2,766	1,813	2,087
Other sciences, n.e.c.	8,105	5,218	4,145	4,225	1,687	3,283
Other sources:						
Total	675,651	613,718	610,901	746,554	834,408	764,934
Engineering	63,868	42,204	49,103	54,364	61,576	70,956
Physical sciences	49,672	84,395	68,652	61,448	54,383	43,345
Environmental sciences	78,468	20,751	17,119	29,357	41,478	19,076
Mathematical and computer sciences	20,371	16,994	19,412	12,458	22,629	21,710
Life sciences	365,613	326,746	354,728	499,269	553,316	507,411
Psychology	15,344	34,465	12,983	9,294	7,164	10,349
Social sciences	49,054	55,846	54,869	46,942	42,214	28,910
Other sciences, n.e.c.	33,261	32,317	34,035	33,422	51,648	63,177

[1] Includes research, development, and instruction.
SOURCE: National Science Foundation

Table B–13. Capital expenditures for scientific activities at universities and colleges by source and institutional control: FY 1972–77

(Dollars in thousands)

Source and institutional control	1972	1973	1974	1975	1976	1977
Total	$914,844	$840,461	$836,412	$1,016,519	$1,041,030	$960,430
Public	664,684	612,710	636,823	775,826	750,625	686,141
Private	250,160	227,751	199,589	240,693	290,405	274,289
Federal sources, total	239,193	226,743	225,511	269,965	206,622	195,496
Public	160,808	157,482	173,543	198,287	126,449	119,322
Private	78,385	69,261	51,968	71,678	80,173	76,174
Non-Federal sources, total	675,751	613,718	610,901	746,554	834,408	764,934
Public	503,876	455,228	463,280	577,539	624,176	566,819
Private	171,775	158,490	147,621	169,015	210,232	198,115

SOURCE: National Science Foundation

Table B–14. Doctorate recipients, 1972–77, and academic employment, 1973–78, by field

Doctorate recipients in science and engineering by field: June 1972–77

Field	1972	1973	1974	1975	1976	1977
Total	19,556	19,555	19,086	19,048	18,790	18,281
Engineering	3,475	3,338	3,144	2,959	2,791	2,641
Physical sciences	3,646	3,439	3,126	3,055	2,858	2,719
Environmental sciences	650	662	674	694	714	691
Mathematical and computer sciences	1,281	1,222	1,196	1,149	1,003	959
Life sciences	4,914	4,983	4,790	4,884	4,841	4,767
Psychology	2,262	2,444	2,587	2,749	2,878	2,960
Social sciences	3,328	3,467	3,569	3,558	3,705	3,544

SOURCE: National Research Council, *Summary Report, Doctorate Recipients from United States Universities,* June 1972 through June 1977, Survey of Earned Doctorates.

Scientists and engineers employed in universities and colleges by field and status: January 1973–78

Field and status	1973	1974	1975	1976	1977	1978
All fields:						
Total	264,900	268,495	278,919	288,155	297,289	306,547
Full time	216,433	218,407	223,336	229,757	235,859	241,099
Part time	48,467	50,088	55,583	58,398	61,430	65,448
Engineers:						
Total	27,530	27,198	27,919	28,505	29,878	30,900
Full time	23,485	22,764	22,580	22,937	23,937	24,601
Part time	4,045	4,434	5,339	5,568	5,941	6,299
Physical scientists:						
Total	30,215	30,605	30,836	31,424	32,078	32,794
Full time	26,669	26,849	26,662	27,077	27,518	27,861
Part time	3,546	3,756	4,174	4,347	4,560	4,933
Environmental scientists:						
Total	6,935	7,636	7,855	8,427	9,207	9,428
Full time	6,092	6,563	6,787	7,231	7,960	8,109
Part time	843	1,073	1,068	1,196	1,247	1,319
Mathematical and computer scientists:						
Total	24,770	27,126	28,475	29,915	31,962	32,947
Full time	20,794	22,157	22,404	23,124	23,853	24,317
Part time	3,976	4,969	6,071	6,791	8,109	8,630
Life scientists:						
Total	112,359	110,445	113,466	114,537	117,360	122,522
Full time	88,423	88,497	90,864	91,829	94,248	97,238
Part time	23,936	21,948	22,782	22,708	23,112	25,284
Psychologists:						
Total	18,876	19,964	21,649	22,937	23,707	23,720
Full time	14,777	14,957	15,973	16,804	17,320	17,362
Part time	4,099	5,007	5,676	6,133	6,387	6,358
Social scientists:						
Total	44,215	45,521	48,719	52,410	53,097	54,236
Full time	36,193	36,620	38,246	40,755	41,023	41,611
Part time	8,022	8,901	10,473	11,655	12,074	12,625

SOURCE: National Science Foundation

Table B-15. Projected full-time labor force of doctoral scientists and engineers by field: FY 1977-87

(In thousands)

Field	1977	1987	Percent change
Total	277	412	48.7
Engineering	44	72	63.6
Physical and environmental sciences	69	95	37.7
Mathematical and computer sciences	20	28	40.0
Life sciences	70	103	47.1
Social sciences, including psychology	73	113	54.8

SOURCE: National Science Foundation

Table B-16. Scientists and engineers employed at universities and colleges by type of institution and status: January 1973-78

Type of institution and status	1973	1974	1975	1976	1977	1978
All institutions:						
Total	264,900	268,495	278,919	288,155	297,289	306,547
Full time	216,433	218,407	223,336	229,757	235,859	241,099
Part time	48,467	50,088	55,583	58,398	61,430	65,448
Doctorates in S/E:						
Total	174,474	175,113	180,001	185,836	192,325	198,872
Full time	143,393	144,525	147,942	153,653	159,242	163,749
Part time	31,081	30,588	32,059	32,183	33,083	35,123
Master's in S/E:						
Total	28,703	29,765	34,075	33,143	34,790	39,181
Full time	24,851	24,957	27,511	26,307	27,118	29,559
Part time	3,852	4,808	6,564	6,836	7,672	9,622
Bachelor's in S/E:						
Total	28,363	29,143	27,402	27,862	27,701	26,259
Full time	23,620	23,940	22,548	22,867	22,615	21,213
Part time	4,743	5,203	4,854	4,995	5,086	5,046
No science degree[1]						
Total	33,360	34,474	37,441	41,314	42,473	42,235
Full time	24,569	24,985	25,335	26,930	26,884	26,578
Part time	8,791	9,489	12,106	14,384	15,589	15,657

[1] Includes 2-year institutions as well as institutions awarding degrees in nonscience fields.
SOURCE: National Science Foundation

Table B-17. Scientists and engineers employed at universities and colleges by type of activity: January 1973-78

Type of activity	1973	1974	1975	1976	1977	1978	Percent change 1973-78
Full-time-equivalent (FTE) basis:							
Total	235,050	238,055	244,381	252,555	258,966	266,251	13.3
Teaching	168,461	175,308	177,443	183,546	187,718	191,286	13.5
Research and development	46,896	47,972	51,171	52,916	54,408	57,123	21.8
Other activities	19,693	14,775	15,767	16,093	16,840	17,842	-9.4
Primarily employed basis:							
Total	264,900	268,495	278,919	288,155	297,289	306,547	15.7
Teaching	199,083	206,745	215,031	222,816	228,729	235,360	18.2
Research and development	46,634	47,386	49,440	50,249	52,316	54,332	16.5
Other activities	19,183	14,364	14,448	15,090	16,244	16,855	-12.1

SOURCE: National Science Foundation

Table B-18. Doctoral scientists and engineers employed at universities and colleges by primary work activity: 1973-77

Primary work activity	1973	1975	1977	Percent change 1973-75	1975-77	1973-77
Total	127,863	147,268	161,086	15.2	9.4	26.0
Teaching	78,456	89,672	88,675	14.3	-1.1	13.0
Research and development[1]	35,157	40,675	48,672	15.7	19.7	38.4
Other activities	14,250	16,921	23,739	18.7	40.3	66.6
Universities and 4-year colleges	124,901	143,701	156,452	15.1	8.9	25.3
Teaching	76,151	86,649	84,832	13.8	-2.1	11.4
Research and development	35,078	40,573	48,497	15.7	19.5	38.3
Other activities	13,672	16,479	23,123	20.5	40.3	69.1
2-year colleges	2,962	3,567	4,634	20.4	29.9	56.4
Teaching	2,305	3,023	3,843	31.2	27.1	66.7
Research and development	79	102	175	29.1	71.6	121.5
Other activities	578	442	616	-23.5	39.4	6.6

[1] Includes management of R&D activities.
SOURCE: National Science Foundation, Survey of Doctorate Recipients

Table B–19. Full-time scientists and engineers employed at universities and colleges by field and sex: January 1974–78[1]

Field	1974			1975			1976			1977			1978		
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
Total	218,407	186,283	32,124	223,336	189,723	33,613	229,757	194,273	35,484	235,859	199,104	36,755	241,099	202,413	38,686
Engineers	22,764	22,425	339	22,580	22,211	369	22,937	22,487	450	23,937	23,439	498	24,601	24,008	593
Aeronautical & astronautical engineers	1,023	1,001	22	944	919	25	966	936	30	971	949	22	965	947	18
Chemical engineers	1,522	1,500	22	1,603	1,578	25	1,637	1,600	37	1,681	1,642	39	1,726	1,694	32
Civil engineers	3,759	3,698	61	3,832	3,771	61	4,017	3,934	83	4,114	4,025	89	4,192	4,067	125
Electrical engineers	5,404	5,347	57	5,393	5,336	57	5,409	5,335	74	5,467	5,395	72	5,594	5,502	92
Mechanical engineers	4,255	4,222	33	4,355	4,325	30	4,353	4,308	45	4,473	4,416	57	4,543	4,482	61
Other engineers	6,801	6,657	144	6,453	6,282	171	6,555	6,374	181	7,231	7,012	219	7,581	7,316	265
Physical scientists	26,849	24,910	1,939	26,662	24,665	1,997	27,077	24,970	2,107	27,518	25,320	2,198	27,861	25,418	2,443
Chemists	14,075	12,690	1,385	13,823	12,395	1,428	14,146	12,632	1,514	14,456	12,899	1,557	14,711	12,987	1,724
Physicists	10,870	10,475	395	10,940	10,554	386	10,838	10,444	394	11,070	10,633	437	11,272	10,794	478
Other physical scientists	1,904	1,745	159	1,899	1,716	183	2,093	1,894	199	1,992	1,788	204	1,878	1,637	241
Environmental scientists	6,563	6,236	327	6,787	6,468	319	7,231	6,843	388	7,960	7,451	509	8,109	7,549	560
Earth scientists	4,957	4,728	229	5,172	4,949	223	5,523	5,237	286	5,898	5,551	347	5,920	5,516	404
Atmospheric scientists	571	532	39	559	525	34	601	568	33	694	656	38	801	766	35
Oceanographers	1,035	976	59	1,056	994	62	1,107	1,038	69	1,368	1,244	124	1,388	1,267	121
Mathematical and computer scientists	22,157	19,335	2,822	22,404	19,479	2,925	23,124	20,025	3,099	23,853	20,607	3,246	24,317	20,854	3,463
Mathematicians	18,490	16,053	2,437	18,699	16,220	2,479	18,994	16,374	2,620	19,271	16,561	2,710	19,545	16,640	2,905
Computer scientists	3,667	3,282	385	3,705	3,259	446	4,130	3,651	479	4,582	4,046	536	4,772	4,214	558
Life scientists	88,497	70,756	17,741	90,684	72,639	18,045	91,829	73,560	18,269	94,248	75,587	10,661	97,238	77,467	19,771
Agricultural scientists	12,459	11,235	1,224	13,235	11,685	1,550	12,942	11,777	1,165	12,884	11,815	1,069	13,594	12,375	1,219
Biological scientists	31,494	25,823	5,671	33,462	27,143	6,319	34,850	27,821	7,029	36,930	29,368	7,562	37,442	29,675	7,767
Medical scientists	44,544	33,698	10,846	43,987	33,811	10,176	44,037	33,962	10,075	44,434	34,404	10,030	46,202	35,417	10,785
Psychologists	14,957	11,769	3,188	15,973	12,391	3,582	16,804	12,815	3,989	17,320	13,054	4,266	17,362	13,061	4,301
Social scientists	36,620	30,852	5,768	38,246	31,870	6,376	40,755	33,573	7,182	41,023	33,646	7,377	41,611	34,056	7,555
Economists	9,830	9,042	788	10,169	9,304	865	10,371	9,436	935	10,685	9,731	954	10,761	9,797	964
Sociologists	10,048	7,672	2,376	10,744	8,104	2,640	11,428	8,501	2,927	11,625	8,594	3,031	11,449	8,430	3,019
Political scientists	8,396	7,533	863	8,687	7,788	899	9,073	8,043	1,030	9,021	7,975	1,046	9,026	7,950	1,076
Other social scientists	8,346	6,605	1,741	8,646	6,674	1,972	9,883	7,593	2,290	9,692	7,346	2,346	10,375	7,879	2,496

[1] Data were not collected by sex in January 1973.
SOURCE: National Science Foundation

Table B–20. U.S. scientists and engineers by sex: 1974–78

Sex	1974	1976	1978	Percent change	
				1974–76	1976–78
Total, all U.S. scientists and engineers	2,481,800	2,705,800	2,741,400	9.0	1.3
Men	2,265,000	2,455,800	2,475,300	8.4	.8
Women	216,800	250,000	266,100	15.3	6.4
Full-time scientists and engineers employed at universities and colleges	218,407	229,757	241,099	5.2	4.9
Men	186,283	194,273	202,413	4.3	4.2
Women	32,124	35,484	38,686	10.5	9.0

SOURCE: National Science Foundation

Table B–21. Unemployment rate of U.S. scientists and engineers by sex: 1974, 1976, and 1978

Year and sex	Labor force	Employed scientists and engineers	Unemployed, seeking employment	Unemployment rate
1974, total	2,288,000	2,248,200	39,800	1.7
Men	2,104,700	2,072,100	32,600	1.5
Women	183,300	176,100	7,200	3.9
1976, total	2,451,700	2,377,200	74,600	3.0
Men	2,240,000	2,179,900	60,100	2.7
Women	211,700	197,200	14,500	6.8
1978, total	2,507,600	2,473,200	34,400	1.4
Men	2,270,400	2,241,700	28,700	1.3
Women	237,200	231,500	5,700	2.4

SOURCE: National Science Foundation

Table B–22. Doctoral scientists and engineers in the U.S. by race: 1973 and 1977

Race	1973[1] Number	1973[1] Percent distribution	1977 Number	1977 Percent distribution	Percent change 1973–77
Total	238,913	100.0	303,267	100.0	26.9
White	217,112	90.9	270,305	89.1	24.5
Minorities, total	12,296	5.1	19,179	6.3	56.0
Black	2,242	.9	2,846	.9	26.9
American Indian	435	.2	630	.2	44.8
Asian	9,619	4.0	15,703	5.2	63.3
No report	9,505	4.0	13,783	4.5	45.0

[1] Revised.
SOURCE: National Science Foundation, Survey of Doctorate Recipients

Table B–23. Doctoral scientists and engineers employed at universities and colleges by field and race: 1973 and 1977

Field of science	1973				1977				Percent change, 1973–77			
	White	Black	American Indian	Asian/ Pacific Islander	White	Black	American Indian	Asian/ Pacific Islander	White	Black	American Indian	Asian/ Pacific Islander
Total	115,922	1,381	274	5,155	144,161	1,793	341	7,289	24.4	29.8	24.5	41.4
Engineers	11,467	66	26	1,001	13,779	58	26	1,312	20.2	−12.1	-0-	31.1
Physical scientists	19,283	271	34	1,093	23,830	271	25	1,408	23.6	-0-	−25.8	28.8
Environmental scientists	4,830	6	13	120	5,823	12	2	217	20.6	100.0	−84.6	80.8
Mathematical and computer scientists	10,575	115	10	494	12,577	100	17	761	18.9	−13.0	70.0	54.0
Life scientists	35,658	455	74	1,541	42,533	545	90	2,322	19.3	19.8	21.6	50.7
Psychologists	13,263	171	43	115	15,828	345	68	154	19.3	101.8	58.1	33.9
Social scientists	20,846	297	74	791	29,791	462	113	1,115	42.9	55.6	53.5	41.0

SOURCE: National Science Foundation, Survey of Doctorate Recipients

Table B–24. Unemployment rate of U.S. scientists and engineers by race: 1974, 1976, and 1978

Year and race	Labor force	Employed scientists and engineers	Unemployed, seeking employment	Unemployment rate
1974, total	2,288,000	2,248,200	39,800	1.7
White	2,188,500	2,152,900	35,600	1.6
Black	35,500	32,500	3,000	8.5
Asian	41,200	40,500	700	1.7
Other	22,800	22,500	300	1.3
1976, total	2,451,700	2,377,200	74,600	3.0
White	2,348,200	2,278,800	69,400	3.0
Black	36,000	33,000	3,000	8.3
Asian	42,600	41,400	1,200	2.8
Other	24,800	23,800	1,000	4.0
1978, total	2,507,600	2,473,200	34,400	1.4
White	2,393,600	2,360,900	32,700	1.4
Black	39,600	39,000	600	1.5
Asian	51,300	50,500	800	1.6
Other	23,200	22,800	400	1.7

SOURCE: National Science Foundation

Table B-25. Scientists and engineers employed at universities and colleges by type: January 1975–78

Type of academic employment	1975	1976	1977	1978	Percent change 1975–76	1976–77	1977–78
Total	278,919	288,155	297,289	306,547	3.3	3.2	3.1
Postdoctorates[1]	16,695	17,068	18,751	19,748	2.2	9.9	5.3
All other academic scientists and engineers	262,224	271,087	278,538	286,799	3.4	2.7	3.0

[1]Data as of fall semester of each preceding year from NSF Survey of Graduate Science Student Support and Postdoctorals for doctorate-granting institutions.
SOURCE: National Science Foundation

Table B-26. Postdoctorates, graduate research assistants, and R&D expenditures by field: Fall 1977[1]

(Dollars in millions)

Field	Postdoctorates		Graduate research assistants		FY 1977 R&D expenditures	
	Number	Percent distribution	Number	Percent distribution	Amount	Percent distribution
Total	19,748	100.0	43,991	100.0	$3,987	100.0
Engineering	1,234	6.2	11,939	27.1	491	12.3
Physical sciences	4,180	21.2	6,763	15.4	414	10.4
Environmental sciences	376	1.9	3,151	7.2	307	7.7
Mathematical and computer sciences	148	.7	1,440	3.4	103	2.6
Life sciences	13,065	66.2	13,252	30.1	2,235	56.0
Psychology	385	2.0	2,293	5.2	80	2.0
Social sciences	360	1.8	5,153	11.7	256	6.4
Other sciences n.e.c.	---	---	---	---	102	2.6

[1]At doctorate-granting institutions.
SOURCE: National Science Foundation

Table B-27. Postdoctorates, graduate research assistants, and R&D expenditures in the sciences and engineering by source of support: Fall 1974–77[1]

(Dollars in millions)

Source	Fall 1974	1975	1976	1977	Percent change 1974–75	1975–76	1976–77
Postdoctorates, total	16,695	17,068	18,751	19,748	2.2	9.9	5.3
Federally supported	11,823	12,046	13,225	13,553	1.9	9.8	2.5
Nonfederally supported	4,872	5,020	5,526	6,195	3.0	10.1	12.1
Graduate research assistants, total	39,686	40,201	42,809	43,991	1.3	6.5	2.8
Federally supported	22,357	23,104	24,460	25,155	3.3	5.9	2.8
Nonfederally supported	17,329	17,097	18,349	18,836	−1.3	7.3	2.7
	Fiscal Year 1974	1975	1976	1977	Percent change 1974–75	1975–76	1976–77
Academic R&D expenditures, total	[2] $2,622	$2,677	$2,745	$2,800	2.1	2.5	2.0
Federal sources	1,764	1,795	1,842	1,874	1.8	2.6	1.7
Non-Federal sources	858	881	903	926	2.7	2.5	2.5

[1]At doctorate-granting institutions.
[2]Based on GNP implicit price deflator in 1972 dollars.
SOURCE: National Science Foundation

Table B–28. Postdoctorates by field, institutional control, and citizenship: Fall 1977[1]

Field	Total		Control				Citizenship			
			Public		Private		Foreign		U.S.	
	Number	Percent distribution	Number	Percent distribution	Number	Percent distribution	Number	Percent distribution	Number	Percent distribution
Total	19,748	100.0	10,577	100.0	9,171	100.0	6,213	100.0	13,535	100.0
Engineering	1,234	6.2	638	6.0	596	6.5	650	10.5	584	4.3
Physical sciences	4,180	21.2	2,418	22.9	1,762	19.2	1,725	27.8	2,455	18.1
Environmental sciences	376	1.9	249	2.4	127	1.4	111	1.8	265	2.0
Mathematical and computer sciences	148	.7	59	.6	89	1.0	53	.9	95	.7
Life sciences	13,065	66.2	6,871	65.0	6,194	67.5	3,538	56.9	9,527	70.4
Psychology	385	2.0	140	1.3	245	2.7	38	.6	347	2.6
Social sciences	360	1.8	202	1.9	158	1.7	98	1.6	262	1.9

[1]At doctorate-granting institutions.
SOURCE: National Science Foundation

Table B–29. Total graduate enrollment in institutions of higher education by field: 1974–77

Field	1974	1975	1976	1977
Total, all students[1]	1,194,090	1,267,537	1,089,290	1,090,463
Science and engineering[2]	265,918	293,612	297,402	306,710
All other fields	928,172	973,925	791,888	783,753

[1]At all graduate institutions, as reported by National Center for Education Statistics, HEW, Survey of Opening Fall Enrollment in Higher Education, annual series.
[2]At doctorate-granting institutions only, as reported by National Science Foundation, Survey of Graduate Science Student Support and Postdoctorals, annual series.
SOURCE: National Science Foundation

Table B–30. Graduate enrollment and academic employment in the sciences and engineering by type of graduate institution

Year	Total	Doctorate-granting	Master's-granting
Graduate enrollment, Fall semester:			
1974	(1)	265,918	(1)
1975	339,699	293,612	46,087
1976	345,998	297,402	48,596
1977	362,978	306,710	56,268
Academic employment, January:			
1975	214,076	180,001	34,075
1976	218,979	185,836	33,143
1977	227,115	192,325	34,790
1978	238,053	198,872	39,181

[1]Not available for 1974.
SOURCE: National Science Foundation

Table B–31. Number of degrees granted by institutions of higher education by level and field: 1974–77

Level and field	Academic year			
	1973–74	1974–75	1975–76	1976–77
Bachelor's and first-professional degrees, total	1,008,654	987,922	997,504	993,008
Science and engineering	305,062	294,920	292,174	288,543
Health fields	61,025	70,058	79,126	82,378
All other fields	642,567	622,944	626,204	622,087
Master's degrees, total	278,259	293,651	313,001	318,241
Science and engineering	54,175	53,852	54,747	56,731
Health fields	9,741	10,842	12,696	13,092
All other fields	214,343	228,957	245,558	248,418
Doctor's degrees, total	33,826	34,086	34,076	33,244
Science and engineering	17,865	17,784	17,288	16,937
Health fields	578	618	577	538
All other fields	15,383	15,684	16,211	15,769

SOURCE: National Center for Education Statistics, HEW

Table B–32. Graduate science and engineering enrollment by status and field: Fall 1974–77[1]

Status and field	1974	1975	1976	1977	Percent change 1974–75	1975–76	1976–77
Full time, total	195,798	210,660	213,843	218,226	7.6	1.5	2.0
Engineering	34,189	37,660	36,838	37,816	10.2	−2.2	2.7
Physical sciences	21,293	21,285	21,612	21,712	(2)	1.5	.5
Environmental sciences	8,114	8,472	8,934	9,234	4.4	5.5	3.4
Mathematical and computer sciences	13,224	13,579	13,882	13,485	2.7	2.2	−2.9
Life sciences	52,287	59,440	61,637	64,339	13.7	3.7	4.4
Psychology	18,959	19,623	21,410	21,130	3.5	9.1	−1.3
Social sciences	47,732	50,601	49,530	50,501	6.0	−2.1	2.0
Part time, total	70,120	82,952	83,559	88,484	18.3	.7	5.9
Engineering	23,798	28,340	28,563	30,292	19.1	.8	6.1
Physical sciences	3,228	3,137	3,130	2,981	−2.8	−.2	−4.8
Environmental sciences	1,640	1,892	1,924	1,920	15.4	1.7	−.2
Mathematical and computer sciences	6,428	6,758	6,622	6,519	5.1	−2.0	−1.6
Life sciences	10,660	13,582	14,798	17,938	27.4	9.0	21.2
Psychology	6,092	7,321	6,778	6,667	20.2	−7.4	−1.6
Social sciences	18,274	21,922	21,744	22,167	20.0	−.8	1.9

[1] At doctorate-granting institutions.
[2] Less than 0.05-percent change.
SOURCE: National Science Foundation

Table B–33. Federal obligations to universities and colleges for fellowships, traineeships, and training grants by field: FY 1971–77

(Dollars in thousands)

Field	1971	1973	1975	1977
Total	$421,029	$287,210	$201,273	$184,671
Engineering	22,085	12,631	10,821	10,015
Physical sciences	15,821	3,901	3,238	3,675
Environmental sciences	5,385	4,124	3,285	764
Mathematical and computer sciences	9,276	3,189	2,389	1,875
Life sciences	225,177	179,222	135,600	118,799
Psychology	42,491	20,513	12,819	17,274
Social sciences	66,676	43,515	30,243	21,755
Other sciences, n.e.c.	34,118	20,115	2,878	10,514

SOURCE: National Science Foundation

Table B–34. Full-time graduate science and engineering enrollment by source of major support: Fall 1974–77[1]

Source	1974	1975	1976	1977	Percent change 1974–75	1975–76	1976–77
Total	195,798	210,660	213,843	218,226	7.6	1.5	2.0
Federal support	47,952	48,210	48,524	50,308	.5	.7	3.7
Institutional support[2]	75,395	77,125	79,330	80,508	2.3	2.9	1.5
Other outside support	16,398	16,866	17,689	18,441	2.9	4.9	4.3
Self-support	56,053	68,459	68,300	68,969	22.1	−.2	1.0

[1] At doctorate-granting institutions.
[2] Includes support from State and local governments.
SOURCE: National Science Foundation

Table B–35. Full-time graduate science and engineering enrollment by type of major support: Fall 1974–77[1]

Type	1974	1975	1976	1977	Percent change 1974–75	1975–76	1976–77
Total	195,798	210,660	213,843	218,226	7.6	1.5	2.0
Fellowships and traineeships	38,597	39,013	37,704	39,414	1.1	−3.4	4.5
Research assistantships	39,686	40,201	42,809	43,991	1.3	6.5	2.8
Teaching assistantships	46,403	47,560	48,566	48,837	2.5	2.1	.6
Other types of support	71,112	83,886	84,764	85,984	18.0	1.0	1.4

[1] At doctorate-granting institutions.
SOURCE: National Science Foundation

Table B–36. Full-time graduate science and engineering enrollment by sex and field: Fall 1974–77[1]

Sex and field	1974	1975	1976	1977	Percent change 1974–75	Percent change 1975–76	Percent change 1976–77
Total	195,798	210,660	213,843	218,226	7.6	1.5	2.0
Men, total	149,114	158,032	155,587	154,484	6.0	−1.5	−.7
Engineering	32,704	35,645	34,689	35,210	9.0	−2.7	1.5
Physical sciences	18,775	18,634	18,719	18,706	−.8	.5	−.1
Environmental sciences	7,165	7,366	7,557	7,727	2.8	2.6	2.2
Mathematical and computer sciences	10,738	10,899	11,042	10,714	1.5	1.3	−3.0
Life sciences	37,151	39,961	39,540	39,424	7.6	−1.1	−.3
Psychology	11,385	11,248	12,062	11,440	−1.2	7.2	−5.2
Social sciences	31,196	34,279	31,978	31,263	9.9	−6.7	−2.2
Women, total	46,684	52,628	58,256	63,742	12.7	10.7	9.4
Engineering	1,485	2,015	2,149	2,606	35.7	6.7	21.3
Physical sciences	2,518	2,651	2,893	3,015	5.3	9.1	4.2
Environmental sciences	949	1,106	1,377	1,507	16.5	24.5	9.4
Mathematical and computer sciences	2,486	2,680	2,840	2,771	7.8	6.0	−2.4
Life sciences	15,136	19,479	22,097	24,915	28.7	13.4	12.8
Psychology	7,574	8,375	9,348	9,690	10.6	11.6	3.7
Social sciences	16,536	16,322	17,552	19,238	−1.3	7.5	9.6

[1]At doctorate-granting institutions.
SOURCE: National Science Foundation

Table B–37. Doctorate recipients in science and engineering by sex and field: June 1974–77

Sex and field	1974	1975	1976	1977	Percent change 1974–75	Percent change 1975–76	Percent change 1976–77
Total	19,086	19,048	18,790	18,281	−0.2	−1.4	−2.7
Men, total	16,382	16,047	15,628	14,989	−2.0	−2.6	−4.1
Engineering	3,110	2,909	2,738	2,567	−6.5	−5.9	−6.2
Physical sciences	2,895	2,793	2,615	2,475	−3.5	−6.4	−5.4
Environmental sciences	637	658	643	632	3.3	−2.3	−1.7
Mathematical and computer sciences	1,081	1,039	890	831	−3.9	−14.3	−6.6
Life sciences	3,935	3,940	3,892	3,810	.1	−1.2	−2.1
Psychology	1,796	1,876	1,932	1,879	4.5	3.0	−2.7
Social sciences	2,928	2,832	2,918	2,795	−3.3	3.0	−4.2
Women, total	2,704	3,001	3,162	3,292	11.0	5.4	4.1
Engineering	34	50	53	74	47.1	6.0	39.6
Physical sciences	231	262	243	244	13.4	−7.3	.4
Environmental sciences	37	36	71	59	−2.7	97.2	−16.9
Mathematical and computer sciences	115	110	113	128	−4.3	2.7	13.3
Life sciences	855	944	949	957	10.4	.5	.8
Psychology	791	873	946	1,081	10.4	8.4	14.3
Social sciences	641	726	787	749	13.3	8.4	−4.8

SOURCE: National Research Council, Survey of Earned Doctorates

Table B–38. Women in science and engineering by field

Field	Full-time graduate enrollment, Fall 1977[1] Number	Full-time graduate enrollment, Fall 1977[1] Percent distribution	Doctorate recipients, June 1977 Number	Doctorate recipients, June 1977 Percent distribution	Employed labor force, 1978 Number	Employed labor force, 1978 Percent distribution
Total	63,742	100.0	3,292	100.0	231,500	100.0
Engineering	2,606	4.1	74	2.2	19,800	8.6
Physical sciences	3,015	4.7	244	7.4	15,000	6.5
Environmental sciences	1,507	2.4	59	1.8	7,700	3.3
Mathematical and computer sciences	2,771	4.3	128	3.9	58,100	25.1
Life sciences	24,915	39.1	957	29.1	63,200	27.3
Psychology	9,690	15.2	1,081	32.8	31,200	13.5
Social sciences	19,238	30.2	749	22.8	36,500	15.8

[1]At doctorate-granting institutions.
SOURCE: National Science Foundation and National Research Council

Table B–39. Full-time graduate science and engineering enrollment by citizenship and field: Fall 1974–77[1]

Citizenship and field	1974	1975	1976	1977	Percent change 1974–75	Percent change 1975–76	Percent change 1976–77
Total	195,798	210,660	213,843	218,226	7.6	1.5	2.0
U.S. citizens, total	164,017	177,457	179,346	181,226	8.2	1.1	1.0
Engineering	23,069	25,685	24,363	24,181	11.3	−5.1	−.7
Physical sciences	16,827	16,891	17,173	17,146	.4	1.7	−.2
Environmental sciences	7,252	7,564	7,960	8,159	4.3	5.2	2.5
Mathematical and computer sciences	10,760	10,914	10,949	10,348	1.4	.3	−5.5
Life sciences	45,777	52,927	54,885	57,398	15.6	3.7	4.6
Psychology	18,408	19,043	20,833	20,511	3.4	9.4	−1.5
Social sciences	41,924	44,433	43,183	43,483	6.0	−2.8	.7
Foreign, total	31,781	33,203	34,497	37,000	4.5	3.9	7.3
Engineering	11,120	11,975	12,475	13,635	7.7	4.2	9.3
Physical sciences	4,466	4,394	4,439	4,575	−1.6	1.0	3.1
Environmental sciences	862	908	974	1,075	5.3	7.3	10.4
Mathematical and computer sciences	2,464	2,665	2,933	3,137	8.2	10.1	7.0
Life sciences	6,510	6,513	6,752	6,941	[2]	3.7	2.8
Psychology	551	580	577	619	5.3	−.5	7.3
Social sciences	5,808	6,168	6,347	7,018	6.2	2.9	10.6

[1]At doctorate-granting institutions.
[2]Less than 0.05 percent change.
SOURCE: National Science Foundation

Table B–40. Total enrollment in institutions of higher education by status: Fall 1977

Status	Fall 1977 Number	Fall 1977 Percent distribution
Total enrollment, all fields	11,415,020	100.0
Full time	6,895,809	60.4
Part time	4,519,211	39.6
Graduate enrollment, all fields	1,090,463	100.0
Full time	437,732	40.1
Part time	652,731	59.9
Graduate enrollment, science/engineering fields[1]	306,710	100.0
Full time	218,226	71.2
Part time	88,484	28.8

[1]At doctorate-granting institutions.
SOURCE: National Center for Education Statistics, HEW, and National Science Foundation

Table B–41. Graduate enrollment by status: Fall 1974–77

Status	1974	1975	1976	1977	Percent change 1974–75	Percent change 1975–76	Percent change 1976–77
Graduate enrollment, all fields	1,194,090	1,267,537	1,089,290	1,090,463	6.2	−14.1	0.1
Full time	428,984	454,599	432,960	437,732	6.0	−4.8	1.1
Part time	765,106	812,938	656,330	652,731	6.3	−19.3	−.5
Graduate enrollment, science and engineering fields[1]	265,918	293,612	297,402	306,710	10.4	1.3	3.1
Full time	195,798	210,660	213,843	218,226	7.6	1.5	2.0
Part time	70,120	82,952	83,559	88,484	18.3	.7	5.9

[1]At doctorate-granting institutions.
SOURCE: National Center for Education Statistics, HEW, and National Science Foundation

ERIC

appendix c

reproduction of questionnaires and instructions

NSF FORM 411 (Oct. 1977)

FORM APPROVED
OMB No. 99-R0279

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

SURVEY OF SCIENTIFIC AND ENGINEERING EXPENDITURES AT UNIVERSITIES AND COLLEGES, FY 1977

(Current and Capital Expenditures for Research, Development, and Instruction in the Sciences and Engineering)

Organizations are requested to complete and return this form to:

NATIONAL SCIENCE FOUNDATION
1800 G Street, N.W.
Washington, D.C. 20550
Attn: UNISG

This form should be returned by November 30, 1977. Your cooperation in returning the survey questionnaire promptly is very important.

Financial data are requested for your institution's 1977 fiscal year.

This information is solicited under the authority of the National Science Foundation Act of 1950, as amended. All information you provide will be used for statistical purposes only. Your response is entirely voluntary and your failure to provide some or all of the information will in no way adversely affect your institution.

All financial data requested on this form should be reported in thousands of dollars; for example, an expenditure of $25,342 should be rounded to the nearest thousand dollars and reported as $25.

Where exact data are not available, estimates are acceptable. Your estimates will be better than ours.

Please correct if name or address has changed

Include data for branches and all organizational units of your institution, such as medical schools and agricultural experiment stations. Also include hospitals or clinics owned, operated, or controlled by universities, and integrated operationally with the clinical programs of your medical schools. Exclude data for federally funded research and development centers (FFRDC's). A separate questionnaire is included in this package if your institution administers an FFRDC. If you have any questions please contact Jim Hoehn (202-634-4674).

Please note in space below:

(1) Any suggestions to improve the design of the survey questionnaire, (2) any suggestions to improve the instructions, or (3) any comments on significant change in R&D in your institution.

(Attach additional sheets, if necessary.)

PLEASE TYPE OR PRINT NAME OF PERSON SUBMITTING THIS FORM	TITLE	AREA CODE	EXCH	NO.	EXT
NAME OF PERSON WHO PREPARED THIS SUBMISSION (If different from above)	**TITLE**	**AREA CODE**	**EXCH**	**NO.**	**EXT**
Please check and correct if necessary the name and address of your institution shown on the mailing label.		DATE			

ITEM 1. CURRENT EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH AND DEVELOPMENT (R&D) IN THE SCIENCES AND ENGINEERING, BY SOURCE OF FUNDS AND TYPE OF ACTIVITY, FY 1977 (Include indirect costs)

ITEM 1. INSTRUCTIONS

Separately budgeted research and development includes all funds expended for activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution. Include expenditures from both the unrestricted and restricted current fund accounts. **Exclude** training grants, public service grants, demonstration projects, etc.

Include in lines a through e and line g restricted funds which include those monies restricted by the sponsor as to the specific operating purpose for which they could be expended. The determination of restricted or unrestricted (institutional) funds reflects the ability of your institution to change the purpose for which the funds are expended without further authorization from the source of the monies. The restricted funds category of Federal, State, or local governments includes all R&D expenditures from funds received through appropriations, grants, or contracts from these sources and restricted by them as to use. The funding source is determined by the organization (e.g., State government, foundation, etc.) that designates the money for R&D even if your organization determines which projects are to be funded. Include indirect costs reimbursed or reimbursable from outside sources.

Under **a. Federal Government** include grants and contracts earmarked for research and development by all agencies of the Federal Government.

Under **b. State government** include funds designated for R&D by the State government and its agencies. Include here State funds supporting research and development at agricultural experiment stations.

Under **c. local government** include funds designated for R&D by county, municipal, or other local governments and their agencies.

Under **d. Foundations and voluntary health agencies** include grants specified for R&D. Funds from foundations which are affiliated with or grant solely to your institution should be included under **f. Institutional funds.** Funds specifically designated for R&D and derived from a health agency that is a unit of a State or local government should be reported under **State or local government.**

Under **e. Industry** include all grants and contracts allocated to R&D by profitmaking organizations, whether engaged in production, distribution, research, service, or other activities. Do not include grants and contracts from nonprofit foundations financed by industry, which should be reported under **Foundations.**

Under **f. Institutional funds** include any funds which the institution was free to designate for R&D (include indirect costs). These funds may include: (1) Unrestricted or general-purpose State or local government appropriations; (2) general-purpose grants from industry, foundations, or other outside sources; (3) tuition and fees; (4) endowment income; and (5) the unreimbursed indirect costs incurred in association with R&D projects financed by outside organizations (e.g., mandatory Federal cost sharing on grants, etc.).

If your institution now separately budgets what was previously classified as departmental research, these data should be included in line f. If your accounts do not separately identify departmental research expenditures but include them as part of the instruction and departmental research account, these data should be reported in item 3 in accordance with the instructions.

Please **exclude** from your response any R&D expenditures in the fields of education, law, humanities, music, the arts, physical education, library science, and all other nonscience fields.

Source of funds		(1) Total R&D expenditures (Thousands of dollars)	(2) Basic research	(3) Applied research	(4) Development
			(Percent of column 1)		
a. Federal Government	1110	$	______ %	______ %	______ %
b. State government	1120		**Basic research** is directed toward an 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 the practical application of knowledge. The definition of applied research differs from 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.
c. Local government	1130				
d. Private foundations and voluntary health agencies	1140				
e. Industry	1150				
f. Institutional funds	1160				
g. All other outside sources	1170				
h. Total (sum of a through g)	1100	$	______ %	______ %	______ %

Total R&D expenditures reported in line 1100 column (1) and line 1400 column (1) should be the same.
Federally financed R&D expenditures reported in line 1110 column (1) and line 1400 column (2) should be the same.

ITEM 2. TOTAL AND FEDERALLY FINANCED EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH AND DEVELOPMENT, BY FIELD OF SCIENCE, FY 1977 (Include indirect costs)				
Field of science	Illustrative disciplines		Thousands of dollars	
			(1) Total	(2) Federal
a. ENGINEERING (TOTAL)	Aeronautical, agricultural, chemical, civil, electrical, industrial, mechanical, metallurgical, mining, nuclear, petroleum, bio- and biomedical, energy, textile, architecture	1410	$	$
b. PHYSICAL SCIENCES (TOTAL)		1420		
(1) Astronomy	Astrophysics, optical and radio, x-ray, gamma-ray, neutrino	1421		
(2) Chemistry	Inorganic, organo-metallic, organic, physical, analytical, pharmaceutical, polymer science (exclude biochemistry)	1422		
(3) Physics	Acoustics, atomic and molecular, condensed matter, elementary particles, nuclear structure, optics, plasma	1423		
(4) Other	Used for multidisciplinary projects within physical sciences and for disciplines not requested separately	1424		
c. ENVIRONMENTAL SCIENCES (TOTAL)	ATMOSPHERIC SCIENCES: Aeronomy, solar weather modification, meteorology, extra-terrestrial atmospheres GEOLOGICAL SCIENCES: Engineering geophysics, geology, geodesy, geomagnetism, hydrology, geochemistry, paleomagnetism, paleontology, physical geography, cartography, seismology, soil sciences OCEANOGRAPHY: Chemical, geological, physical, marine geophysics, marine biology, biological oceanography	1430		
d. MATHEMATICAL AND COMPUTER SCIENCES (TOTAL)		1440		
(1) Mathematics	Algebra, analysis, applied mathematics, foundations and logic, geometry, numerical analysis, statistics, topology	1441		
(2) Computer sciences	Design, development, and application of computer capabilities to data storage and manipulation, information science	1442		
e. LIFE SCIENCES (TOTAL)		1450		
(1) Biological sciences	Anatomy, biochemistry, biophysics, biogeography, ecology, embryology, entomology, genetics, immunology, microbiology, nutrition, parasitology, pathology, pharmacology, physical anthropology, physiology, botony, zoology	1451		
(2) Agricultural	Agricultural chemistry, agronomy, animal science, conservation, dairy science, plant science, range science, wildlife	1452		
(3) Medical	Anesthesiology, cardiology, endocrinology, gastroenterology, hematology, neurology, obstetrics, ophthamology, preventive medicine and community health, psychiatry, radiology, surgery, veterinary medicine, dentistry, pharmacy	1453		
(4) Other	Used for multidisciplinary projects within life sciences	1454		
f. PSYCHOLOGY (TOTAL)	Animal behavior, clinical, educational, experimental, human development and personality, social	1460		
g. SOCIAL SCIENCES (TOTAL)		1470		
(1) Economics	Econometrics, international, industrial, labor, agricultural, public finance and fiscal policy	1471		
(2) Political science	Regional studies, comparative government, international relations, legal systems, political theory, public administration	1472		
(3) Sociology	Comparative and historical, complex organizations, culture and social structure, demography, group interactions, social problems and welfare, theory	1473		
(4) Other	History of science, cultural anthropology, linguistics, socio-economic geography, research in education	1474		
h. OTHER SCIENCES, n.e.c. (TOTAL)*	To be used when the multidisciplinary and interdisciplinary aspects make the classification under one primary field impossible	1480		
i. TOTAL (SUM of a through h) Check to insure that column totals are identical with data reported in item 1.		1400		

*PLEASE EXCLUDE FROM YOUR RESPONSE ANY R&D EXPENDITURES IN THE FIELDS OF EDUCATION, LAW, HUMANITIES, MUSIC, THE ARTS, PHYSICAL EDUCATION, LIBRARY SCIENCE, AND ALL OTHER NONSCIENCE FIELDS.

ITEM 3. CURRENT EXPENDITURES FOR INSTRUCTION AND DEPARTMENTAL RESEARCH IN THE SCIENCES AND ENGINEERING, BY FIELD OF SCIENCE, FY 1977 (Direct expenditures only)

COMPLETE ITEM 3 IF YOUR INSTITUTION GRANTS A DOCTORATE OR MASTER'S DEGREE IN EITHER THE SCIENCES OR ENGINEERING

ITEM 3. INSTRUCTIONS

Include the salaries of department heads, faculty members, secretaries and technicians; office and laboratory supplies; and expenditures for degree credit instructional programs in science and engineering subjects. The time spent in supervising the thesis work of graduate students should be reported as an expenditure for instruction, not for departmental research. Departmental research (nonsponsored research) is "personal" or "faculty" research supported by General Funds of the department as a specifically assigned, departmentally planned, or mutually understood part of the faculty member's total activity. If departmental research expenditures are now separately budgeted at your institution, they should be reported in items 1 & 2 rather than in item 3.

Does your institution separately budget departmental research? YES_____ beginning in 19___ NO______

If YES, are the expenditures for this item reported in items 1 & 2? YES_____ NO______

Field of science		Total instruction and departmental research (Thousands of dollars) (1)	Departmental research as a percent of col. 1 (No decimals) (2)
a. Engineering	1510	$	%
b. Physical sciences	1520		%
c. Environmental sciences	1530		%
d. Mathematical and computer sciences	1540		%
e. Life sciences	1550		%
f. Psychology	1560		%
g. Social sciences	1570		%
h. Other sciences, n.e.c.	1580		%
i. **Total (sum of a through h)**	1500	$	

ITEM 4. CAPITAL EXPENDITURES FOR SCIENTIFIC AND ENGINEERING FACILITIES AND EQUIPMENT FOR RESEARCH, DEVELOPMENT, AND INSTRUCTION, BY FIELD OF SCIENCE, FY 1977

ITEM 4. INSTRUCTIONS

Report funds for facilities which were in process or completed during FY 1977. 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. Exclude small equipment items in your current fund account costing approximately $200 to $500 or less, as determined by institutional policy.

Facilities and equipment expenditures include the following: (a) fixed equipment such as built-in equipment and furnishings; (b) movable scientific equipment such as oscilloscopes, pulse-height analyzers; (c) movable furnishings such as desks; (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; (e) facilities constructed to house separate components such as medical schools and teaching hospitals; and (f) special separate facilities used to house scientific apparatus such as accelerators, oceanographic vessels, and computers.

Field of science		Thousands of dollars		
		Total (1)	Federal Government (2)	All other sources (3)
a. Engineering	1710	$	$	$
b. Physical sciences	1720			
c. Environmental sciences	1730			
d. Mathe[illegible]ical and computer sciences	1740			
e. Life [illegible]iences	1750			
f. P[illegible]ology	1760			
g. Social sciences	1770			
h. Other sciences, n.e.c.	1780			
i. **Total (sum of a through h)**	1700	$	$	$

OMB No. 99-R0282
Approval Expires December 1978

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

SURVEY OF SCIENTIFIC AND ENGINEERING PERSONNEL EMPLOYED AT UNIVERSITIES AND COLLEGES, JANUARY 1978

Organizations are requested to complete and return this form to:

NATIONAL SCIENCE FOUNDATION
1800 G Street, N.W.
Washington, D.C. 20550 Attn: UNISG

This information is solicited under the authority of the National Science Foundation Act of 1950, as amended. All information you provide will be used for statistical purposes only. Your response is entirely voluntary and your failure to provide some or all of the information will in no way adversely affect your institution.

Name and address of institution:

(Please correct if name or address has changed)

This survey requests employment data as of January 1978. The completed 1978 questionnaire should be returned to NSF by March 31, 1978. Your cooperation in returning the survey questionnaire promptly will be appreciated. If you determine, however, that you cannot respond by March 31, please notify NSF and request an extension of time.

Please read the enclosed instructions before completing this form. If you have any questions about the completion of the form, **contact Robert Loycano (202-634-4673).** Where exact data are not available, use estimates. Please complete all items; estimates by college officials will be better than NSF estimates. Enter "O" as an item total (lines 2100; 2200, etc., are item totals) rather than leave the total blank.

All entries should be in whole numbers. Please do not enter decimals or fractions, except in column 5 of item 6 where 1 decimal place is optional.

Institutions of Higher Education

Include data for branches (including regional campuses) and all organizational units of your institution, such as a medical school or agricultural experiment station. Also include any hospital or clinic owned, operated, or controlled by the University, and integrated operationally with the clinical programs of your medical school. **Exclude** data for any federally funded research and development centers (FFRDC's) administered by your institution. **(See below).**

Please classify your institution according to (1) highest degree granted in the sciences or engineering and (2) primary administrative control.

Highest degree granted in the sciences or engineering during 1976-77	Check one	One example of a science or engineering field in which highest degree was awarded	Check primary administrative control of your institution	
Ph.D.	☐	________	Federal	☐
M.D., D.D.S., etc.	☐	________	State	☐
Master's	☐	________	Local	☐
Bachelor's or equivalent	☐	________	Private	☐
Degree other than in science or engineering	☐	________		
2-year program	☐	________		

Federally Funded Research and Development Centers (FFRDC's)

Separate forms have been mailed directly to all FFRDC's administered by academic institutions. A list of these centers appears on page 2 of the Instructions and Definitions.

NSF FORM 724 (12-77)

SECTION A. NUMBER OF SCIENTISTS AND ENGINEERS, JANUARY 1978
(INCLUDE postdoctorals; EXCLUDE graduate students)

Item 1. Full-time scientists and engineers, by field and function in which primarily employed (enter the totals of 1a thru 1g in 1h); and total full-time-equivalents (FTE), by function, January 1978 (enter in 1i)

FIELD OF EMPLOYMENT		TOTAL (1)	TEACHING (2)	R&D (3)	Other activities (4)
a. Engineers (total)	2110				
(1) Aeronautical & astronautical engineers	2111				
(2) Chemical engineers	2112				
(3) Civil engineers	2113				
(4) Electrical engineers	2114				
(5) Mechanical engineers	2115				
(6) Other engineers	2116				
b. Physical scientists (total)	2120				
(1) Chemists	2121				
(2) Physicists	2122				
(3) Other physical scientists	2123				
c. Environmental scientists (total)	2130				
(1) Earth scientists	2131				
(2) Atmospheric scientists	2132				
(3) Oceanographers	2133				
d. Mathematical & computer scientists (total)	2140				
(1) Mathematicians (exclude computer scientists)	2141				
(2) Computer scientists (exclude programmers)	2142				
e. Life scientists (total)	2150				
(1) Agricultural scientists	2151				
(2) Biological scientists	2152				
(3) Medical scientists (see instructions, p.1)	2153				
f. Psychologists (total)	2160				
g. Social scientists (total) (exclude historians)	2170				
(1) Economists	2171				
(2) Sociologists	2172				
(3) Political scientists	2173				
(4) Other social scientists	2174				
h. Total headcount (sum of a thru g) a/	2100				
i. FTE distribution, by function b/	2190				

Item 2. Full-time scientists and engineers, by highest earned degree and function in which primarily employed, January 1978

HIGHEST EARNED DEGREE		TOTAL (1)	TEACHING (2)	R&D (3)	Other activities (4)
Doctorate holders, by type					
a. Ph.D. or Sc.D.	2210				
b. Ed.D.	2220				
c. M.D., D.D.S., D.V.M., etc.	2230				
d. Master's	2240				
e. Bachelor's or the equivalent	2250				
f. Total (sum of a thru e)	2200				

a/ Totals in line 1h should be the same as the corresponding totals in line 2f.

b/ The total reported in item 1i, column 1, should, by definition, be the same as the total in item 1h, column 1. However, the FTE distribution by function (columns 2, 3, and 4) will not necessarily coincide with the functional distribution on a "primarily employed" basis in line 1h.

Item 3. Part-time scientists and engineers, by field and function in which primarily employed (enter the totals of 3a thru 3g in 3h); and total FTE's by function, January 1978 (enter in 3i) (INCLUDE postdoctorals; EXCLUDE graduate students)

FIELD OF EMPLOYMENT		TOTAL (1)	TEACHING (2)	R&D (3)	Other activities (4)
a. Engineers (total)	2310				
(1) Aeronautical & astronautical engineers	2311				
(2) Chemical engineers	2312				
(3) Civil engineers	2313				
(4) Electrical engineers	2314				
(5) Mechanical engineers	2315				
(6) Other engineers	2316				
b. Physical scientists (total)	2320				
(1) Chemists	2321				
(2) Physicists	2322				
(3) Other physical scientists	2323				
c. Environmental scientists (total)	2330				
(1) Earth scientists	2331				
(2) Atmospheric scientists	2332				
(3) Oceanographers	2333				
d. Mathematical & computer scientists (total)	2340				
(1) Mathematicians (exclude computer scientists)	2341				
(2) Computer scientists (exclude programmers)	2342				
e. Life scientists (total)	2350				
(1) Agricultural scientists	2351				
(2) Biological scientists	2352				
(3) Medical scientists (see instructions, p.1.)	2353				
f. Psychologists (total)	2360				
g. Social scientists (total) (exclude historians)	2370				
(1) Economists	2371				
(2) Sociologists	2372				
(3) Political scientists	2373				
(4) Other social scientists	2374				
h. Total headcount (sum of a thru g) a/	2300				
i. FTE distribution, by function b/	2390				

Item 4. Part-time scientists and engineers, by highest earned degree and function in which primarily employed, January 1978

HIGHEST EARNED DEGREE		TOTAL (1)	TEACHING (2)	R&D (3)	Other activities (4)
Doctorate holders, by type a. Ph.D. or Sc.D.	2410				
b. Ed.D.	2420				
c. M.D., D.D.S., D.V.M., etc.	2430				
d. Master's	2440				
e. Bachelor's or the equivalent	2450				
f. Total (sum of a thru e)	2400				

a/ Totals in line 3h should be the same as the corresponding totals in line 4f.

b/ The totals in item 3i converting figures on part-time employment into FTE's will necessarily differ from headcount totals in line 3h.

Item 5	Full-time scientists and engineers, by field in which primarily employed, and sex, January 1978 (Totals reported in item 5, column 1, should equal the totals reported in item 1, column 1.)				
	FIELD OF EMPLOYMENT		TOTAL (1)	MEN (2)	WOMEN (3)
	a. Engineers (total)	2610			
	(1) Aeronautical & astronautical	2611			
	(2) Chemical engineers	2612			
	(3) Civil engineers	2613			
	(4) Electrical engineers	2614			
	(5) Mechanical engineers	2615			
	(6) Other engineers	2616			
	b. Physical scientists (total)	2620			
	(1) Chemists	2621			
	(2) Physicists	2622			
	(3) Other physical scientists	2623			
	c. Environmental scientists (total)	2630			
	(1) Earth scientists	2631			
	(2) Atmospheric scientists	2632			
	(3) Oceanographers	2633			
	d. Mathematical & computer scientists (total)	2640			
	(1) Mathematicians (exclude computer scientists)	2641			
	(2) Computer scientists (exclude programmers)	2642			
	e. Life scientists (total)	2650			
	(1) Agricultural scientists	2651			
	(2) Biological scientists	2652			
	(3) Medical scientists (see instructions, p.1.)	2653			
	f. Psychologists (total)	2660			
	g. Social scientists (total) (exclude historians)	2670			
	(1) Economists	2671			
	(2) Sociologists	2672			
	(3) Political scientists	2673			
	(4) Other social scientists	2674			
	h. Total headcount (sum of a thru g)	2600			

Item 6

Scientists and engineers, by field in which primarily employed, employment status, and total full-time equivalents (FTE's) by field, January 1978

NOTE: This information is needed by NSF and others interested in the current status and trends in the level of academic research, by field.

FIELD OF EMPLOYMENT		Headcounts: Total (1)	Headcounts: Full time [a] (2)	Headcounts: Part time [b] (3)	Estimated full-time-equivalents (FTE): Total FTE's (Include all activities, e.g., teaching, R&D etc., of all individuals reported in col. 1) (4)	Estimated full-time-equivalents (FTE): Percent of total FTE's devoted to R&D (5)
a. Engineers (total)	2710					%
(1) Aeronautical & astronautical engineers	2711					%
(2) Chemical engineers	2712					%
(3) Civil engineers	2713					%
(4) Electrical engineers	2714					%
(5) Mechanical engineers	2715					%
(6) Other engineers	2716					%
b. Physical scientists (total)	2720					%
(1) Chemists	2721					%
(2) Physicists	2722					%
(3) Other physical scientists	2723					%
c. Environmental scientists (total)	2730					%
(1) Earth scientists	2731					%
(2) Atmospheric scientists	2732					%
(3) Oceanographers	2733					%
d. Mathematical & computer scientists (total)	2740					%
(1) Mathematicians (exclude computer scientists)	2741					%
(2) Computer scientists (exclude programmers)	2742					%
e. Life scientists (total)	2750					%
(1) Agricultural scientists	2751					%
(2) Biological scientists	2752					%
(3) Medical scientists (see instructions, p. 1)	2753					%
f. Psychologists (total)	2760					%
g. Social scientists (total) (exclude historians)	2770					%
(1) Economists	2771					%
(2) Sociologists	2772					%
(3) Political scientists	2773					%
(4) Other social scientists	2774					%
h. Total (sum of a thru g)	2700					%

NOTE: If you presented data in column 5 in terms of absolute numbers instead of percentages, please check this box ☐

a/ Totals in column 2 should be the same as corresponding totals in column 1 of item 1.

b/ Totals in column 3 should be the same as corresponding totals in column 1 of item 3.

SECTION B. NUMBER OF TECHNICIANS EMPLOYED IN THE SCIENCES AND ENGINEERING, January 1978

Item 7. Technicians, by field and function in which primarily employed, January 1978

FIELD OF EMPLOYMENT		TOTAL (1)	R&D (2)	Other activities (3)
a. Engineering technicians	2810			
b. Physical science technicians	2820			
c. Environmental science technicians	2830			
d. Mathematical and computer science technicians	2840			
e. Life science technicians	2850			
f. Psychology technicians	2860			
g. Social science technicians	2870			
h. Total (sum of a thru g)	2800			

CHECK LIST

( ) 1. Are all entries rounded to whole numbers? (Please do not enter fractions or decimals, except in column 5 of item 6 where one decimal place is optional.)

( ) 2. Do the data add to subtotals?

( ) 3. Are all items completed? YOUR ESTIMATES will be better than OURS. An explanation of estimates may be noted on a separate sheet or in the remarks.

( ) 4. Are all branches and components such as a medical school and agricultural experiment station included?

( ) 5. Have you included all postdoctorals?

1977-78 DATA CHECK

Please compare your January 1978 personnel data with your survey response for January 1977, particularly for the following item totals. Please explain below or on a separate sheet any significant changes and where possible, indicate any required adjustments in data reported in previous surveys.

	1977	1978
Total full-time scientists & engineers	Line 2100, col. 1	Line 2100, col. 1
Total part-time scientists & engineers	Line 2300, col. 1	Line 2300, col. 1
Total technicians employed in the sciences and engineering	Line 2800, col. 1	Line 2800, col. 1

CONFIDENTIALITY

The National Science Foundation recognizes that its ability to gather much of the enclosed information would be severely impaired if it could not be held in confidence. Please indicate below the number of any items which would not be supplied but for assurance that the source will be held in confidence. The Foundation will hold in confidence such information to the extent permitted by law.

ITEM:

REMARKS

PLEASE TYPE OR PRINT NAME OF PERSON SUBMITTING THIS FORM	TITLE	AREA CODE	EXCH	NO.	EXT
NAME OF PERSON WHO PREPARED THIS SUBMISSION (If different from above)	TITLE	AREA CODE	EXCH	NO.	EXT

NAME OF INSTITUTION	DATE	ADDRESS (number, street, city, State, ZIP code)

OMB No. 99-R0282
Approval Expires December 1978

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

SURVEY OF SCIENTIFIC AND ENGINEERING PERSONNEL EMPLOYED AT UNIVERSITIES AND COLLEGES, JANUARY 1978

INSTRUCTIONS AND DEFINITIONS

The National Science Foundation requests your cooperation in completing the attached questionnaire covering the personnel characteristics of your institution as they relate to the sciences and engineering. This form requests employment data as of January 1978. The questionnaire should be completed and returned to NSF by March 31, 1978. If you determine, however, that you will not be able to respond by that date, please notify NSF and request an extension of time.

This survey is similar to that conducted by this office each year. The major difference this year is the deletion of the question (formerly item 5) on Ph.D./Sc.D.'s by field and employment status and the removal of the "optional" designation for the item requesting FTE data by field, (formerly item 7).

Where data reported in the current survey differ significantly from those reported in the previous survey, please indicate the reasons for the difference, such as "opening of new medical school," etc., at the end of the questionnaire in the "Remarks" section, or on a separate sheet of paper.

If you have any questions regarding information requested on this form, write or telephone Mr. Robert Loycano at the Universities and Nonprofit Institutions Studies Group, Division of Science Resources Studies, National Science Foundation, 1800 G Street, N.W., Room L-602, Washington, D.C. 20550 (Telephone: 202/634-4673). Additional forms, as well as copies of previous responses, may be obtained by writing to the above address.

Institutions of Higher Education

Academic institutions should include in the form for the parent institution data on professional and technical personnel employed in the sciences and engineering in all branches and other units of the parent institution. *Include* regional campuses, medical school, or an agricultural experiment station, but *exclude* an associated federally funded research and development center (FFRDC). FFRDC's are to report their data separately from the administering university.

Include all personnel who were paid a salary or stipend, including *postdoctorals,* and other staff, such as members of religious orders, who received no remuneration while employed at the institution.

Exclude: (1) Personnel on sabbatical or other leave status; (2) personnel employed in branches of your institution located in foreign countries; (3) unpaid voluntary staff; (4) student health service personnel; and (5) those agricultural extension personnel primarily involved in home economics and 4-H youth programs.

Medical Schools

Incorporate data for medical schools in the data for the parent institution. Medical schools are those 2- or 4-year schools of medicine approved by the Council on Medical Education and Hospitals and the Association of American Medical Colleges. *Include:* (1) Teaching and R&D functions of hospitals or clinics owned, operated, or controlled by universities and integrated operationally with the clinical programs of their medical schools; (2) research bureaus or institutes which are integral parts of medical schools; (3) research bureaus and institutes which are nonuniversity owned but are affiliated with the medical school and any university bureaus, and institutes which may be outside the departmental structure of universities, but whose senior research staff members hold teaching appointments with medical schools.

Personnel employed at such organizations that are to be reported in the survey include all M.D.'s, D.D.S.'s, etc., with *faculty* or *academic* appointments. Typical among these are physicians, dentists, public health specialists, pharmacists, etc., who spend the *greatest* proportion of their time in teaching, clinical investigation, or other R&D activities.

Exclude: (1) All medical practitioners, interns, residents, and clinical fellows *without* faculty or academic appointments; (2) scientists whose primary employment is at independent hospitals even though they may perform some teaching or research functions for your institution through cooperative agreements; (3) nurses; (4) some allied health professionals primarily involved in direct patient care, such as optometrists, nurse anesthetists, occupational therapists, and physical therapists; and, (5) unpaid voluntary staff at medical or dental schools.

Federally Funded Research and Development Centers (FFRDC's)

For purposes of this survey, FFRDC's are defined as R&D organizations exclusively or substantially financed by the Government and administered on a contractual basis by educational institutions or other organizations. The following is a current list of FFRDC's administered by universities and colleges:

Ames Laboratory
Applied Physics Laboratory (Johns Hopkins University)
Applied Research Laboratory
Argonne National Laboratory
Brookhaven National Laboratory
Center for Naval Analyses
Cerro Tololo Inter-American Observatory
E. O. Lawrence Berkeley Laboratory
E. O. Lawrence Livermore Laboratory
Fermi National Accelerator Laboratory
Jet Propulsion Laboratory
Kitt Peak National Observatory
Lincoln Laboratory
Los Alamos Scientific Laboratory
National Astronomy and Ionosphere Center
National Center for Atmospheric Research
National Radio Astronomy Observatory
Oak Ridge Associated Universities
Plasma Physics Laboratory
Space Radiation Effects Laboratory
Stanford Linear Accelerator Center

Data Elements Required to Complete This Survey

If the following seven characteristics are known for each science and engineering employee, the request can be substantially completed without estimates. The characteristics are further described elsewhere in the instructions.

1. Scope of personnel included:
   a. Scientists and engineers
   b. Science and engineering technicians
2. Assignment status:
   a. Full time
   b. Part time
3. Field of employment (22 detailed fields in 7 broad groupings)
4. Full-time-equivalents (FTE's)
5. Function:
   a. Teaching
   b. Research and development
   c. Other science and engineering activities
6. Highest earned degree
   a. Ph. D. or Sc. D.
   b. Ed. D.
   c. M. D., D.D.S., D.V.M., etc.
   d. Master's
   e. Bachelor's or its equivalent
7. Classification of scientists and engineers by sex.

Classification of Fields of Employment in the Sciences and Engineering

Listed below are the broad and detailed fields of employment corresponding to those shown on the questionnaire with illustrative disciplines in each field.

Please classify persons (including those employed in interdisciplinary or multidisciplinary specializations) in the listed fields with which their activities (teaching, research, or other) are *most closely identified*. In the case of a scientist employed in a general category such as science education, he should be reported in the field *most closely related* to the academic requirements of his position—such as mathematics, sociology, or psychology.

Because of the importance of academic departments in the organizational structure and, thus, in the information systems of institutions of higher education, many institutions must report individuals in terms of the departmental assignment shown in their personnel information systems. In some instances, the designated department will not necessarily be the same as the field in which an individual is actually employed.

Because of the departmental structure, it is important that respondents include in the survey organizational units that are not part of *any* academic department. For example, scientists and engineers employed at a computer center that is not affiliated with a particular academic department should be *included* in the survey.

ENGINEERING

Aeronautical & Astronomical: aerodynamics, aerospace, space technology
Chemical: ceramic, petroleum, petroleum refining process
Civil: architectural, hydraulic, hydrologic, marine, sanitary and environmental, structural, transportation
Electrical: communication, electronic, power
Mechanical: engineering mechanics
Other Engineering: agricultural, industrial and management, metallurgical and materials, mining, nuclear, ocean engineering systems, textile, welding, interdisciplinary fields for the training of technicians.

PHYSICAL SCIENCES

Chemistry: analytical, inorganic, organo-metallic, organic, pharmaceutical, physical, polymer science (exclude biochemistry)
Physics: acoustics, atomic and molecular, condensed matter, elementary particles, nuclear structure, optics, plasma
Other Physical Sciences: astronomy (laboratory astrophysics, optical astronomy, radio astronomy, theoretical astrophysics, X-ray, gamma-ray, neutrino astronomy), metallurgy, interdisciplinary fields for the training of technicians

ENVIRONMENTAL SCIENCES (TERRESTRIAL AND EXTRATERRESTRIAL)

Earth Sciences: engineering geophysics, general geology, geodesy and gravity, geomagnetism, hydrology, inorganic geochemistry, isotopic geochemistry, organic geochemistry, lab geophysics, paleomagnetism, paleontology, physical geography and cartography, seismology
Atmospheric Sciences: aeronomy, solar, weather modification, extraterrestrial atmospheres, meteorology
Oceanography: biological oceanography, chemical oceanography, geological oceanography, physical oceanography, marine geophysics

MATHEMATICAL AND COMPUTER SCIENCES

Mathematics: algebra, analysis, applied mathematics, foundations and logic, geometry, numerical analysis, statistics, topology

Computer Sciences: computer programming,[1] computer and information sciences (general); design, development, and application of computer capabilities to data storage and manipulation; information sciences and systems; systems analysis

LIFE SCIENCES

Agricultural Sciences: agronomy, animal science, dairy science, food science and technology, forestry, horticulture, poultry science
Biological Sciences: anatomy, bacteriology, biochemistry, biogeography, biophysics, ecology, embryology, entomology, evolutionary biology, genetics, immunology, microbiology, nutrition and metabolism, parasitology, pathology, pharmacology, physical anthropology, physiology, plant sciences, radiobiology, systematics, zoology, interdisciplinary fields for the training of technicians
Medical Sciences: Internal medicine, neurology, ophthalmology, preventive medicine and public health, psychiatry, radiology, surgery, veterinary medicine, dentistry, pharmacy, podiatry, anesthesiology, chemotherapy, dermatology, geriatrics, nuclear medicine, obstetrics, gynecology, oncology, pediatrics, physical medicine and rehabilitation, interdisciplinary fields for the training of technicians[2]

PSYCHOLOGY: animal behavior; clinical psychology; comparative psychology, counseling and guidance; development and personality; educational, personnel, vocational psychology and testing; experimental psychology; ethology; industrial and engineering psychology; social psychology

SOCIAL SCIENCES

Economics: agricultural economics; econometrics and economic statistics; history of economic thought; international economics; industrial, labor and agricultural economics; macroeconomics; microeconomics; public finance and fiscal policy; theory; economic systems and development
Sociology: comparative and historical, complex organizations, culture and social structure, demography, group interactions, social problems and social welfare, sociological theory
Political Science: area or regional studies, comparative government, history of political ideas, international relations and law, national, political and legal systems; political theory, public administration

Other Social Sciences: cultural anthropology, criminology, history of science, linguistics, socioeconomic geography, urban studies, research in education, and research in law, i.e., attempt to assess impact of legal systems and practices on society.

[1] Personnel employed as computer programmers should be reported as technicians (item 7).
[2] *Exclude* personnel primarily involved in direct patient care.

Section A—Number of Scientists and Engineers, January 1978

(Includes postdoctorals and excludes graduate students)

This section requests data on full- and part-time employed scientists and engineers. Scientists and engineers include *faculty members, postdoctorals, and other professionals* working in the sciences and engineering at your institution, including those in research administration. These professionals work at a level at which the knowledge acquired by academic training equal to a bachelor's degree is essential in the performance of duties. Graduate students are not considered scientists and engineers for survey purposes.

Two possible criteria used in determining whether an individual is employed full time are (1) his/her working 40 hours per week; or (2) his/her teaching 12 credit hours per week. (The preceding serve as illustrations only; the "full-time" workload may vary somewhat from institution to institution.)

Avoid double counting; if an individual is a full-time employee, but his assignment involves more than 1 department or more than 1 campus, he/she should be counted as 1 full-timer in his/her actual or primary field of employment and at his/her primary campus location.

Item 1. Full-time scientists and engineers, by field and function in which *primarily* employed, January 1978.

In items 1a to 1h, the functional classification of professional personnel into teaching (column 2), R&D (column 3), and other science and engineering activities (column 4), should be based on the function in which the person is *primarily* engaged or employed at the institution. For example, a person engaged in two or all three of the specified functional categories should be classified in the function in which he spends the *largest* proportion of his time. *Exclude* outside consulting work and teaching not performed under the auspices of your institution.

In classifying personnel by function, note that determinations made solely on the basis of job titles may produce a significant bias primarily toward teaching. It is important to recognize that persons with professorial rank may also be engaged in research.

In classifying an individual under a particular category (teaching, research and development, or other science and engineering activities), take into consideration all official activities even if carried on in a school or department other than the one in which he holds his principal appointment.

Teaching (column 2) is defined as encompassing those 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.

Include under "teaching" any academic administrator—such as the President, a Dean, or a department chairman—who holds a science or engineering degree, unless the individual is primarily involved in the administration of R&D activities. If the individual cannot be identified with *one* specific discipline, report the field of his highest earned degree. Administrators primarily involved in R&D activities should be reported in the "R&D" column.

Include personnel engaged in instruction of: first-year trainees, residents, and other professional personnel receiving advanced training such as postdoctoral fellows or trainees.

Time spent by faculty or other staff members in supervising the thesis work of graduate students is considered to be part of the teaching function.

Exclude instructors in nursing programs, dental hygiene, etc., specialties that relate primarily to direct patient care.

Research and development (column 3) includes basic and applied research in the sciences and engineering and design and development of prototypes and processes.

Research is a systematic, intensive study directed toward fuller knowledge of the subject studied. *Research* includes activities that are separately budgeted, including all activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution. This activity includes all departmental research that is separately budgeted. *Include* in this function the preparation for publication of books and papers describing the results of the specific research and development. Also *include* the *administration* of research and development.

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.

Under *Other science and engineering activities* (column 4) report all professional personnel *not* primarily employed in teaching or research and development, as defined above. Examples of such activities are agricultural demonstration work not specifically excluded on page 1; adult education (if not for degree credit); dissemination of scientific information; and student counseling by individuals with degrees in psychology. *Exclude* hospital employees predominantly involved in patient services, Student Health Service professionals, and other individuals that are *not* primarily engaged in science or engineering activities. *Do not use* this category to report individuals for which there is difficulty in determining their primary function. It is preferable that you classify each person in the most appropriate functional category according to your best estimate.

Full-time-equivalent distribution, by function. In line 1i, apportion staff members across the three functions on the basis of the proportion of effort or time spent in each of the functions, thus correcting for the "primarily engaged" headcount data reported in line 1h. For example, an individual devoting three-fourths of his time to teaching and one-fourth to research and development should be counted as 0.75 in teaching and 0.25 in research and development. The FTE values should then be accumulated for each function. This sum should then be *rounded to the nearest whole number* before entering the total on the questionnaire. In line 1i, totals entered in columns 2, 3, and 4 should add to the total in column 1.

Item 2. Full-time scientists and engineers, by highest earned degree and function in which *primarily* employed, January 1978.

For the purposes of this survey, earned degrees are classified in five categories:

a. *"Ph.D. or Sc.D."* degrees (include all such earned degrees.) *Include* individuals holding both the Ph.D. (or Sc.D.) degree and any other doctorate degree.

b. *"Ed.D."* (includes all such earned degrees.)

c. *"M.D., D.D.S., D.V.M., etc." includes* individuals whose highest earned degrees are first-professional medical degrees that represent the completion of the academic requirements based on programs that require at least 2 academic years of previous college work for entrance and require a total of at least 6 academic years of college work for completion. Specifically include in line 2c first-professional degrees in Medicine (M.D.), Dentistry (D.D.S. or D.M.D.), Veterinary Medicine (D.V.M.), Chiropody or Podiatry (D.S.C. or D.P.), and Osteopathy (D.O.). Individuals holding both the Ph.D. (Sc.D.) degree and a first-professional degree such as the M.D., should be included in line 2a as mentioned in (a) above.

d. *"Master's" degrees* includes all degrees above the bachelor's and first-professional degree and other than the doctorate degrees reported between lines 2a and 2c.

e. *"Bachelor's or the equivalent" degrees* includes all individuals whose highest earned degree is the bachelor's degree or a 4- or 5-year first-professional degree, or who have the equivalent in experience, even if they have not earned such a degree (line 2e).

Item 3. Part-time scientists and engineers, by field and function in which *primarily* employed, January 1978.

Instructions for item 1 relating to classification by field and function also relate to part-time professional staff in item 3.

In estimating the full-time-equivalents of part-time personnel in line 3i, take into account both the overall workload and the proportion of time spent on each of the three functions of activity. For example, if full-time workload is 40 hours per week, and an individual is estimated to spend 10 hours on teaching and related duties and 6 hours on research, his FTE values would be teaching—.25 (10/40); R&D—.15 (6/40). The FTE values should be accumulated for each function and *rounded to the nearest whole number* before entering the total on the questionnaire. The FTE values entered in columns 2, 3, and 4 should then be summed to arrive at the total to be entered in column 1.

Item 4. Part-time scientists and engineers, by highest earned degree and function in which *primarily* employed, January 1978.

Instructions for item 2 relating to the classification by field and highest earned degree also relate to part-time professional staff in item 4.

Item 5. Full-time scientists and engineers, by field in which *primarily* employed and **sex,** January 1978.

Institutions are requested to report total full-time scientists and engineers, by sex and field in which primarily employed. Data in column 1 (total of men and women) should equal data shown in item 1, column 1.

Item 6. Scientists and engineers, by field in which *primarily* employed, employment status, and full-time-equivalents (FTE's), January 1978.

Data in columns 1, 2, and 3 are derived from data reported in column 1 of items 1 and 3. To estimate total full-time-equivalents (FTE's) in column 4, take into account both allocation of effort, by field, and proportion of full-time workload accounted for by part-time personnel. FTE's in column 5 should reflect research effort of both full- and part-time professional personnel.

The following example showing how data might be reported in columns 1 through 5 is included for illustrative purposes only. For the sake of this computation, it is assumed that the data are estimated on the basis of detailed records on faculty activity. The Foundation recognizes, however, that the information systems at many academic institutions do not, in fact, yield data at this level of detail. In such cases, or in instances where institutions would be required to expend an excessive effort to produce the information in the desired format, your best estimates on an alternative basis would be completely acceptable.

Example

If your institution employs:

20 full-time chemical engineers
10 part-time chemiscal engineers
30

4 full-time electrical engineers
4 part-time electrical engineers
8

And:
Of the 20 full-time chemical engineers, 6 have split appointments (50-50 basis) with the electrical engineering department; thus, 14 are employed solely as chemical engineers.

All part-time personnel carry, on the average, one-third the normal workload.

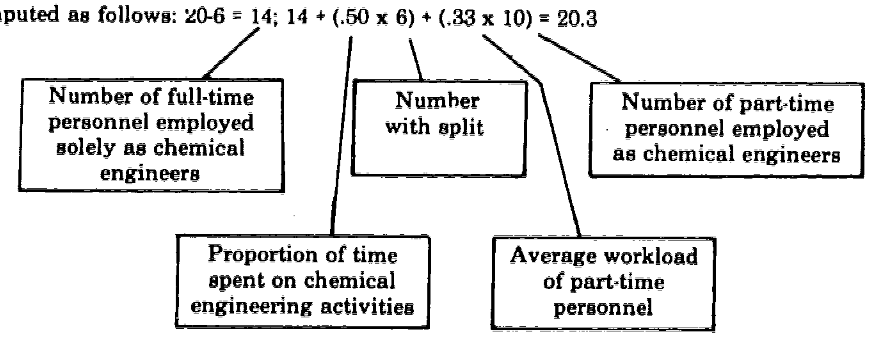
Concerning R&D effort, 12 of the 20 full-time chemical engineers and 2 of the 4 full-time engineers expend, on the average, one-fourth of their time on R&D activities.

Then, the data in lines 2712 (chemical engineers) and 2714 (electrical engineers) should be estimated as follows:

Item 6

Line	Total Headcount (Col. 1)	Full time (Col. 2)	Part time (Col. 3)	Total FTE's (Col. 4)	R&D FTE's (as percent of col. 4) (Col. 5)
2712 (chemical engineers)	30	20	10	[1]20	[3]15
2714 (electrical engineers)	8	4	4	[2]8	[4]6

[1] Computed as follows: 20-6 = 14; 14 + (.50 x 6) + (.33 x 10) = 20.3



[2] Computed as follows: 4 + (.50 x 6) + (.33 x 4) = 8.33
[3] Computed as follows: .25 x 12 = 3; 3÷20 = .15 = 15%
[4] Computed as follows: .25 x 2 = .50; .50÷8 = .06 = 6%

Section B—Number of Technicians Employed in the Sciences and Engineering, January 1978

Item 7. Technicians, by field and function in which *primarily* employed, January 1978.

Technicians include all persons employed in positions which involve technical work at a level requiring knowledge in any of the fields of engineering, mathematics, physical sciences, environmental sciences, life sciences, psychology, or social sciences comparable to that acquired through formal post-high school training *(less than a bachelor's degree)*, such as that obtained at technical institutes and junior colleges or through equivalent on-the-job training or experience. All personnel performing the duties described above should be reported as technicians *even* if they hold a bachelor's or higher degree. Some typical job titles include laboratory technician or assistant, physical science aide, engineering aide, statistical aide, draftsman, and computer programmer.

Exclude graduate students; technicians involved primarily in patient care service in university affiliated hospitals; and craftsmen such as electricians, carpenters, machinists, etc. In the case where undergraduate students, juniors or seniors, are employed in R&D activities, they may, where applicable, be included as technicians.

NSF Form 812, Oct. 77

Form Approved
OMB. No.99-R0275

NATIONAL SCIENCE FOUNDATION and NATIONAL INSTITUTES OF HEALTH
SURVEY OF GRADUATE SCIENCE STUDENT SUPPORT AND POSTDOCTORALS, FALL 1977

DEPARTMENTAL DATA SHEET

(NOTE: BEFORE FILLING OUT PLEASE READ THE ATTACHED INSTRUCTIONS)

1. Name and address of institution: ______________________
2. Science or engineering department (or unit) covered by this data sheet: ______________________
3. Person in department (or unit) preparing this form:
   Name: ______________________
   Title: ______________________ Tel: ( ) ________
4. Highest degree program offered by department (or unit) in fall 1977? (CHECK ONE ONLY) Master's ___ (1) Doctorate ___ (2)

Institution and department code (Leave blank)

(NOTE: IF YOUR DEPARTMENT DOES NOT ENROLL GRADUATE STUDENTS, PLEASE MOVE TO ITEM 7 BELOW)

5. FULL-TIME GRADUATE STUDENTS enrolled for advanced degrees (master's and doctorate) in fall 1977 (See Item 5 - Instructions)

MECHANISMS OF SUPPORT	LEVEL OF STUDY		STUDENTS RECEIVING FINANCIAL ASSISTANCE: FEDERAL SOURCES (Excluding loans): Department of Defense (A)	DHEW: National Institutes of Health (B)	DHEW: Other DHEW (C)	National Science Foundation (D)	Other Federal sources (E)	NON-FEDERAL SOURCES: Institutional support1/ (F)	Foreign sources (G)	Other U.S. sources2/ (H)	SELF-SUPPORTED STUDENTS (Including loans and family sources) (I)	TOTAL FOR ALL SOURCES [Sum of (A) thru (I)] (J)
Graduate fellowships and traineeships	First year	(1)										
	Beyond first	(2)										
Graduate research assistantships	First year	(3)										
	Beyond first	(4)										
Graduate teaching assistantships	First year	(5)										
	Beyond first	(6)										
Other types of support	First year	(7)										
	Beyond first	(8)										
TOTAL		(9)										
For each total on line (9) how many are WOMEN?	First year	(10)										
	Beyond first	(11)										

FOREIGN STUDENTS	(12)	Of the full-time graduate students shown in line (9), column (J), how many are FOREIGN students?	

6. PART-TIME GRADUATE STUDENTS FALL 1977

First year (A)	Beyond first (B)	TOTAL (C)
Of the total in column C above, how many are WOMEN?		(D)

CHECK LIST

- ☐ Are all items completed?
- ☐ Do the data add to totals in line 9 and in column J?
- ☐ All self-supported students should be INCLUDED in column I.
- ☐ Be sure to EXCLUDE M.D., D.V.M., and D.D.S. candidates from items 5 and 6.

7. POSTDOCTORALS AND/OR RESEARCH ASSOCIATES FALL 1977

SOURCE OF SUPPORT: Federal: Fellowships/traineeships (A)	Federal: Research associates (B)	Non-Federal (C)	TOTAL (Sum of (A) thru (C)) (D)	Of the TOTAL in column D, how many are FOREIGN? (E)

1/ Include support from this university and State and local governments.

2/ Include support from nonprofit institutions, industry, and all other U.S. sources.

NOTE: This information is solicited under the authority of the National Science Foundation Act of 1950, as amended. All information you provide will be used for statistical purposes only. Your response is entirely voluntary and your failure to provide some or all of the information will in no way adversely affect your institution.

INSTRUCTIONS FOR COMPLETING THE DEPARTMENTAL DATA SHEET, FALL 1977

General

Information supplied by your department on a Departmental Data Sheet (NSF Form 812) should reflect enrollment and postdoctoral appointments in fall 1977. A Form 812 is to be completed by each science and engineering department that supplied similar data in our 1976 survey or by any newly formed departments or any departments that were inadvertently omitted last year. A list of departments for which data were submitted in 1976 has been provided to your Survey Coordinator on NSF Form 811.

A graduate student is defined as a student enrolled for credit in an advanced-degree program leading to a master's or Ph.D. degree. M.D., D.V.M. or D.D.S. candidates, interns, and residents should NOT be reported UNLESS they are concurrently working for a master's or Ph.D. Individuals who already hold an M.D., D.V.M. or D.D.S., master's, or Ph.D. degree but who are working on ANOTHER master's or Ph.D. degree are to be counted as graduate students, either full or part time. DO NOT report such individuals as postdoctorals in item 7.

Graduate students performing thesis or dissertation research away from the campus at Government and contractor-owned facilities in the United States are to be included as long as they are enrolled for credit in an advanced-degree program. Students enrolled at a branch or extension center in a foreign country are to be EXCLUDED.

A graduate student, whether full- or part-time, should be reported in only one department. If any students or postdoctorals are in interdisciplinary programs, please coordinate your response with the other participating departments, so that each student or postdoctoral will be counted only once.

Care should be taken to submit as complete and accurate a report as possible so that followup procedures with your institution may be reduced to a minimum, and more timely statistics can be made available. If there are any questions concerning your response, please contact:

Tele Sec Data Preparation Division
1725 K Street, N.W., Suite 16
Washington, D.C. 20 16

Or call (collect): (202)-223-2651

Item Instructions

HIGHEST DEGREE PROGRAM OFFERED, item 4: Check the box which refers to the HIGHEST DEGREE program offered by this science department in fall 1977.

FULL-TIME GRADUATE STUDENTS, item 5: A full-time graduate student is defined as a student enrolled for credit in a master's or Ph.D. degree program (not a regular staff member) who is engaged full time in training activities in his field of science; these activities may embrace any appropriate combination of study, teaching, and research, depending upon YOUR INSTITUTION'S OWN POLICY. If your department has no full-time graduate students, write "NONE" in item 5 and move to item 6.

MECHANISMS OF SUPPORT, item 5, lines 1-8: Report each full-time graduate student according to the TYPE OF MAJOR SUPPORT received in the fall of 1977. Students should be reported as receiving a fellowship or traineeship in lines 1 and 2, if this mechanism constitutes the major source of his support. A student receiving primary support from an assistantship should be classified as a research assistant in lines 3 and 4, or as a teaching assistant in lines 5 and 6, according to how each spends the majority of his time, e.g., a graduate assistant devoting most of his time to teaching should be classified as a graduate teaching assistant. All other full-time students should be reported in lines 7 and 8.

LEVEL OF STUDY, FIRST-YEAR AND BEYOND-FIRST, items 5 & 6: A FIRST-YEAR graduate student is defined as one who will have completed LESS THAN A FULL YEAR of graduate study as of the beginning of the fall term in 1977. All other graduate students should be considered BEYOND THEIR FIRST YEAR.

STUDENTS RECEIVING FINANCIAL ASSISTANCE, item 5, columns (A) thru (H): Report the number of full-time graduate students in the appropriate column according to the source of the largest portion of their support. In determining the source of major support, consider only tuition and other academic expenses. If a graduate student receives stipend support from more than one source, choose the MAJOR category of support.

FEDERAL SOURCES, Columns (A) thru (E): Report the number of full-time graduate students in the appropriate column where they receive the largest portion of their support. Full-time graduate students receiving the largest portion of their support from Federal Government LOANS should be reported as SELF-SUPPORTED, column I.

Department of Defense (DOD), column (A): Report full-time graduate students receiving support from the Department of the Army, Navy, or Air Force. Students receiving their MAJOR support from the Veterans Administration under the G.I. Bill should be reported under column (E), "Other Federal sources;" if this form of support does not constitute his MAJOR source, the student should be counted in the appropriate column representing that source.

Department of Health, Education, and Welfare (DHEW), columns (B) and (C): Report full-time graduate students receiving support from the institutes or divisions of the NATIONAL INSTITUTES OF HEALTH (NIH), under column (B); support from all other components of DHEW should be reported under column (C), as indicated below:

Column (B)

Division of Research Resources
Fogarty International Center
National Cancer Institute
National Eye Institute
National Heart, Lung, and Blood Institute
National Institute on Aging
National Institute of Allergy and Infectious Diseases
National Institute of Arthritis, Metabolism, and Digestive Diseases
National Institute of Child Health and Human Development
National Institute of Dental Research
National Institute of Environmental Health Sciences
National Institute of General Medical Sciences
National Institute of Neurological and Communicative Disorders and Stroke

Column (C)

Alcohol, Drug Abuse, and Mental Health Administration (including National Institute of Mental Health)
Center for Disease Control
Food and Drug Administration
Health Resources Administration
Health Services Administration
National Institute of Education
Office of Education
Social and Rehabilitation Service

NONFEDERAL SOURCES, columns (F) thru (H):

Institutional support, column (F): Report full-time graduate students receiving support from your own institution and State and local governments. Funds given to a university by the FEDERAL GOVERNMENT, such as training grant funds, should be reported under the appropriate Federal agency and NOT reported as institutional support.

Foreign sources, column (G): Include support from any non-U.S. source.

Other U.S. sources, column (H): Include support from nonprofit institutions, private industry, and all other U.S. sources.

SELF-SUPPORTED STUDENTS, column (I): Include full-time graduate students whose major source of support is derived from loans from any source and from personal or family financial contributions. Full-time graduate students receiving the largest portion of their support from Federal loans should be reported here.

WOMEN, lines 10 and 11: Report the sources of support of all first-year women students in line 10 and those beyond their first year in line 11. Please note that in each column, line 10 should not exceed the total of all first-year students and line 11 should not exceed the total of those beyond their first year.

FOREIGN STUDENTS, line 12: A FOREIGN full-time graduate student is defined as one who has not attained U.S. citizenship. Do not include native residents of a U.S. possession, such as American Samoa. Applicants for U.S. citizenship are to be considered as "FOREIGN" until the date their citizenship becomes effective.

PART-TIME GRADUATE STUDENTS, item 6: A part-time graduate student is defined as a student who is enrolled in a master's or Ph.D. program, who is NOT pursuing graduate work full time as defined above in item 5. Please report the total number of women enrolled part time in column D. If your department has no part-time graduate students, write "NONE" in item 6 and move to item 7.

POSTDOCTORALS AND/OR RESEARCH ASSOCIATES, item 7: Under this category, include individuals with science or engineering doctorates or M.D.'s (including foreign degrees that are equivalent to U.S. doctorates) who devote FULL TIME to RESEARCH activities or study in the department under temporary appointments carrying no academic rank. Such appointments are usually for a SPECIFIC TIME PERIOD. They may contribute to the academic program through seminars, lectures, or working with graduate students. Their postdoctoral activities have an element of additional training for them. Exclude medical residents, unless RESEARCH TRAINING under the supervision of a Senior Mentor is the PRIME PURPOSE of the appointment. Under column (A) enter the number of fellows and trainees receiving support under Federal training grants and/or fellowships. Under column (B) enter the number of research associates appointed with Federal support. Those remaining appointees with non-Government support are to be entered under column (C). Of the total in column (D), enter in column (E) the number of postdoctorals with FOREIGN citizenship.

Fields of Science

This form is being mailed to all institutions of higher education in the United States that confer doctorate-level degrees in the sciences and/or engineering, and to all medical schools contributing to the training of science master's and Ph.D. candidates and postdoctorals. Please return the completed forms for each graduate department in your institution represented by the following fields:

Engineering

Aeronautical
Agricultural
Architectural
Biomedical
Chemical
Civil
Electrical
Engineering sciences
Industrial
Mechanical
Metallurgical
Mining
Nuclear
Petroleum
Other engineering

Physical Sciences

Astronomy
Chemistry
Physics
Other physical sciences

Environmental Sciences

- Atmospheric sciences
- Geosciences
- Oceanography
- Other environmental sciences

Mathematical Sciences

- Applied mathematics and computer sciences
- Mathematics
- Statistics

Life Sciences

- Agriculture
- Biological sciences
  - Anatomy
  - Biochemistry
  - Biology
  - Biometry and biostatistics
  - Biophysics
  - Botany
  - Cell biology
  - Ecology
  - Entomology and parasitology
  - Genetics
  - Microbiology
  - Nutrition
  - Pathology
  - Pharmacology
  - Physiology
  - Zoology
  - Other biosciences
- Other life sciences
  - Anesthesiology
  - Cardiology
  - Clinical medicine
  - Clinical pharmacology
  - Dental sciences
  - Endocrinology
  - Gastroenterology
  - Hematology
  - Neurology
  - Nursing
  - Obstetrics and gynecology
  - Ophthalmology
  - Otorhinolaryngology
  - Pediatrics
  - Pharmaceutical sciences
  - Preventive medicine, community and public health
  - Psychiatry
  - Pulmonary disease
  - Radiology
  - Speech pathology and audiology
  - Surgery
  - Veterinary sciences
  - Other health related sciences

Psychology

- Clinical psychology
- Experimental psychology
- Human development
- Physiological psychology
- Social psychology
- Other psychology

Social Sciences

- Agricultural economics
- Anthropology
- Economics (except agric.)
- Geography
- History and philosophy of science
- Linguistics
- Political science
- Public administration
- Social work
- Sociology
- Urban planning
- Other social sciences

PLEASE EXCLUDE FROM YOUR RESPONSE ALL GRADUATE DEPARTMENTS IN THE FIELDS OF EDUCATION, LAW, HUMANITIES, MUSIC, THE ARTS, PHYSICAL EDUCATION, LIBRARY SCIENCE, AND ALL OTHER NONSCIENCE FIELDS.

Form 812 is to be returned to each institution's Survey Coordinator for transmittal by January 31, 1978 to:

Tele Sec Data Preparation Division
1725 K Street, N.W., Suite 16
Washington, D.C. 20006

Thank you very much for your cooperation.

Office of Program Planning and Evaluation
National Institutes of Health
Bethesda, Maryland 20014

Division of Science Resources Studies
National Science Foundation
Washington, D.C. 20550

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other science resources publications

Reports

Reports	NSF No.	Price
Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1978	80-312	In press
Projections of Science and Engineering Doctorate Supply and Utilization, 1982 and 1987	79-303	$2.25

Detailed Statistical Tables

Research and Development in Industry, 1978. Funds, 1978; Scientists and Engineers, January 1979	80-307	—
Employment of Scientists, Engineers, and Technicians in Manufacturing Industries, 1977	[illegible]	—
Academic Science: Scientists and Engineers, January 1979	79-328	—
Characteristics of Experienced Scientists and Engineers, 1978	79-322	—
Academic Science: R&D Funds, Fiscal Year 1978	79-320	—
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