R E P O R T R E S U M E S

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REVIEWS OF DATA ON SCIENCE RESOURCES.
NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C.
REPORT NUMBER NSF-66-27 PUB DATE AUG 66
EDRS PRICE MF-$0.25 HC-$0.88 20P.

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Reviews OF DATA ON SCIENCE RESOURCES

NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C., 20550 • NSF 66-27 • No. 9, August 1966

Resources for Scientific Activities at Universities and Colleges, 1964

A PRELIMINARY REPORT OF A SURVEY OF 1964 EXPENDITURES AND JANUARY 1965 EMPLOYMENT IN THE SCIENCES AND ENGINEERING [1]

Highlights

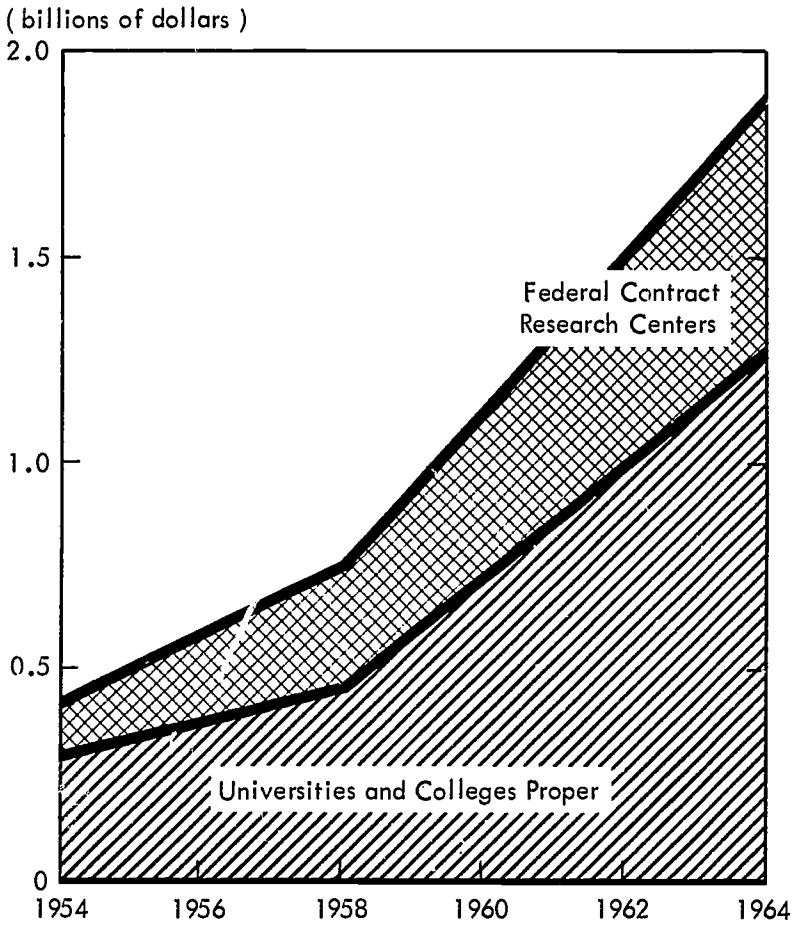
Current expenditures for separately budgeted research and development performed in institutions of higher education totaled $1.9 billion in 1964. Of this total, universities and colleges proper accounted for 68 percent ($1.3 billion); university-managed Federal contract research centers for the remainder ($590 million).

The Federal Government financed nearly three-fourths (72 percent) of the separately budgeted R&D performance in universities and colleges proper and virtually all the R&D performance in Federal contract research centers in 1964.

During 1954–64, separately budgeted R&D expenditures in universities and colleges proper increased from $290 million to $1.3 billion (chart 1), or at a rate of 16 percent per year. R&D expenditures in university-managed Federal contract research centers increased from $130 million to $590 million during this period, also at an annual rate of 16 percent.

[1] See Definitions and Terminology at the end of this report for explanations of terms.

Chart 1. Current Expenditures for Separately Budgeted Research and Development in Universities and Colleges, 1954–64



Source: National Science Foundation (table A)

Federally financed R&D expenditures increased from 55 percent of the total in universities and colleges proper in 1954 to 72 percent in 1964. The Federal Government financed virtually all of the R&D expenditures of university-administered Federal contract research centers throughout the period.

Universities and colleges account annually for nearly one-half of the basic research performed in the United States, measured in dol-

lar terms.[2] This is attributable to the heavy orientation of universities and colleges proper toward projects concerned with advancing the frontiers of knowledge. About four-fifths of their R&D expenditures were allocated to basic research in 1964, compared with one-fourth in Federal contract research centers (chart 2). The research centers on the other hand allocated 40 percent of their R&D expenditures to development, while universities and colleges proper allocated only 3 percent.

Universities and colleges employed 261,000 scientists and engineers in January 1965. This total included 158,900 full-time scientists and engineers, 41,000 part-time scientists and engineers, and 61,100 graduate students employed part time as scientists and engineers.

Nearly all of the scientists and engineers (250,000, or 96 percent of total) were employed in universities and colleges proper, with the remaining 11,000 (4 percent) employed in Federal contract research centers.

[2] National Science Foundation, *Reviews of Data on Research & Development,* No. 41, "National Trends in R&D Funds, 1953–62". Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, September 1963, p. 5.

In terms of full-time equivalents, the universities and colleges proper employed 192,600 scientists and engineers in January 1965. In aggregate, the full-time-equivalent number of scientists and engineers were distributed among principal functions as follows: Teaching, 61 percent; research and development, 29 percent; and other activities, 10 percent.

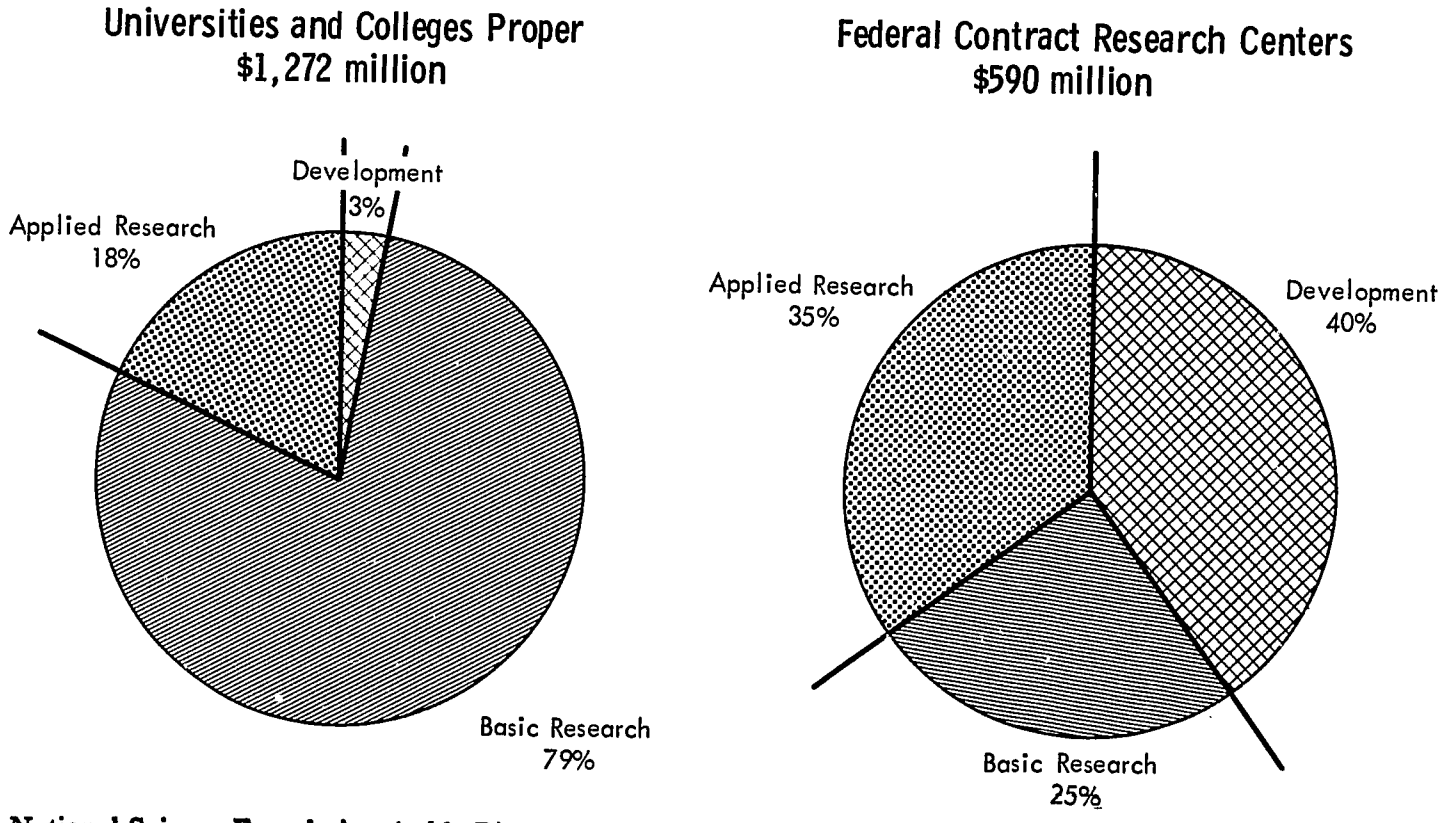
The employment of scientists and engineers in universities and colleges proper increased from 148,800 in March 1958 to 250,000 in January 1965, or at an annual rate of 8 percent. This rate of increase was double the comparable rate in Federal contract research centers, where employment increased from 8,400 in March 1958 to 11,000 in January 1965.

The full-time-equivalent number of scientists and engineers in all scientific activities in universities and colleges proper increased from 119,500 in March 1958 to 192,600 in January 1965. This 7-percent annual rate of increase for all activities was identical with the rate for those in research and development in these institutions.

Scope and Method

This preliminary report of the Survey of Scientific Activities of Institutions of Higher Education, 1963–64, is part of the National Science Foundation's program of periodic surveys to provide comprehensive

Chart 2. Distribution of Current Expenditures for Separately Budgeted Research and Development in Universities and Colleges, by Character of Work, 1964



Source: National Science Foundation (table B)

financial and manpower data on scientific activities of government, industry, and nonprofit organizations.

Preliminary estimates are presented for selected data, such as current expenditures for separately budgeted research and development and the numbers of scientists and engineers employed by universities and colleges. The final report on the survey, to be issued later, will present a more comprehensive and detailed analysis.

The survey covered 1,942 institutions with programs in the sciences and engineering. They included all institutions listed in the U.S. Office of Education's *Directory, Higher Education, Part 3, 1963–64,*[3] except for about 250 independent schools of music, art, theology, law, and other specialized institutions that do not normally maintain science and engineering programs. Each institution in the United States and its territories was asked to provide information on the scientific activities of all its branches and other units, both on and off the main campus.

Graduate-degree-granting institutions were asked to complete relatively detailed questionnaires, while liberal arts and junior colleges and institutions not granting graduate degrees received questionnaires requesting similar but less detailed information on their scientific activities. Institutions with medical schools, agricultural experiment stations, or Federal contract research centers were asked to provide separate data for these organizations.

Questionnaires were mailed to 1,942 institutions in February 1965, followed by mailings to nonrespondents in May 1965 and July 1965. Field visits to certain academic institutions and telephone followups to institutions that submitted incomplete reports continued up to December 15, 1965, the cutoff date for this report.

Of the 1,942 universities and colleges, 1,600 (82 percent) returned usable questionnaires. To estimate the data for the nonresponding institutions as well as for institutions that did not submit complete reports, published and unpublished data from the following sources were used: U.S. Office of Education; the American Council of Education; Federal agencies' reports of their obligations for research and development to educational institutions; and the academic institutions' own bulletins, catalogs, and financial reports.

[3] U.S. Department of Health, Education, and Welfare, Office of Education, *Education Directory, 1963–64, Part 3. Higher Education,* OE–50000–64. Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1964.

As requested, the universities and colleges reported financial data for academic year 1963–64 relating to their current expenditures for separately budgeted research and development. To facilitate the identification of annual statistics, financial data for academic year 1963–64 are shown in this bulletin as "1964." Financial data shown for 1953–54 and 1957–58 are shown as 1954 and 1958, respectively. Data relating to employment in the sciences and engineering were reported as of January 1965.

Academic institutions in this study are classified under two major categories, *universities and colleges proper* and *university-managed Federal contract research centers.* The first includes all organizational units owned, operated, or controlled by such institutions,[4] except Federal contract research centers. The second category consists of university-managed R&D organizations exclusively or substantially financed by the Federal Government.

Limitations. As the survey covered all 1,942 universities and colleges that were known or thought to have science and engineering programs, estimates are not subject to a sampling error. Estimates are, however, subject to limitations attributable to such factors as survey nonresponse or failure of respondents to interpret or apply survey definitions in the same way. Since the 342 nonrespondents were mostly institutions with relatively small science and engineering programs, errors attributable to estimating for nonresponse are believed to be also small (less than 1 percent of national aggregates). In all cases of nonresponse, available secondary sources of information were used in estimating magnitudes for survey data. Estimates also were made for nonresponse to items on individual questionnaires. Thus, data presented in this report represent, within reasonable error limits, totals for the higher education sector of the economy.

Current expenditures for separately budgeted research and development include the direct and indirect costs associated with the conduct of R&D projects separately organized, financed, and identified in the institutions' financial records. Included are wages and salaries, supplies and materials, and other direct and indirect costs.[5] These R&D projects are financed

[4] The definition of universities and colleges proper used in the 1963–64 survey differs from that in previous NSF surveys, which did not define agricultural experiment stations as part of universities and colleges proper. See Definitions and Terminology at the end of this report.

[5] These data do not include *unreimbursed indirect costs.* This is because a large number of respondent institutions reported that indirect costs incurred on research projects were not fully reimbursed by sponsors, but failed to report data on such costs. Estimates of unreimbursed costs will be presented in a final report on this survey, to be issued later.

by the various agencies of the Federal Government, industrial firms, nonprofit organizations, State and local governments, and others by grants, contracts, and restricted gifts. Institutions themselves financed less than 5 percent of this separately budgeted research and development.

It should be noted that data on current R&D expenditures shown here do not include expenditures for departmental research, which is carried out in universities and colleges as part of the normal workload of their faculty and other professional staff. This type of research is performed in institutions both with and without separately budgeted R&D projects. Because departmental research is financed jointly with instruction through budgetary allocations for "instruction and departmental research," the relative costs of the two activities are not readily available in financial records of universities and colleges. Estimates of current expenditures for departmental research will be presented in the final report of the survey, to be issued later.

Perhaps, the main limitation of statistical measures of scientific activities results from difficulties encountered by respondents in interpreting and applying survey definitions. Records available at many of the institutions do not yield exact information on financial and manpower resources allocated to "scientific activities," as defined for survey purposes. If exact information was not available, respondents were asked to supply estimates. The degree of accuracy of estimates no doubt varied somewhat. The magnitude of response error attributed to respondent's lack of records and to difficulties in interpreting or applying survey definitions can not be precisely estimated. However, institutional accounting procedures, particularly in universities with large science and engineering programs, yield relatively accurate data on the disposition of restricted funds, such as separately budgeted research and development.

Universities and Colleges Proper [6]

R&D Expenditures. The growth in importance of R&D activities in universities and colleges proper is shown in greatly increased outlays for such activities over the past decade. From 1954 (when the National Science Foundation began this series of surveys) to 1964, separately budgeted R&D expenditures in universities and colleges proper increased from $290 million to $1.3 billion, or at an annual rate of 16 percent. During the same decade Federal support for these R&D activities increased at an annual rate of 19 percent, from $160 million to $917 million. This relative increase in Federal R&D financing during the period was appreciably higher than the 11-percent average increase from other sources (table A).

Institutions with graduate programs in the sciences and engineering accounted for 99 percent of the $1.3 billion current expenditures for research and development in universities and colleges proper in 1964. Other institutions of higher education that do not grant graduate degrees in the sciences and engineering accounted for R&D expenditures of only 1 percent of the total. The heavy concentration of R&D activities in graduate-degree granting institutions is attributable to having the scientific and engineering personnel and the facilities required for such activities. Moreover, the necessary relationship between research and graduate education, particularly in the sciences and engineering, largely explains why graduate-degree-granting institutions, with few exceptions, perform separately budgeted research and development.

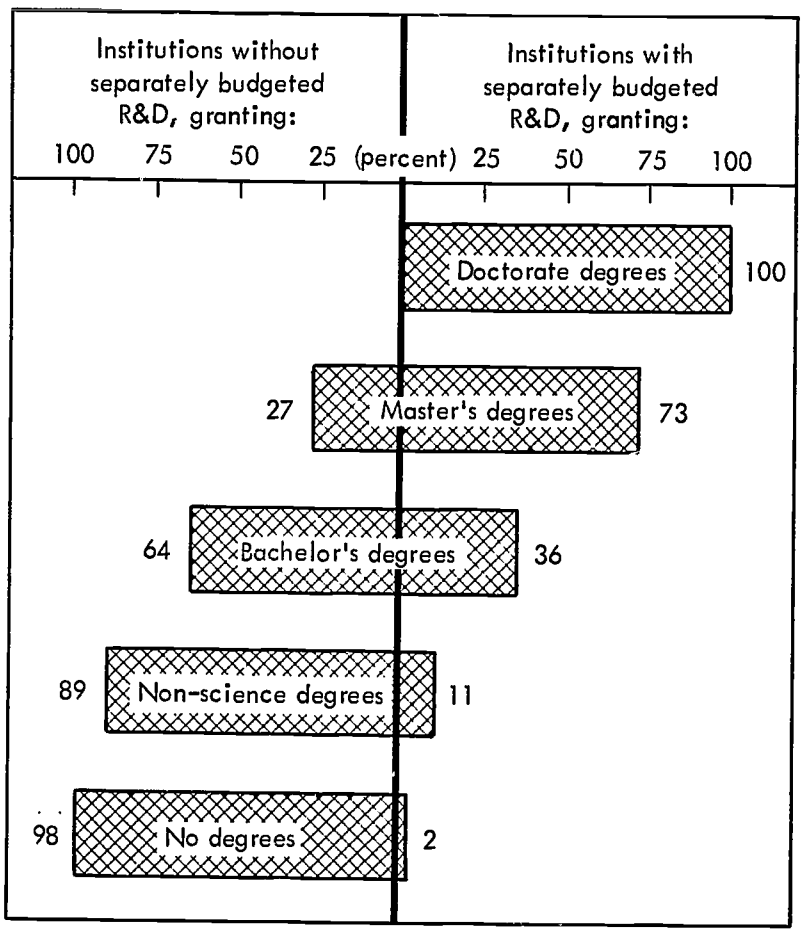
It should be noted that medical schools and agricultural experiment stations together accounted for $560 million in separately budgeted R&D expenditures, or 44 percent of the total for universities and colleges proper in 1964. The fact that the 89 medical schools and all but 1 of the 59 agricultural experiment stations [7] were parts of graduate-degree-granting institutions contributed to the concentration of R&D activities in such institutions. As noted later in this bulletin, the relatively heavy orientation of scientific activities of universities and colleges proper toward the life sciences results mainly from predominance of medical science activities in medical schools, and of agricultural science activities in agricultural experiment stations.

Number of Institutions With Separately Budgeted Research and Development. The relative number of institutions that performed separately budgeted research and development in 1964 varied directly with the level of degrees offered in the sciences and engineering (chart 3). The proportions of these institutions in various degree-granting categories ranged from 100 percent of the doctorate-granting institutions and 73 percent of those offering master's degrees (but not doctorates) down to 2 percent of the junior colleges and other non-degree-granting institutions. Of the 1,942 institutions in this survey, 636 (33 percent) had separately budgeted R&D expenditures in 1964.

[6] See Definitions and Terminology.

[7] Includes affiliated colleges of agriculture and agricultural extension services; see Definitions and Terminology.

Chart 3. Distribution of Universities and Colleges Performing Separately Budgeted Research and Development, by Level of Degrees Granted, 1964 [a]



[a] Universities and colleges were classified on the basis of highest level of degrees granted in the sciences and engineering.

Source: National Science Foundation.

The Federal Government financed R&D performance in 561 of the 636 universities and colleges reporting separately budgeted research and development (table B). As might be expected, institutions granting graduate degrees in the sciences and engineering received relatively more Federal R&D support than did others. All medical schools and agricultural experiment stations performed federally financed research and development.

Sources of R&D Support. Research and development constitute the part, among the various activities carried out by institutions of higher education, in which Federal financing plays a predominant role. In 1964, Federal R&D support to universities and colleges proper totaled $917 million; all other sources of support together accounted for $355 million (table B).

The principal sources of non-Federal support were State and local governments ($173 million), foundations and voluntary health agencies ($61 million), institutions' own funds ($59 million), and industry ($40 million). It should be noted that "sources of funds," as defined here, refers to immediate sources rather than ultimate sources of funds concerned. For example, a foundation was identified as the source of support if it financed research through a restricted gift or grant even though an industrial concern may have been the source of all or part of the foundation's funds.

Character of Work. Basic research expenditures totaling $1.0 billion comprised 79 percent of the $1.3 billion total separately budgeted R&D performance in 1964 (chart 2). Applied research and development amounted to 18 percent and 3 percent, respectively.

Geographic Distribution of R&D Expenditures. Although R&D activities are carried on in universities and colleges throughout the country, there is considerable variation in the size of programs among educational institutions. By and large, institutions with large programs in the sciences and engineering accounted for large shares of R&D activities. That these institutions are not evenly distributed among geographic areas is the main reason for the regional variations in the dollar amounts of R&D performance.

Institutions located in the Middle Atlantic division expended $257 million, or 20 percent, of the $1.3 billion total separately budgeted R&D expenditures in universities and colleges proper. Ranked next were institutions in the East North Central and Pacific divisions. These three divisions together accounted for more than one-half of the 1964 total separately budgeted R&D expenditures and also for more than one-half of the Federal part of that total.

The distribution of R&D expenditures by geographic division nearly parallels the distribution of certain educational variables, such as doctorate degrees awarded and graduate enrollment in the sciences and engineering (table 1). Thus, the three geographic divisions that ranked highest in separately budgeted R&D expenditures also ranked highest in the two educational variables, accounting for more than one-half of each. Similarly, the three divisions that ranked lowest in separately budgeted R&D expenditures also ranked lowest in doctorates awarded and in graduate enrollment in the sciences and engineering.

Federally financed research and development constituted 72 percent of the total in universities and colleges proper. In each of the geographic divisions, the Federal Government financed three-fifths or more of the separately budgeted R&D activities (chart 4). The federally financed share was highest in the New England (81 percent) and Middle Atlantic divisions (77 percent).

TABLE 1. PERCENT DISTRIBUTION OF SELECTED R&D AND EDUCATIONAL VARIABLES IN UNIVERSITIES AND COLLEGES PROPER, BY GEOGRAPHIC DIVISION

Geographic division	Separately budgeted R&D expenditures, 1964		Doctorates awarded in the sciences and engineering, 1963–64 *	Graduate enrollment in the sciences and engineering, fall 1963 *
	Total	Federally financed		
Total	100.0	100.0	100.0	100.0
New England	11.5	12.9	10.6	7.6
Middle Atlantic	20.2	21.6	18.8	23.0
East North Central	18.1	18.8	25.0	19.4
West North Central	7.2	6.3	9.6	8.2
South Atlantic	11.5	10.8	9.5	10.4
East South Central	3.5	3.1	2.4	2.9
West South Central	6.2	5.4	6.1	7.4
Mountain	5.8	5.1	3.4	5.2
Pacific	15.4	15.5	14.6	15.8
Territories	.5	.4	----------	.1

* Source: U.S. Office of Education.
NOTE: Percent detail may not add to 100 because of rounding.

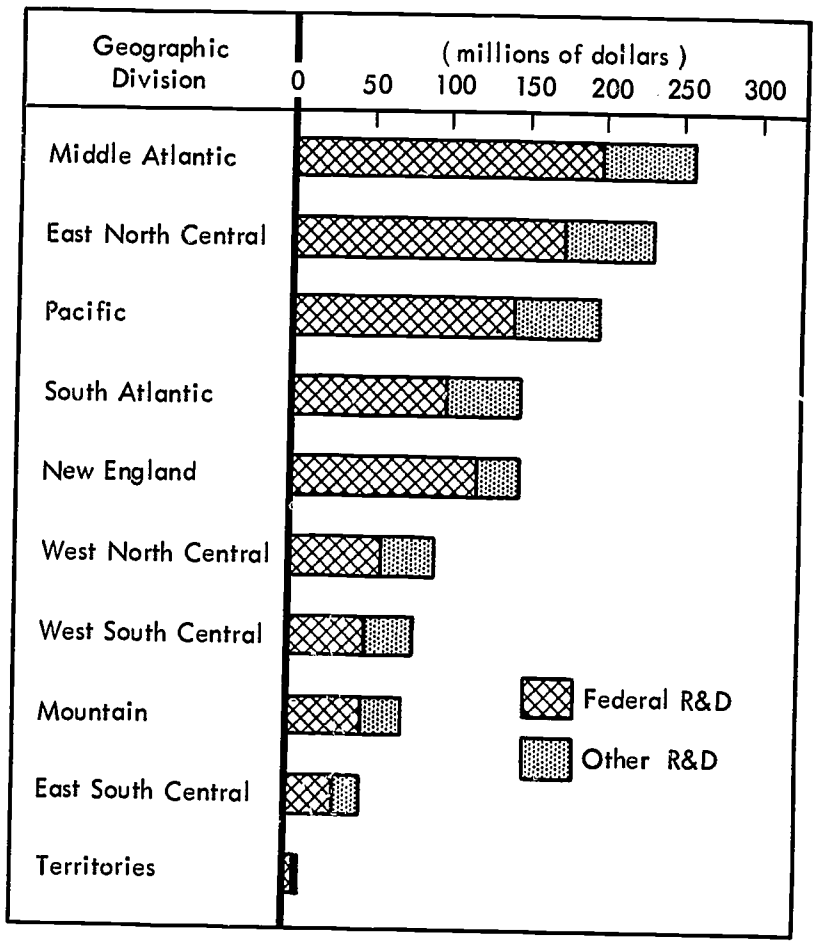
When distributed among individual States, separately budgeted research and development in universities and colleges proper ranged from $150 million in New York to below $3 million in the States of Maine, Nevada, Vermont, and Delaware (table C). Universities and colleges located in 10 leading States accounted for about three-fifths of the total and for about two-thirds of the Federal part of that total.

Research Expenditures, by Field of Science. Basic and applied research accounted for almost all of the separately budgeted R&D expenditures in universities and colleges proper. More than one-half ($660 million) was expended in the life sciences; nearly one-fourth ($294 million) in the physical sciences; and the remainder in engineering, social sciences, psychology, and other sciences (chart 5).

The relatively large share of research expenditures in the life sciences results mainly from their importance in medical schools and agricultural experiment stations (table D). Together they accounted for 79 percent of research expenditures in the life sciences in universities and colleges proper. Medical schools accounted for 85 percent of the research expenditures in the medical sciences; agricultural experiment stations for 91 percent of research in the agricultural sciences, and together for 56 percent of the research in the biological sciences.

Employment of Scientists and Engineers. From 1958 to 1965, the number of full-time and part-time scientists and engineers and graduate students employed in all activities by universities and colleges proper increased from 148,800 to 250,000 or at an annual rate of 8 percent. In full-time-equivalent terms scientists and engineers employed both in all activities and in research and development increased at an annual rate of 7 percent during the same period (table E).

Chart 4. Current Expenditures for Separately Budgeted Research and Development in Universities and Colleges Proper, by Geographic Division and Source of Funds, 1964



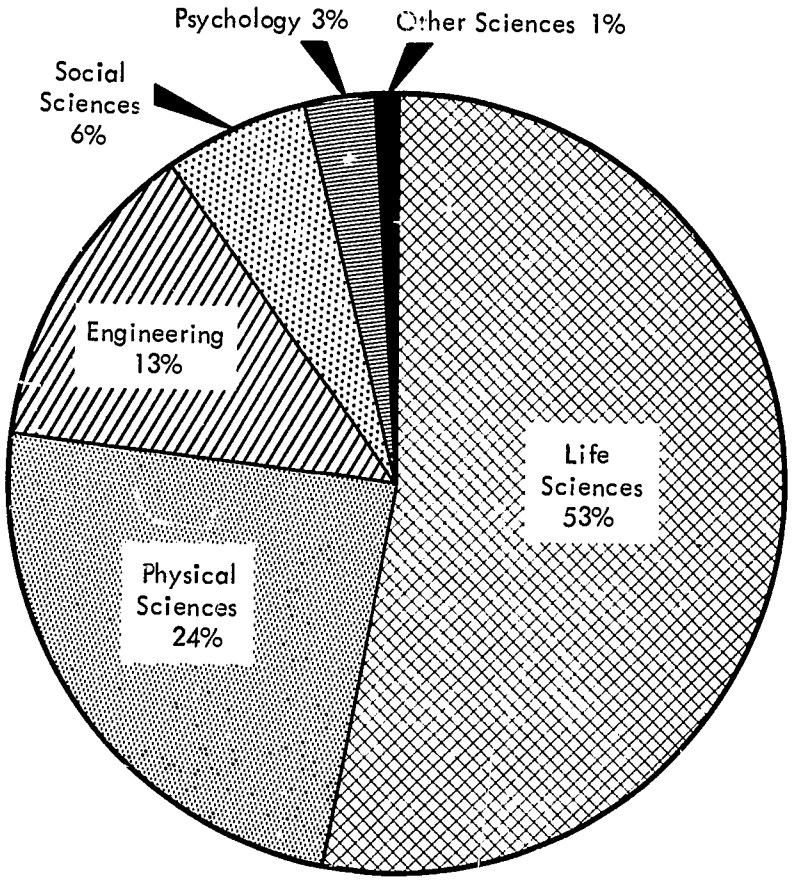
Source: National Science Foundation (table C).

In January 1965, universities and colleges proper employed 250,000 scientists and engineers in all activities. Of these, 60 percent were employed full time, 16 percent were part time, and 24 percent were employed graduate students. Graduate-degree-granting institutions accounted for 210,300 scientists and engineers, or 84 percent of the total.

Of these full-time and part-time scientists and engineers, including graduate students, 40 percent were life scientists; 25 percent, physical scientists; 16 percent, social scientists; and 13 percent, engineers (chart 6). As noted earlier in regard to research expenditures in the life sciences, medical schools and agricultural experiment stations also employed a relatively large proportion of the life scientists in universities and colleges (69 percent).

Chart 5. Distribution of Current Expenditures for Separately Budgeted Research in Universities and Colleges Proper, by Field of Science, 1964

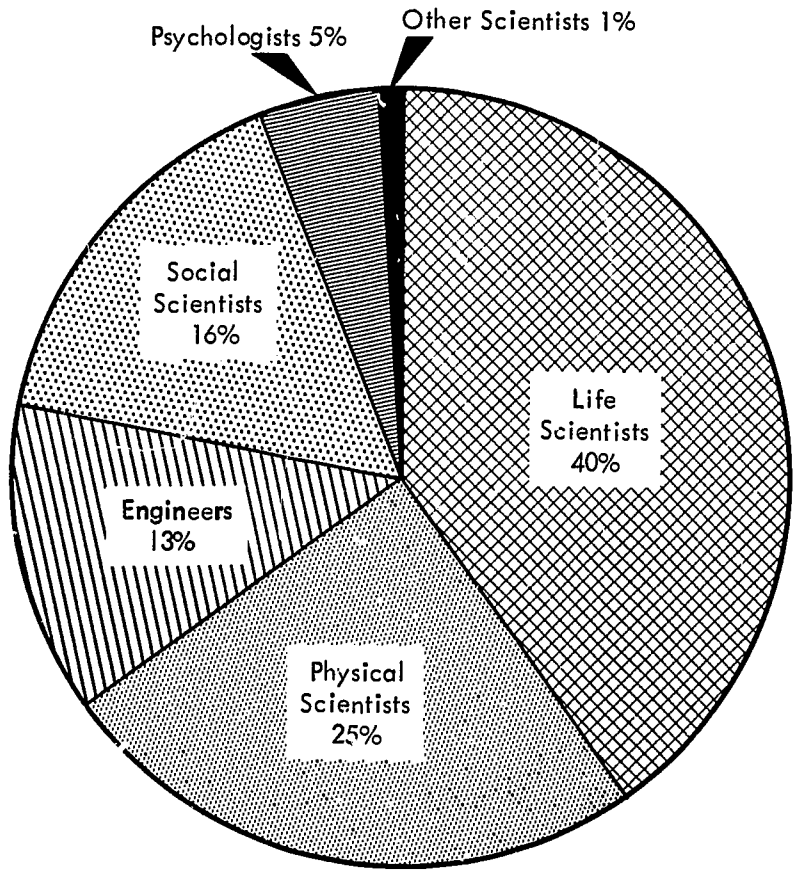
Research Expenditures - $1,235 million



Source: National Science Foundation (table D).

Chart 6. Distribution of Scientists and Engineers Employed in Universities and Colleges Proper, by Field, January 1965

Scientists and Engineers - 250,000



Source: National Science Foundation (table F)

In full-time-equivalent terms, universities and colleges proper employed 192,600 scientists and engineers in January 1965. Of these, 61 percent were employed in teaching, 29 percent in research and development, and 10 percent in other activities. Medical schools and agricultural experiment stations together accounted for 43 percent of the full-time-equivalent number of scientists and engineers employed in research and development.[8] Medical schools and agricultural experiment stations also accounted for 71 percent of the full-time-equivalent number of scientists and engineers employed in "other activities" in universities and colleges proper.

The relatively high proportion of scientists and engineers in "other activities" in medical schools results from the employment of scientists in administration; student health services; diagnosis and treatment of patients in offices, hospitals, clinics, and outpatient facilities; and other such activities. Agricultural experiment stations also employ a large number of scientists and engineers in administration as well as in agricultural demonstration work, non-degree-credit adult education, and other similar activities.

Geographic Distribution of Scientists and Engineers. The geographic distribution of scientists and engineers is influenced by various interrelated factors. However, the level of degrees offered in the sciences and engineering in a given locality is of prime importance. As noted, 84 percent of the 250,000 scientists and engineers in universities and colleges proper were employed in graduate-degree-granting institutions. Other relevant factors are the number of graduate and undergraduate students enrolled and the amount of research carried out in the sciences and engineering.

Also of some relevance is the size and location of medical schools and agricultural experiment stations, which together in January 1965 employed 29 percent of the scientists and engineers in universities and colleges proper (table 2). For example, medical schools accounted for relatively high proportions of the total employed scientists and engineers in universities and colleges proper of the territories (40 percent) and the

[8] As noted on page 4, medical schools and agricultural experiment stations accounted for 44 percent of the separately budgeted R&D expenditures in universities and colleges proper in 1964.

Middle Atlantic (30 percent) and South Atlantic divisions (25 percent), compared with only 11 percent in the Mountain division. Agricultural experiment stations accounted for 15 percent or more of the total scientists and engineers in the West North Central, East South Central, Mountain, and West South Central divisions, compared with 5 percent in New England and only 2 percent in the Middle Atlantic division.

TABLE 2. SCIENTISTS AND ENGINEERS EMPLOYED IN ALL ACTIVITIES BY UNIVERSITIES AND COLLEGES PROPER, MEDICAL SCHOOLS, AND AGRICULTURAL EXPERIMENT STATIONS, BY GEOGRAPHIC DIVISION, JANUARY 1965

(Numbers in thousands)

Geographic division	Total, universities and colleges proper	Selected components			
		Medical schools		Agricultural experiment stations	
		Number	Percent of total	Number	Percent of total
Total	250.0	51.1	20	22.4	9
New Englaud	20.7	3.7	18	1.1	5
Middle Atlantic	49.1	14.7	30	1.0	2
East North Central	47.7	8.2	17	3.7	8
West North Central	22.8	4.8	21	3.4	15
South Atlantic	30.7	7.6	25	3.8	12
East South Central	10.7	2.0	19	1.6	15
West South Central	19.4	2.9	15	3.3	17
Mountain	12.2	1.3	11	1.9	16
Pacific	35.2	5.2	15	2.5	7
Territories	1.5	.6	40	.2	13

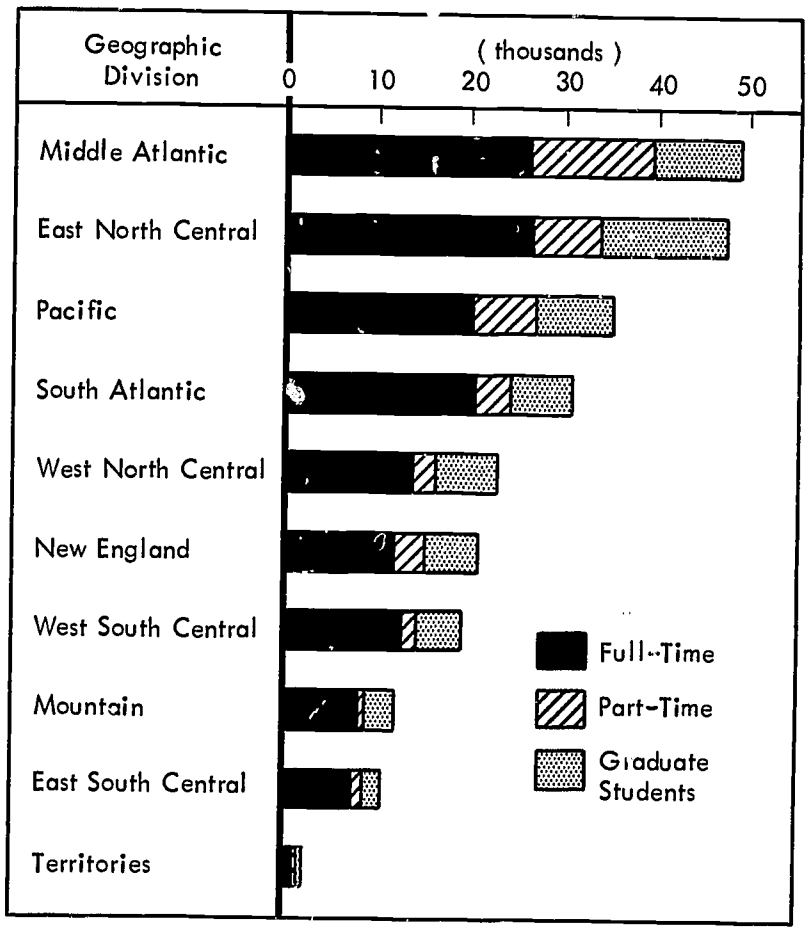
NOTE: Details may not add to totals because of rounding.

The geographic divisions leading in numbers of scientists and engineers employed in universities and colleges proper, as shown in chart 7, were the Middle Atlantic (20 percent of the total), East North Central (19 percent), and the Pacific (14 percent). States with the largest numbers of scientists and engineers were New York, California, Pennsylvania, Illinois, Massachusetts, Ohio, Michigan, and Texas. Table G shows for each State the number of scientists and engineers employed in universities and colleges proper in January 1965.

The pattern of full-time-equivalent number of scientists and engineers among geographic areas differs slightly from that of actual numbers. For example, the Middle Atlantic and East North Central divisions ranked first and second respectively in actual numbers of persons employed (chart 7), but their positions were reversed in full-time-equivalent terms (chart 8). This is because appreciably more part-time scientists and engineers were employed in the Middle Atlantic division than in the East North Central.

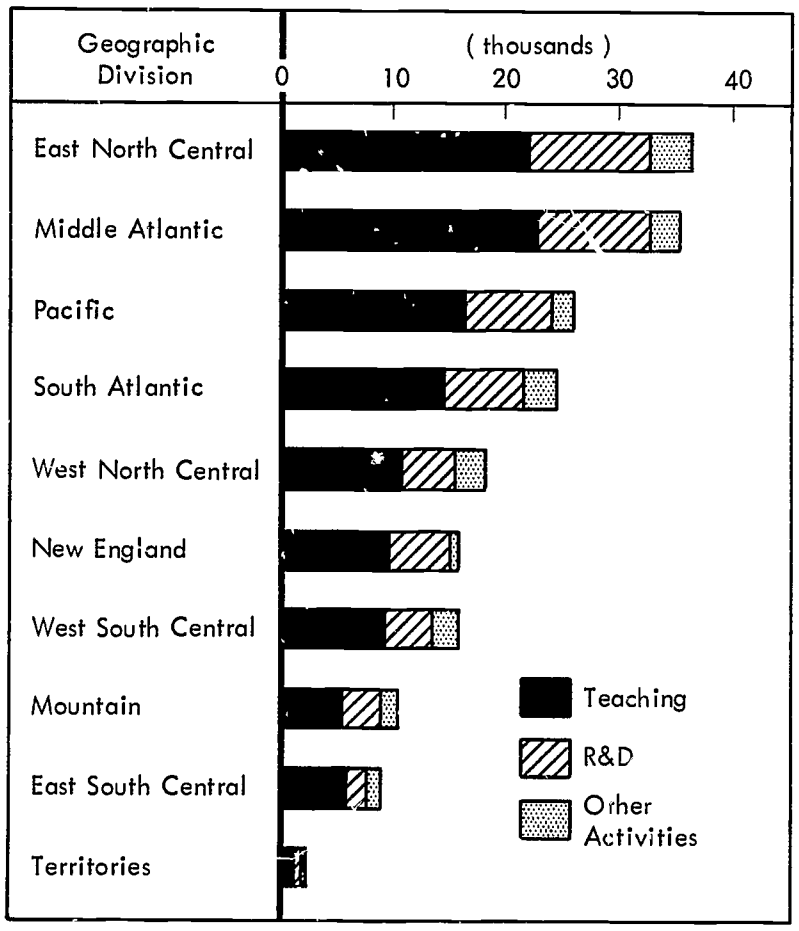
Table G shows State distribution of January 1965 full-time-equivalent employment, by principal function. This distribution of employment of all scientists and engineers in universities and colleges proper shows a rather close relationship with the distribution of R&D scientists and engineers employed there. Universities and colleges in the East North Central division ranked highest in the employment of scientists and engineers both in all activities and in research and development; universities and colleges located in the Middle Atlantic and Pacific divisions ranked second and third, respectively. These three divisions together accounted for roughly one-half the scientists and engineers employed by universities and colleges proper in all activities, in research and development, and in teaching. These three divisions also accounted for about one-half of the R&D expenditures.

Chart 7. Scientists and Engineers Employed in Universities and Colleges Proper, by Geographic Division and Employment Status, January 1965



Source: National Science Foundation (table G)

Chart 8. Full-Time-Equivalent Number of Scientists and Engineers Employed in Universities and Colleges Proper, by Geographic Division and Function, January 1965



Source: National Science Foundation (table G)

Medical Schools

In the past decade, significant changes have taken place in the scope and magnitude of scientific activities carried out in the Nation's medical schools. Population growth, increased personal income, and the spread of health insurance programs are among factors that have contributed to progressively increasing demands for medical and health services. Striking developments in the field of medicine in recent years include the rapid expansion of research funds available to medical schools and the corresponding growth of research programs in the medical sciences. Current expenditures for separately budgeted research and development in medical schools increased from about $45 million in 1954 [9] to $351 million in 1964.

The 89 medical schools operating in 1964, as pointed out earlier, account for a significant share of the scientific activities of universities and colleges proper, in terms of both financial and manpower resources. However, 10 States do not have medical schools. And since universities without them perform relatively little, if any, research in the medical sciences, this lack affects geographical distributions of expenditures and manpower in this field.

R&D Expenditures. Current expenditures for separately budgeted research and development in the Nation's 89 medical schools totaled $351 million in 1964, representing more than one-fourth of total R&D expenditures in universities and colleges proper. Of these R&D expenditures, basic research accounted for 86 percent; applied research, 13 percent; and development, 1 percent.

Medical schools received relatively more Federal support for R&D activities than did other organizational components of universities and colleges proper in 1964. The Federal Government financed 81 percent of the R&D expenditures of medical schools, compared with 69 percent in the rest of universities and colleges proper. The principal non-Federal sources of R&D support at medical schools were foundations, voluntary health agencies, and State and local governments (table B).

Almost all (99 percent) of the research expenditures of medical schools were for medical and biological sciences in 1964 (table D). Research expenditures in the medical sciences totaled $269 million, or 85 percent of medical science research in universities and colleges proper. The $76 million for biological science research in medical schools comprised 42 percent of the total for such research in universities and colleges proper.

Employment of Scientists in Medical Schools. In January 1965, medical schools employed 51,100 scientists in research, teaching, and other activities. Of these, 30,900 were employed full time, 16,000 were part time, and 4,200 were employed graduate students. In full-time-equivalent terms, employment of scientists by medical schools in all activities totaled 38,200. Of these, 42 percent were employed principally in teaching, 37 percent in research, and 21 percent in other activities (chart 9).

This functional distribution of scientists employed in medical schools differed somewhat from that in the rest of universities and colleges proper. The relatively large proportion engaged in research at medical schools (37 percent, compared with 26 percent for the rest of universities and colleges proper) reflects the heavy commitment of medical schools to research. As noted, medical schools accounted for 28 percent of

[9] National Science Foundation, *Scientific Research and Development in Colleges and Universities, 1953–54,* NSF 59–10. Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1959, p. 45.

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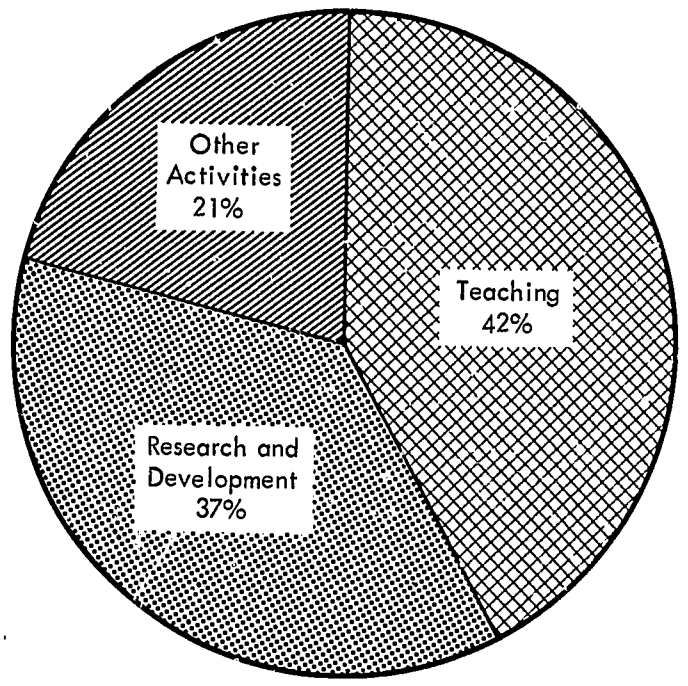
Chart 9. Distribution of Full-Time-Equivalent Number of Scientists Employed in Medical Schools, by Function, January 1965



Source: National Science Foundation (table F)

the 1964 R&D expenditures of universities and colleges proper. In January 1965, medical schools had 26 percent of the full-time-equivalent employment of R&D scientists and engineers in universities and colleges proper. The relatively large number of scientists in medical schools engaged in "other activities" points up the responsibilities of medical schools and their associated hospitals, clinics, bureaus, and centers for providing clinical services, patient care, and other community services.

Life scientists comprised 99 percent of the 51,100 scientists and engineers employed in medical schools in January 1965. Roughly four-fifths of the 50,400 life scientists in medical schools were medical scientists and most of the remainder were biologists.

Agricultural Experiment Stations and Schools of Agriculture

Agricultural experiment stations were established in large part as a result of the Hatch Act of 1887. There are 59 main stations today, with each State and the Commonwealth of Puerto Rico operating at least 1. The States of Connecticut, New York, and Ohio each operate two stations; Georgia and California operate three and four, respectively. Except for the New Haven, Conn., station,[10] all are organized as autonomous departments in State land-grant universities and colleges of which they are integral parts and in whose schools of agriculture most of their staff members hold faculty appointments. In the NSF surveys, therefore, all agricultural experiment stations have been treated as integral parts of universities and colleges.[11]

R&D Expenditures. Separately budgeted 1964 R&D expenditures in agricultural experiment stations and their affiliated schools of agriculture totaled $209 million, or 16 percent of all such expenditures in universities and colleges proper. The 1964 total represented a 70-percent increase since 1958, and 2½ times the amount for 1954.[12]

State governments financed 56 percent ($117 million) of the research and development performed in 1964 at agricultural experiment stations (chart 10). This represented 68 percent of all State and local government funds for R&D financing at universities and colleges proper. This support has been rapidly increasing in the past 30 years, reflecting interest by local authorities in agricultural research and education, which directly affect their commerce and standards of living. Federal R&D financing at agricultural experiment stations in 1964 totaled $71 million.

In contrast to medical schools and other components of universities and colleges proper where basic research expenditures predominated, agricultural experiment stations were heavily engaged in applied research in 1964. Of their $209 million total R&D expenditures, basic research accounted for 52 percent; applied research, 42 percent; and development, 6 percent.

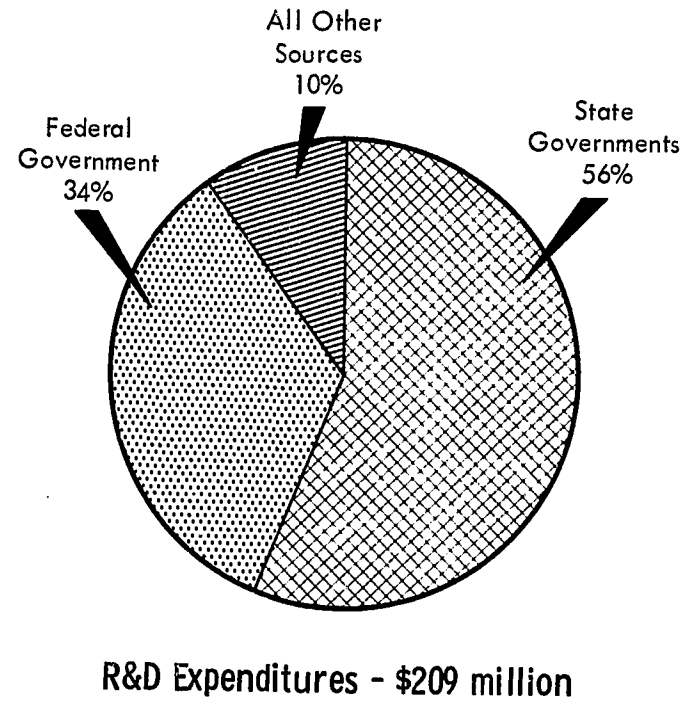
Employment of Scientists and Engineers. In 1965, agricultural experiment stations and affiliated schools of agriculture employed 22,400 scientists and engineers, approximately 9 percent of the total in universities and colleges proper. In full-time-equivalent terms, the total was 19,000, of which 9,400 were engaged in research and development, 3,500 in teaching, and 6,100 in "other activities." This functional distri-

[10] Knoblauch, H. C., et al., *State Agricultural Experiment Stations: A History of Research Policy and Procedure.* Miscellaneous Publication No. 904, U.S. Department of Agriculture, 1962, p. 22.

[11] To present complete data on agricultural experiment stations, this bulletin includes data for the New Haven, Conn., station which is not administered by an institution of higher education. Moreover, all agricultural experiment stations and their affiliated colleges of agriculture now are considered as parts of universities and colleges proper, as defined in this bulletin.

[12] National Science Foundation, *Scientific Research and Development in Colleges and Universities, 1958,* NSF 62–44. Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1962, p. 8.

Chart 10. Distribution of Current Expenditures for Separately Budgeted Research and Development Performed in Agricultural Experiment Stations, by Source of Funds, 1964



Source: National Science Foundation (table B)

bution delineates the basic missions of the stations and colleges in which R&D activities and "other activities" are important programs. "Other activities" are to a great extent performed by scientists and engineers as a part of the Agricultural Extension Service, which involves agricultural demonstration work, preparation of technical bulletins, adult education, and similar projects.

Faculty members of the agricultural schools normally also hold appointments with the stations and may engage in the extension services as well. This integration of research personnel in education and extension service activities was reflected by the strong State and local support of R&D activities just noted. Of the 22,400 scientists and engineers employed, 15,800 were full time; 1,200 were part time; and 5,400 were employed graduate students. This proportion of part-time to total professional employment was lower than in most components of the universities and colleges proper.

Table F shows the distribution of these scientists and engineers by field of discipline. Most (85 percent) were life scientists. The stations and colleges also employed small numbers of social scientists, engineers, and physical scientists. These life scientists were 19 percent of all life scientists employed by universities and colleges proper.

Federal Contract Research Centers

Federal contract research centers are R&D organizations that are exclusively or substantially financed by the Federal Government and in most instances were established to meet a particular R&D need of a Federal agency.[13] They are managed on a contractual basis by either profit or nonprofit organizations. This section concerns only 32 Federal contract research centers that were managed by individual educational institutions in 1964.[14] The Federal agencies sponsoring these centers are the Atomic Energy Commission, the Department of Defense, and the National Aeronautics and Space Administration.

R&D Expenditures. Separately budgeted R&D expenditures in Federal contract research centers increased from $130 million in 1954 to $590 million in 1964, an annual rate of 16 percent (table A).[15] The average rate of increase was the same as for separately budgeted R&D expenditures in universities and colleges proper during the period.

Of the amount expended for research and development in these research centers in 1964, 25 percent was allocated to basic research, 35 percent to applied research, and 40 percent to development. The Federal Government financed all but $1 million of these expenditures (table H).

Although Federal contract research centers performed most of the development in universities and colleges in 1964, they also expended $352 million for basic and applied research. As shown in table D, this research was distributed as follows: Physical sciences, 79 percent; engineering, 13 percent; life sciences, 7 percent; and psychology and social sciences combined, 1 percent.

R&D allocations, by character of work and field of science, in the Federal contract research centers differed markedly from those in the universities and col-

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[13] For additional information on Federal contract research centers see National Science Foundation, *Federal Funds for Research, Development, and Other Scientific Activities,* Volumes XII, XIII, and XIV. (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1964 and 1965.)

[14] This report does not cover the six Federal contract research centers managed by "University Consortia," which expended $58.2 million for research and development in 1964. Data for these centers will be included in the final report.

[15] These figures do not include current expenditures for R&D performance subcontracted to industrial firms by the Jet Propulsion Laboratory, a NASA-sponsored Federal contract research center managed by the California Institute of Technology.

leges proper, described on pages 5 and 6. The latter were almost exclusively performers of research, more than one-half of it in the life sciences. In contrast, Federal contract research centers allocated 60 percent of their R&D expenditures for research, largely in the physical sciences and engineering.

Geographic Distribution. University-managed Federal contract research centers are located in the four geographic regions as follows: 13 in the West, 9 in the Northeast, 5 in the North Central, and 5 in the South (including Puerto Rico). Data for the Puerto Rico Nuclear Center, managed by the University of Puerto Rico, was included in the Southern region so that geographical data could be shown without releasing information reported for an individual center (table H).

Although these individual centers vary in size, the geographic regions have approximately the same rank order in regard to the number of Federal contract research centers, expenditures for separately budgeted research and development, and the number of scientists and engineers employed, as follows:

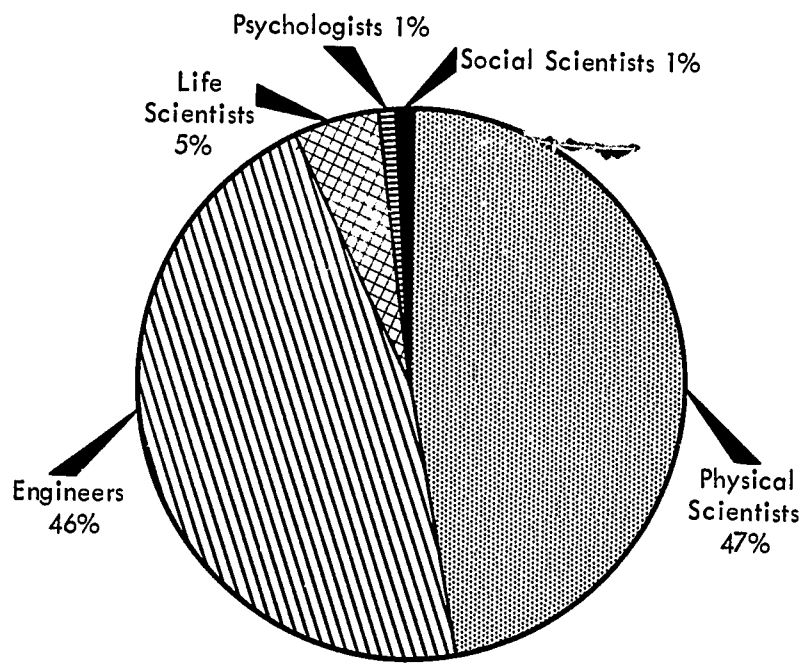
	Number of centers	*R&D expenditures, 1964 (millions of dollars)*	*Full-time-equivalent number of scientists and engineers, January 1965*
West	13	323	5,600
Northeast	9	140	2,400
North Central	5	72	1,500
South	5	55	1,100

Employment of Scientists and Engineers. The number of scientists and engineers employed in all activities by Federal contract research centers increased from 8,400 in 1958 to 11,000 in 1965. This 4-percent annual rate of increase was one-half of the 8-percent annual rate of increase in universities and colleges proper (table E).

Of the 11,000 scientists and engineers employed in all activities at these centers in 1965, 10,100 were full time, 200 were part time, and 700 were employed graduate students. The strong orientation of these centers toward R&D activities is illustrated by the small number, only 100, who were not employed in research and development.

The distribution of employment in these centers, by field of science, was as follows: Engineering, 5,100; physical sciences, 5,200; life sciences, 500; social sciences, 100; and psychology, 100 (chart 11). This distribution differed considerably from that shown for universities and colleges proper. For example, life scientists in universities and colleges proper accounted for 40 percent of the scientists and engineers, compared with 5 percent in Federal contract research centers. Further, physical scientists accounted for 25 percent and engineers for 13 percent of the total in universities and colleges proper, compared with 47 percent and 46 percent, respectively, in Federal contract research centers.

Chart 11. Distribution of Scientists and Engineers Employed in Federal Contract Research Centers, by Field, January 1965



NOTE: "Other Scientists" accounted for less than 0.5 percent.
Source: National Science Foundation (table F)

TABLE A. TRENDS IN CURRENT EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH AND DEVELOPMENT IN UNIVERSITIES AND COLLEGES, BY ORGANIZATIONAL COMPONENT AND SOURCE OF FUNDS, SELECTED YEARS, 1954, 1958, AND 1964[a]

Organizational component and source of funds	1954[b]	1958[b]	1964	Compound annual rate of increase, 1954–64
	Millions of dollars			Percent
Total	$420	$740	$1,862	16
Federal Government	290	540	1,506	18
Non-Federal sources	130	200	356	11
Universities and colleges proper	290	450	1,272	16
Federal Government	160	250	917	19
Non-Federal sources	130	200	355	11
Federal contract research centers	130	290	590	16
Federal Government	130	290	589	16
Non-Federal sources	(c)	(c)	1	(d)

[a] Excludes unreimbursed indirect costs and departmental research.
[b] Estimates were based on NSF surveys of universities and colleges conducted in 1954 and 1958. Figures were rounded to the nearest $10 million.
[c] Less than $5 million.
[d] Not available.

TABLE B. NUMBER OF UNIVERSITIES AND COLLEGES INCLUDED IN THE SURVEY AND SELECTED FINANCIAL CHARACTERISTICS OF SCIENTIFIC ACTIVITIES OF UNIVERSITIES AND COLLEGES WITH SCIENCE AND ENGINEERING PROGRAMS, BY ORGANIZATIONAL COMPONENT, 1964

Item	Total	Universities and colleges proper			Federal contract research centers	Selected components of universities and colleges proper	
		Total	Graduate-degree-granting institutions in the sciences and engineering	Other institutions		Medical schools	Agricultural experiment stations
Number of institutions in the survey	1,942	1,942	400	1,542	32	89	59
Number with separately budgeted research and development	636	636	341	295	32	89	59
Number with federally financed research and development	561	561	328	233	32	89	59
Separately budgeted research and development, 1964 (millions of dollars)	$1,862.3	$1,272.4	$1,259.6	$12.8	$589.9	$351.1	$208.7
Source of funds:							
Federal Government	1,506.0	917.3	907.3	10.0	588.7	284.0	71.0
State and local governments	173.2	173.2	172.7	.5	(a)	11.5	117.1
Foundations and voluntary health agencies	61.7	61.4	60.5	.9	.3	29.5	2.8
Industry	41.0	40.4	39.8	.5	.6	8.0	8.2
Institutions' own funds	59.1	58.9	58.0	.9	.2	9.4	6.7
Other sources	21.3	21.3	21.2	.1	(a)	8.6	2.9
Character of work:							
Basic research	1,147.6	1,003.0	994.0	8.9	144.6	300.2	108.8
Applied research	439.6	231.9	228.5	3.4	207.7	45.7	87.5
Development	275.3	37.6	37.1	.5	237.6	5.2	12.5

[a] Less than $50,000.

NOTE: Detail may not add to totals because of rounding.

TABLE C. GEOGRAPHIC DISTRIBUTION OF TOTAL AND FEDERALLY FINANCED CURRENT EXPENDITURES FOR SEPARATELY BUDGETED RESEARCH AND DEVELOPMENT IN UNIVERSITIES AND COLLEGES PROPER, 1964

(Dollar amounts in millions)

Area	Total	Federally financed	
		Amount	Percent of total
UNITED STATES, TOTAL	$1,272.4	$917.3	72.1
NORTHEAST	403.2	317.1	78.6
New England	146.1	118.6	81.2
Maine	2.7	1.5	55.6
New Hampshire	5.1	4.4	86.3
Vermont	2.9	2.3	79.3
Massachusetts	99.4	81.4	81.9
Rhode Island	8.9	7.7	86.5
Connecticut	27.0	21.3	78.9
Middle Atlantic	257.1	198.5	77.2
New York	149.5	120.3	80.5
New Jersey	36.6	23.4	63.9
Pennsylvania	71.0	54.8	77.2
NORTH CENTRAL	322.8	230.1	71.3
East North Central	230.7	172.3	74.7
Ohio	39.3	29.0	73.8
Indiana	26.5	19.3	72.8
Illinois	77.5	59.3	76.5
Michigan	52.2	42.5	81.4
Wisconsin	35.3	22.2	62.9
West North Central	92.0	57.8	62.8
Minnesota	23.4	17.1	73.1
Iowa	17.8	11.2	62.9
Missouri	22.8	14.9	65.4
North Dakota	3.6	1.9	52.8
South Dakota	3.6	2.2	61.1
Nebraska	7.0	3.0	42.9
Kansas	13.9	7.6	54.7
SOUTH	270.5	177.6	65.5
South Atlantic	146.2	99.2	67.9
Delaware	2.9	1.6	55.2
Maryland	36.0	28.7	79.7
District of Columbia	12.8	11.2	87.5
Virginia	14.1	9.3	66.0
West Virginia	$3.5	$1.9	54.3
North Carolina	27.1	18.2	67.2
South Carolina	4.7	2.6	55.3
Georgia	18.1	9.9	54.7
Florida	27.1	15.8	58.3
East South Central	45.0	28.6	63.6
Kentucky	8.7	4.8	55.2
Tennessee	18.6	13.0	69.9
Alabama	11.0	6.9	62.7
Mississippi	6.7	4.0	59.7
West South Central	79.3	49.8	62.8
Arkansas	6.6	3.4	51.5
Louisiana	18.2	11.7	64.3
Oklahoma	10.8	6.6	61.1
Texas	43.6	28.2	64.7
WEST	270.2	188.8	69.9
Mountain	73.7	47.0	63.8
Montana	3.8	1.6	42.1
Idaho	3.8	1.5	39.5
Wyoming	3.1	1.0	32.3
Colorado	20.3	15.9	78.3
New Mexico	14.6	11.4	78.1
Arizona	14.4	6.6	45.8
Utah	11.1	7.8	70.3
Nevada	2.6	1.2	46.2
Pacific	196.5	141.8	72.2
Washington	24.3	16.3	67.1
Oregon	15.8	10.8	68.4
California	144.8	108.3	74.8
Alaska	4.2	2.3	54.8
Hawaii	7.3	4.2	57.5
Territories	5.8	3.5	60.3

NOTE: Detail may not add to totals because of rounding.

TABLE D. CURRENT EXPENDITURES FOR SEPARATELY BUDGETED BASIC AND APPLIED RESEARCH IN UNIVERSITIES AND COLLEGES, BY FIELD OF SCIENCE AND ORGANIZATIONAL COMPONENT, 1964

(Millions of dollars)

Field of science	Total	Universities and colleges proper			Federal contract research centers	Selected components of universities and colleges proper	
		Total	Graduate-degree-granting institutions	Other institutions		Medical schools	Agricultural experiment stations
Total	$1,587.1	$1,234.8	$1,222.5	$12.3	$352.2	$345.9	$196.3
Engineering	202.1	156.6	155.8	.8	45.5	----	3.5
Physical sciences	570.7	293.5	289.5	4.0	277.2	(a)	3.6
Chemistry	109.7	68.5	67.0	1.6	41.2	(a)	3.1
Earth sciences	64.4	52.4	52.2	.2	11.9	----	.2
Physics	300.6	117.4	115.8	1.6	183.2	----	.1
Mathematics	46.9	28.3	27.8	.6	18.5	(a)	.2
Other physical sciences	49.2	26.8	26.8	.1	22.3	----	----
Life sciences	683.9	660.1	655.9	4.2	23.7	345.5	179.1
Agricultural sciences	162.9	161.9	161.9	(a)	1.0	----	146.8
Biological sciences	201.7	183.1	180.2	2.9	18.6	76.4	26.4
Medical sciences	319.2	315.1	313.8	1.3	4.1	269.0	5.9
Psychology	35.6	31.3	29.7	1.6	4.3	.4	.2
Social sciences	80.4	78.9	77.8	1.1	1.5	(a)	9.4
Other sciences	14.4	14.4	13.8	.6	----	----	.4

[a] Less than $50,000.

NOTE: Detail may not add to totals because of rounding.

TABLE E. TRENDS IN THE EMPLOYMENT OF SCIENTISTS AND ENGINEERS IN UNIVERSITIES AND COLLEGES, BY EMPLOYMENT STATUS AND ORGANIZATIONAL COMPONENT, SELECTED YEARS, 1958, 1961, AND 1965 [a]

(Thousands)

Employment status and organizational component	March 1958 [b]	March 1961 [b]	January 1965	Compound annual rate of increase, 1958–65 (percent)
SCIENTISTS AND ENGINEERS IN ALL ACTIVITIES	157.2	185.0	261.0	8
Universities and colleges proper	148.8	175.4	250.0	8
Federal contract research centers	8.4	9.6	11.0	4
Full-time-equivalent number in all scientific activities [c]	127.6	148.0	203.2	7
Universities and colleges proper	119.5	138.4	192.6	7
Federal contract research centers	8.1	9.6	10.6	4
Full-time-equivalent number in research and development [c]	42.0	52.0	65.4	7
Universities and colleges proper	33.9	42.7	54.9	7
Federal contract research centers	8.1	9.3	10.5	4

[a] Includes graduate students employed as scientists and engineers.

[b] Estimates based on NSF surveys of universities and colleges conducted in 1958 and 1961.

[c] Includes scientists and engineers working full time and the full-time-number equivalent of part-time scientists and engineers and graduate students employed as scientists and engineers.

TABLE F. SCIENTISTS AND ENGINEERS, BY EMPLOYMENT STATUS AND FIELD, AND FULL-TIME-EQUIVALENT NUMBER OF SCIENTISTS AND ENGINEERS, BY FUNCTION, IN UNIVERSITIES AND COLLEGES WITH SCIENCE AND ENGINEERING PROGRAMS, BY ORGANIZATIONAL COMPONENT, JANUARY 1965

(Thousands)

Item	Total	Universities and colleges proper			Federal contract research centers	Selected components of universities and colleges proper	
		Total	Graduate-degree-granting institutions in the sciences and engineering	Other institutions		Medical schools	Agricultural experiment stations
Scientists and engineers, total	261.0	250.0	210.3	39.8	11.0	51.1	22.4
Employment status:							
Full-time	158.9	148.8	118.1	30.6	10.1	30.9	15.8
Part-time	41.0	40.8	31.9	8.9	.2	16.0	1.2
Graduate students	61.1	60.4	60.2	.2	.7	4.2	5.4
Field:							
Engineers	37.4	32.4	28.2	4.1	5.1	(a)	.7
Physical scientists	67.6	62.4	49.6	12.7	5.2	.2	.4
Life scientists	101.2	100.7	93.6	7.1	.5	50.4	19.0
Psychologists	12.8	12.7	9.3	3.4	.1	.3	----
Social scientists	40.8	40.7	29.0	11.7	.1	.1	2.0
Other scientists	1.1	1.1	.5	.6	(a)	----	.3
Full-time-equivalent number of scientists and engineers, total	203.2	192.6	158.5	34.1	10.6	38.2	19.0
Function:							
Teaching	117.7	117.7	85.1	32.6	(a)	16.1	3.5
Research and development	65.4	54.9	54.3	.6	10.5	14.1	9.4
Other activities	20.0	19.9	19.1	.9	.1	8.0	6.1

[a] Less than 50.

NOTE: Detail may not add to totals because of rounding.

TABLE C. GEOGRAPHIC DISTRIBUTION OF SCIENTISTS AND ENGINEERS IN UNIVERSITIES AND COLLEGES PROPER, BY EMPLOYMENT STATUS AND FUNCTION, JANUARY 1965

(Thousands)

Area	Scientists and engineers				Full-time-equivalent numbers			
	Total	Full-time	Part-time	Graduate students	Total	Teaching	Research and development	Other activities
UNITED STATES, TOTAL	250.0	148.8	40.8	60.4	192.6	117.7	54.9	19.9
NORTHEAST	69.9	38.1	16.7	15.1	51.2	32.4	15.4	3.3
New England	20.7	11.9	3.4	5.5	15.8	9.5	5.6	.6
Maine	.8	.6	(a)	.1	.7	.5	.1	.1
New Hampshire	1.1	.8	.1	.3	.9	.5	.4	(a)
Vermont	1.0	.7	.2	.1	.8	.5	.2	.1
Massachusetts	12.6	6.8	2.2	3.6	9.4	5.8	3.4	.2
Rhode Island	1.4	.8	.1	.5	1.1	.7	.3	.1
Connecticut	3.9	2.3	.8	.8	2.9	1.6	1.2	.1
Middle Atlantic	49.1	26.2	13.3	9.6	35.4	22.8	9.8	2.7
New York	28.5	15.6	7.7	5.2	21.0	13.6	5.9	1.4
New Jersey	5.0	2.9	.9	1.2	3.9	2.5	1.2	.3
Pennsylvania	15.6	7.6	4.7	3.2	10.5	6.8	2.7	1.0
NORTH CENTRAL	70.5	40.6	9.6	20.3	54.3	32.7	15.2	6.4
East North Central	47.7	26.6	7.3	13.8	36.4	21.9	10.7	3.7
Ohio	11.9	7.2	2.0	2.7	9.2	5.8	1.9	1.5
Indiana	6.4	3.5	.3	2.6	4.9	3.4	1.4	.1
Illinois	12.8	6.9	2.2	3.7	9.6	5.2	3.5	1.0
Michigan	10.6	6.0	1.7	2.9	8.1	4.7	2.7	.7
Wisconsin	6.1	3.1	1.0	2.0	4.5	2.9	1.2	.4
West North Central	22.8	13.9	2.3	6.5	18.0	10.8	4.5	2.7
Minnesota	5.5	3.0	.6	1.9	4.2	2.5	1.3	.4
Iowa	5.1	3.3	.5	1.4	4.1	2.1	1.0	1.0
Missouri	4.7	2.8	.7	1.2	3.7	2.5	.9	.3
North Dakota	.7	.5	(a)	.1	.6	.4	.1	(a)
South Dakota	.8	.6	(a)	.2	.7	.5	.1	(a)
Nebraska	1.9	1.2	.2	.5	1.5	.9	.4	.2
Kansas	4.0	2.6	.3	1.2	3.1	1.8	.7	.7
SOUTH	60.7	40.8	6.8	13.1	49.5	30.0	12.7	6.8
South Atlantic	30.7	20.3	4.0	6.4	24.6	14.7	6.9	3.1
Delaware	.8	.3	(a)	.4	.6	.3	.2	(a)
Maryland	6.1	3.7	1.1	1.2	4.6	2.5	1.5	.6
District of Columbia	3.2	1.6	1.0	.6	2.1	1.2	.6	.2
Virginia	3.1	2.3	.3	.5	2.7	1.9	.6	.2
West Virginia	1.5	1.0	.1	.3	1.3	.8	.3	.1
North Carolina	5.3	3.6	.4	1.3	4.4	2.8	1.2	.4
South Carolina	1.8	1.2	.3	.4	1.4	.9	.2	.3
Georgia	3.9	3.1	.3	.6	3.4	1.8	.9	.7
Florida	5.0	3.4	.5	1.1	4.2	2.3	1.3	.5
East South Central	10.7	7.6	1.1	1.9	9.0	6.0	1.8	1.2
Kentucky	2.5	1.8	.2	.4	2.1	1.3	.5	.4
Tennessee	4.2	2.9	.5	.8	3.4	2.3	.5	.6
Alabama	2.0	1.4	.3	.3	1.8	1.4	.3	(a)
Mississippi	1.9	1.5	.1	.3	1.7	1.0	.5	.1
West South Central	19.4	12.9	1.6	4.9	15.8	9.3	4.0	2.5
Arkansas	1.6	1.3	.1	.3	1.4	.7	.4	.4
Louisiana	4.0	2.7	.4	.9	3.3	2.1	.7	.5
Oklahoma	3.2	1.9	.2	1.1	2.5	1.5	.6	.4
Texas	10.5	7.0	.9	2.6	8.6	5.0	2.3	1.2

See footnotes at end of table.

TABLE G. GEOGRAPHIC DISTRIBUTION OF SCIENTISTS AND ENGINEERS IN UNIVERSITIES, ETC.—Con.

(Thousands)

Area	Scientists and engineers				Full-time-equivalents numbers			
	Total	Full-time	Part-time	Graduate students	Total	Teaching	Research and development	Other activities
WEST	47.4	28.2	7.6	11.6	36.3	22.0	11.0	3.3
Mountain	12.2	8.1	.7	3.3	10.2	5.5	3.3	1.3
Montana	1.0	.7	.1	.2	.8	.4	.2	.2
Idaho	.8	.6	(a)	.1	.7	.4	.3	(a)
Wyoming	.4	.3	(a)	.1	.3	.2	.1	(a)
Colorado	3.6	2.6	.1	.9	3.1	1.9	.6	.6
New Mexico	1.3	.8	.1	.4	1.1	.5	.5	(a)
Arizona	2.4	1.3	.1	1.0	1.8	.9	.7	.2
Utah	2.3	1.5	.2	.6	2.1	1.0	.8	.3
Nevada	.4	.3	(a)	.1	.3	.2	.1	.1
Pacific	35.2	20.0	6.9	8.3	26.1	16.4	7.7	2.0
Washington	4.8	3.0	.4	1.4	3.8	2.2	.8	.7
Oregon	3.4	2.2	.2	.9	2.8	1.6	.9	.3
California	26.0	14.1	6.2	5.7	18.7	12.2	5.6	.9
Alaska	.3	.2	(a)	.1	.2	.1	.1	(a)
Hawaii	.8	.5	(a)	.2	.6	.3	.3	.1
Territories	1.5	1.1	.1	.3	1.3	.7	.5	.1

[a] Less than 50.

NOTE: Detail may not add to totals because of rounding.

TABLE H.—SELECTED FINANCIAL AND EMPLOYMENT CHARACTERISTICS OF SCIENTIFIC ACTIVITIES OF FEDERAL CONTRACT RESEARCH CENTERS ADMINISTERED BY UNIVERSITIES AND COLLEGES, BY REGION [a]

Item	Total	Region			
		Northeast	North Central	South [a]	West
Number of federal contract research centers	32	9	5	5	13
Separately budgeted research and development, 1964 (millions of dollars)	$589.9	$139.6	$72.3	$54.6	$323.4
Source of funds:					
Federal Government	588.7	138.5	72.3	54.6	323.4
Non-federal sources	1.2	1.2	(b)	(b)	(b)
Character of work:					
Basic research	144.6	45.6	30.6	4.8	63.5
Applied research	207.7	52.2	12.4	13.0	130.1
Development	237.6	41.9	29.3	36.7	129.8
Scientists and engineers, January 1965 (thousands)	11.0	2.5	1.6	1.1	5.8
Employment status:					
Full-time	10.1	2.3	1.4	1.1	5.3
Part-time	.2	(c)	(c)	(c)	.2
Graduate students	.7	.1	.2	(c)	.3
Full-time-equivalent number of scientists and engineers, January 1965 (thousands)	10.6	2.4	1.5	1.1	5.6
Function:					
Teaching	(c)	(c)	(c)	(c)	(c)
Research and development	10.5	2.4	1.5	1.1	5.6
Other activities	.1	(c)	(c)	(c)	(c)

[a] In this table, data for the Puerto Rico Nuclear Center, administered by the University of Puerto Rico, are included in the Southern region. Separately budgeted R&D expenditures at this relatively small contract center amounted to about one percent of the total shown for the Southern region.

[b] Less than $50,000.

[c] Less than 50.

Definitions and Terminology

Institutions of higher education include those universities and colleges listed in the U.S. Office of Education's *Directory, Higher Education, Part 3, 1963–64.* To be listed, an institution must offer at least a 2-year program of college-level studies in residence and meet certain criteria of eligibility for listing established by the U.S. Office of Education. Some minor differences in numbers of institutions shown in this bulletin and the *Directory* may be due to differing methods of counting separate campuses of multiunit institutions.

Classification of universities and colleges by highest degree granted in the sciences and engineering is based on the level of earned degrees granted by a particular institution during the 4-year period 1960–61 to 1963–64. For this report, all institutions granting the M.D. degree were included in the "doctorate-granting" category.

Universities and colleges proper include all organizational units owned, operated, or controlled by such institutions, except university-managed Federal contract research centers. Defined as part of universities and colleges proper are graduate schools, colleges of arts and sciences, engineering schools, medical schools, schools of dentistry, schools of agriculture, agricultural experiment stations, liberal arts colleges, teacher's colleges, junior colleges, and affiliated organizational units.

Agricultural experiment stations, as defined here, include all such stations and their branches established under the provisions of the Hatch Act of 1887, schools of agriculture in land-grant institutions that are affiliated with experiment stations, and agricultural extension services established under the provisions of the Smith-Lever Act of 1914.

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. Included are hospitals or clinics owned, operated, or controlled by universities and integrated operationally with the clinical programs of their medical schools. Also included are research bureaus or institutes that are integral parts of medical schools.

Federal contract research centers are R&D organizations exclusively or substantially financed by the Federal Government and managed on a contractual basis by educational or other organizations. Among the Federal contract research centers managed by institutions of higher education are the Jet Propulsion Laboratory, California Institute of Technology; Los Alamos Scientific Laboratory, University of California; and the Cornell Aeronautical Laboratory, Cornell University. It should be noted that classification of Federal contract research centers is reviewed annually by Federal agencies sponsoring such centers. This annual review occasionally results in changes in classification, as may be noted in listings in the National Science Foundation's annual publication, *Federal Funds for Research, Development, and Other Scientific Activities* (e.g., Vol. XIII, NSF 65–13, pp. 104–05).

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

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

Basic research is directed toward increase of knowledge in science; 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 of it.

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

Development is the systematic use of scientific knowledge directed toward the design and production of useful prototypes, materials, devices, systems, methods, or processes. It excludes quality control or routine product testing.

Current expenditures for separately budgeted research and development include all direct and indirect outlays associated with the conduct of R&D projects separately organized, financed, and identified in the financial records of universities and colleges. They include all current expenditures relating to research activities in universities and colleges with the exception of *departmental research,* which is performed and financed as part of the regular instructional functions of universities and colleges and identified in their financial records under "instruction and departmental research."

Professional personnel employed in the sciences and engineering include salaried personnel of an institution who have received a bachelor's degree or higher or, if foreign educated, academic training equal to a bachelor's degree or higher, and who are working at a professional level (a level at which the knowledge acquired by such academic training is essential in the performance of duties in the sciences and engineering). Included are employed professional personnel who were paid a salary or stipend and also members of religious orders who received no remuneration while employed at the institution. Excluded are personnel who work without compensation, such as voluntary staff members at medical schools.

Employment status of professional personnel reflects the definitions used by respondent universities and colleges to differentiate between full-time and part-time employment. Full-time scientific and engineering professional personnel include those holding full-time appointments, as defined by respondent institutions. Similarly, respondent institutions were requested to use their own definitions of part-time employment. Graduate students employed in the sciences and engineering include individuals who receive compensation for part-time services performed and who meet the criteria for professional personnel.

Classification of professional personnel employed in the sciences and engineering, by function. Respondent institutions were requested to classify personnel in three broad functional categories as follows:

Teaching is defined as encompassing those activities connected with the conduct of degree-credit courses or courses that are intended to lead ultimately to degrees, certificates, or professional certification or licensing. Included are instruction and training performed in connection with degree-credit courses and the administration of such instruction and training. Also included is the instruction of interns, residents, and other professional personnel receiving advanced training, such as postdoctoral fellows and trainees.

Research and development include all activities associated with the conduct of research and development, as defined previously. Included in this function is the preparation for publication of books and papers describing the results of the specific research and development, if carried out as an integral part of that research and development.

Other activities include all functions of professional scientific and technical personnel not encompassed within teaching or research and development, as defined above. Examples of such activities are agricultural demonstration work; adult education (if not degree credit); dissemination of scientific information; student health services; diagnosis and treatment of patients in offices, hospitals, clinics, and out-patient facilities; and general administration.

Full-time-equivalent number of scientists and engineers include personnel employed full-time in the sciences and engineering and the full-time-equivalent number of part-time scientists and engineers (including graduate students employed as scientists and engineers). Respondent institutions were requested to use their own definitions in translating part-time employment of scientists and engineers into full-time-equivalent number of scientists and engineers among the three functional categories (teaching, research and development, and other activities, as defined above).

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