

DOCUMENT RESUME

ED 249 083

SE 045 089

TITLE Science and Technology Data Book.
 INSTITUTION National Science Foundation, Washington, D.C. Div. of Science Resources Studies.
 PUB DATE Oct 83
 NOTE 49p.; Source notes/footnotes are in small print; color contrasts in graphics may not reproduce clearly.
 PUB TYPE Statistical Data (110)
 EDRS PRICE MF01/PC02 Plus Postage.
 DESCRIPTORS *Degrees (Academic); Employment; Engineering; Engineers; *Expenditures; Federal Aid; Graduate Students; Higher Education; *Industry; Labor Force; Labor Supply; Patents; *Research and Development; *Sciences; Scientists; *Technology

ABSTRACT

This pocket guide presents data on research and development (R&D) funding, human resources, and international science and technology (S&T) indicators. Among the R&D funding data provided are: national R&D funding by source and performer; federal R&D obligations by agency and character of work; industrial expenditures by sources of funds and character of work; and academic R&D expenditures by source (FY 1984), by field (FY 1982), and by character of work. Data on human resources include: employed scientists and engineers by field (1982), sector (1983), primary work activity (1982), and highest degree (1982); females and racial minorities in the S&T work force; retention rates; and supply as represented by degrees awarded in all science and engineering fields and by full-time graduate students in doctorate-granting institutions. Data on international S&T indicators include: scientists and engineers engaged in R&D per 10,000 labor force by country; R&D/GNP (gross national product) by country; nondefense R&D/GNP; United States patents granted to inventors from selected countries by year of grant and country of inventor; U.S. international transactions in royalties and fees; U.S. trade balance in R&D-intensive manufactured produce groups; and U.S. scientific and technical (S/T) publications as a percent of all S/T publications.
 (JN)

 * Reproductions supplied by EDRS are the best that can be made *
 * from the original document. *

ED249083

SE045089

DATA BOON

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

**science
and
technology**

DATA BOOK

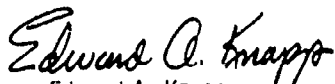
**Division of Science Resources Studies
National Science Foundation
Washington, D.C. 20550**

3

foreword

The National Science Foundation's Division of Science Resources Studies (SRS), a division of the Directorate for Scientific, Technological, and International Affairs, is publishing this pocket Data Book as a handy reference for information on the funding, staffing, and impacts of the Nation's scientific and technological activities. These data were compiled by SRS in fulfilling its responsibilities to collect, interpret, and analyze data on scientific and technical resources in the United States.

Comments and suggestions as to the materials presented are requested. Please contact the Editorial and Inquiries Unit, SRS, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550, phone (202) 634-4622.



Edward A. Knapp
Director
National Science Foundation

October 1983

contents

| | page |
|--|------|
| Foreword | v |
| R&D FUNDING | i |
| National The National R&D Effort | 5 |
| National R&D Funding by Source | 6 |
| National R&D Funding by Performer | 7 |
| National R&D Spending by Character of Work | 8 |
| Federal Federal R&D Obligations by Character of Work | 9 |
| Federal R&D Obligations by Agency | 10 |
| Federal R&D Obligations by Major Performer | 11 |
| Federal Obligations for Basic Research by Major Field of Science | 12 |
| Federal Obligations for Basic Research by Major Performer | 13 |
| Industry Industrial R&D Expenditures by Source of Funds | 14 |
| Industrial R&D Expenditures by Character of Work | 15 |
| Total R&D Expenditures of Five Leading Industries | 16 |
| Academic Academic R&D Expenditures by Source: FY 1984 | 17 |
| Academic R&D Expenditures by Character of Work | 18 |
| Academic R&D Expenditures by Field: FY 1982 | 19 |
| Federal Obligations to Universities and Colleges by Type of Activity | 20 |

| | |
|--|----|
| HUMAN RESOURCES | 21 |
| Utilization | |
| Employed Scientists and Engineers by Field: 1982 | 25 |
| Employed Scientists and Engineers by Sector: 1983 | 26 |
| Employed Scientists and Engineers by Primary Work Activity: 1982 | 27 |
| Employed Scientists and Engineers by Highest Degree: 1982 | 28 |
| Employed Doctorates in Science and Engineering by Field: 1981 | 29 |
| Women as a Proportion of All Employed Scientists, Engineers, and Professional and Technical Workers | 30 |
| Racial Minorities as a Percent of Technical Work Force | 31 |
| Retention Rates, Fifth Grade through Receipt of S/E Doctorate: 1963-82 | 32 |
| Supply | |
| Bachelor's Degrees Awarded in Major Science and Engineering (S/E) Fields | 33 |
| Master's Degrees Awarded in Major Science and Engineering (S/E) Fields | 34 |
| Doctoral Degrees Awarded in Major Science and Engineering (S/E) Fields | 35 |
| Full-Time Science and Engineering Graduate Students in Doctorate-Granting Institutions by Source of Major Support | 36 |
| Full-Time Science and Engineering Graduate Students in Doctorate-Granting Institutions by Type of Major Support | 37 |
| Full-Time Science and Engineering Graduate Students in Doctorate-Granting Institutions by Field and Citizenship | 38 |

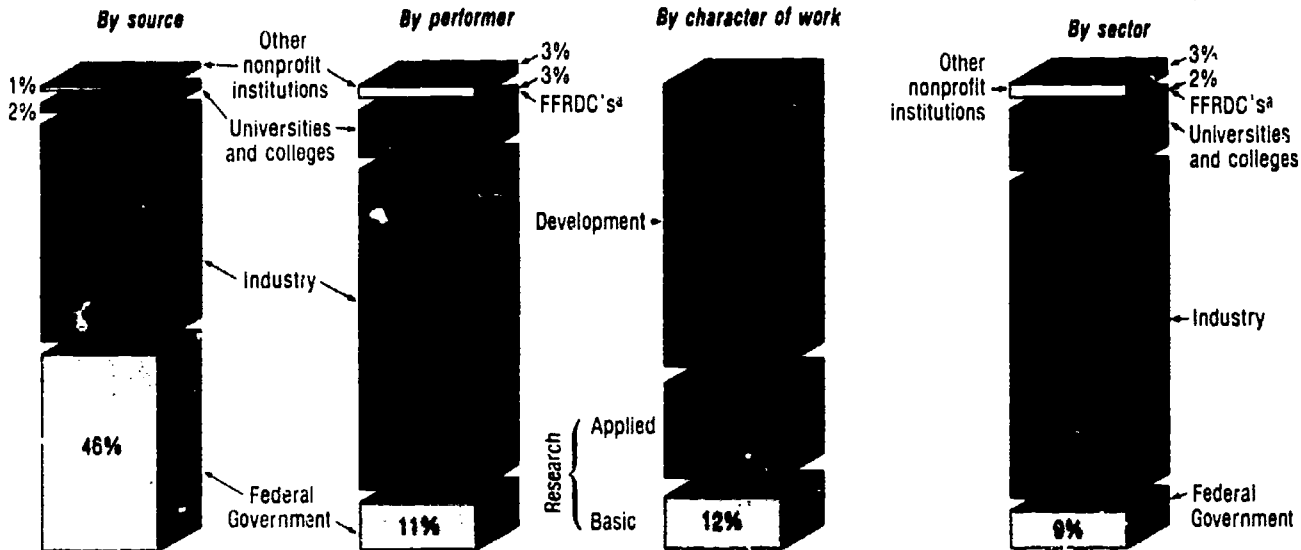
| | |
|---|----|
| INTERNATIONAL | 39 |
| International S&T Indicators | |
| Scientists and Engineers Engaged in R&D per 10,000 Labor Force by Country | 43 |
| R&D/GNP Ratios by Country | 44 |
| Nondefense R&D/GNP Ratios by Country | 44 |
| U.S. Patents Granted to Inventors from Selected Countries by Year of Grant and Country of Inventor | 45 |
| U.S. International Transactions in Royalties and Fees | 46 |
| U.S. Trade Balance in R&D-Intensive Manufactured Product Groups | 47 |
| U.S. Scientific and Technical (S/T) Publications as a Percent of All S/T Publications: 1980 | 48 |

R&D FUNDING

The national R&D effort

Expenditures for research and development = \$97.9 billion, 1984 (est.)

Employed R&D scientists/engineers = 765,000,^b 1983 (est.)

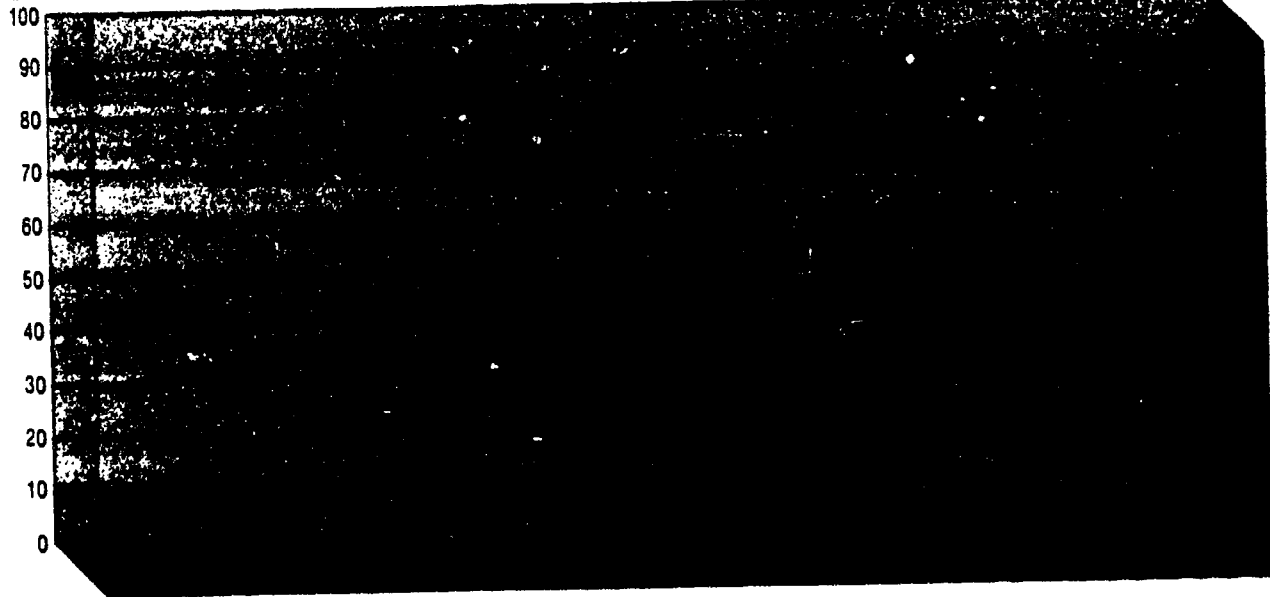


^a Federally funded research and development centers administered by universities and colleges
^b Full-time equivalents

Source: Science and Technology Administration

National R&D funding by source

Billions of dollars



National R&D funding by performer

[Dollars in millions]

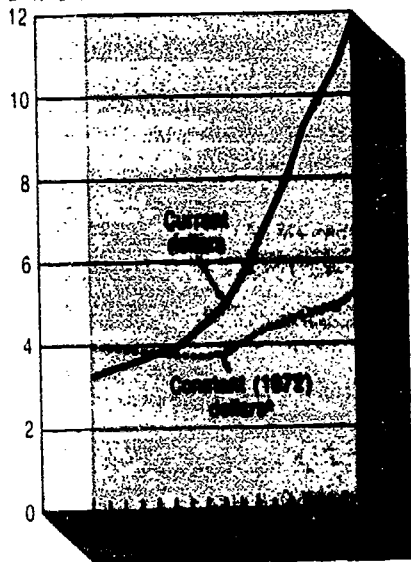
| Year | Current dollars | | | | | Constant (1972) dollars* | | | | |
|--------|-----------------|--------------------|----------|-----------------------|------------------|--------------------------|--------------------|----------|-----------------------|------------------|
| | Total | Federal Government | Industry | Universities/colleges | Other performers | Total | Federal Government | Industry | Universities/colleges | Other performers |
| 1953 | \$ 5 124 | \$ 1 010 | \$ 3 630 | \$ 231 | \$ 255 | \$ 8.677 | \$1.692 | \$ 6.171 | \$ 428 | \$ 386 |
| 1967 | 23 146 | 3 396 | 16 385 | 1.921 | 1 444 | 29.241 | 4.276 | 20.725 | 2.417 | 1.823 |
| 1975 | 35 213 | 5 354 | 24.187 | 3.409 | 2.233 | 28.153 | 4.344 | 19.229 | 2.766 | 1.814 |
| 1980 | 62 618 | 7 632 | 44.505 | 6.060 | 4.421 | 35.136 | 4.297 | 24.944 | 3.412 | 2.483 |
| 1983 | 88 153 | 10 228 | 65 000 | 7 675 | 5.250 | 40.764 | 4.697 | 30 139 | 3 525 | 2.423 |
| (est.) | | | | | | | | | | |
| 1984 | 97 894 | 10 970 | 73 000 | 8.375 | 5.550 | 43.329 | 4 827 | 32.365 | 3.685 | 2.452 |
| (est.) | | | | | | | | | | |

*Based on...
SOURCE: ...

National R&D spending by character of work

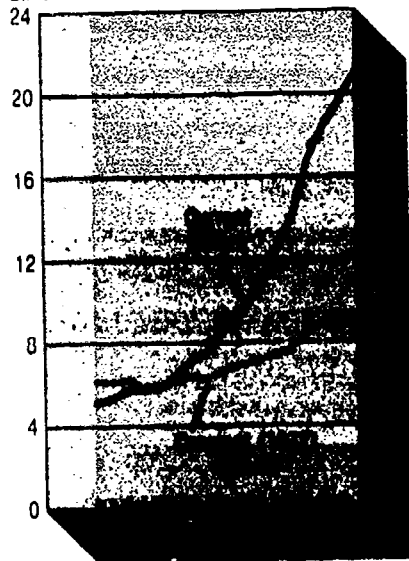
Basic research

Billions of dollars



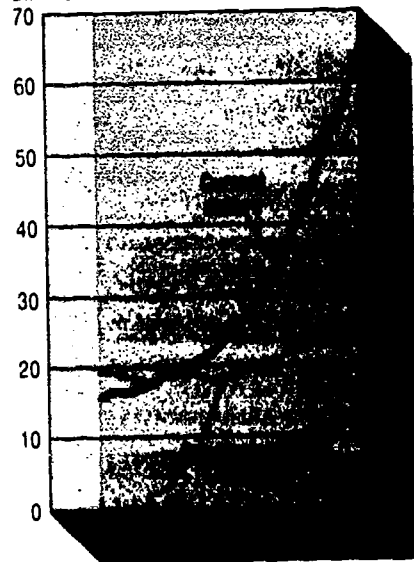
Applied research

Billions of dollars



Development

Billions of dollars



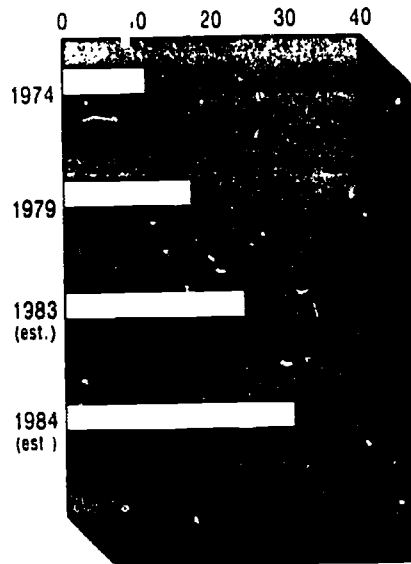
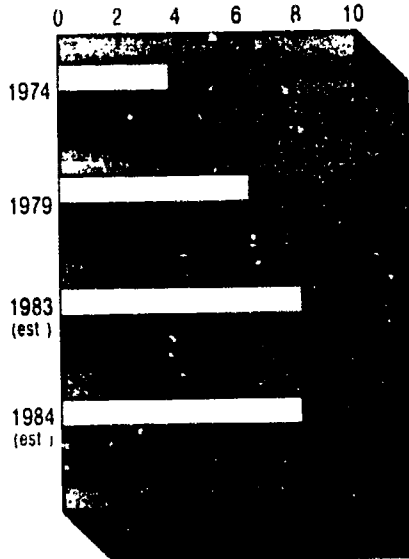
Federal R&D obligations by character of work

Billions of dollars

Basic research

Applied research

Development

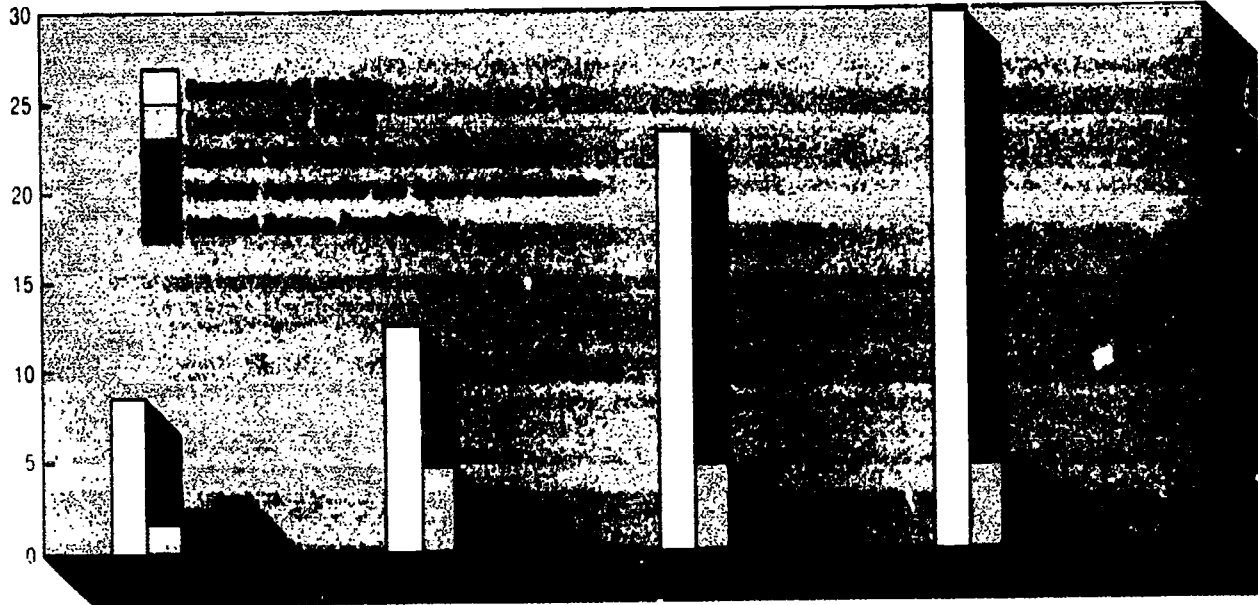


□ Current dollars

■ Constant (1972) dollars^a

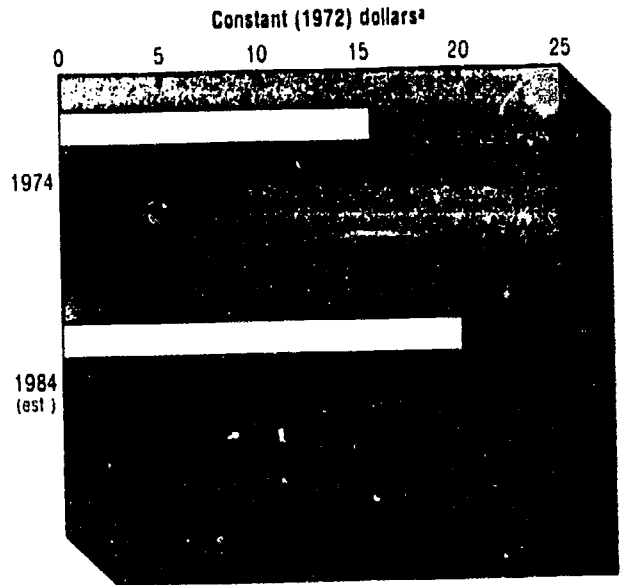
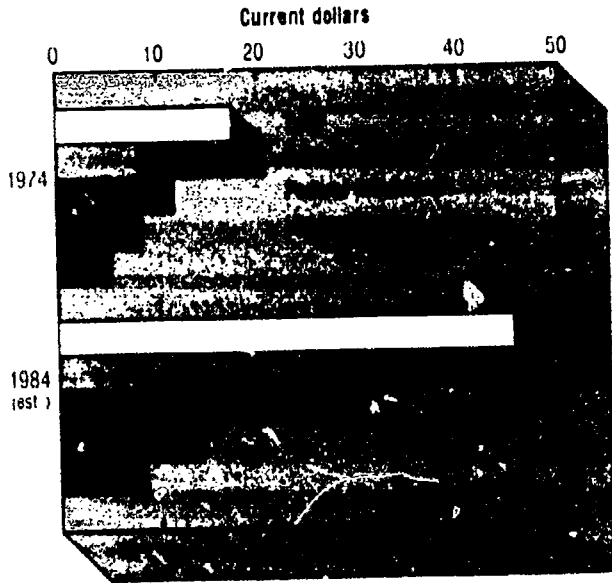
Federal R&D obligations by agency

Billions of dollars



Federal R&D obligations by major performer

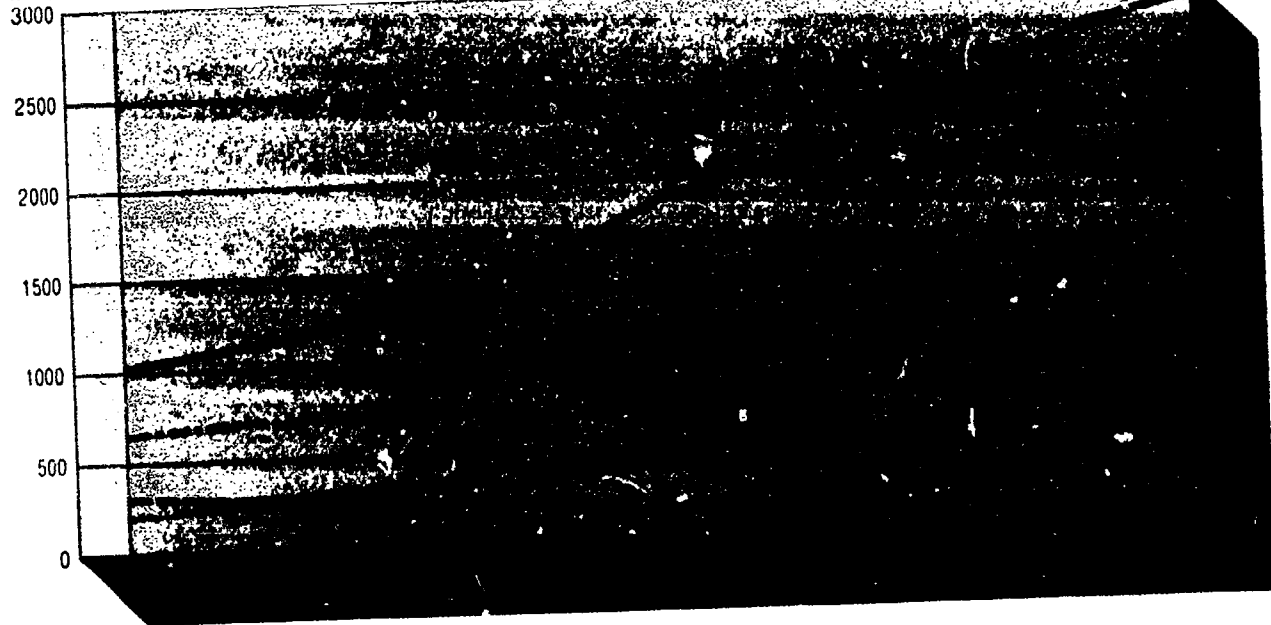
Billions of dollars



Source: Office of Technology Assessment, U.S. Congress, "Federal R&D Obligations: A Report to Congress," 1984.

Federal obligations for basic research by major field of science

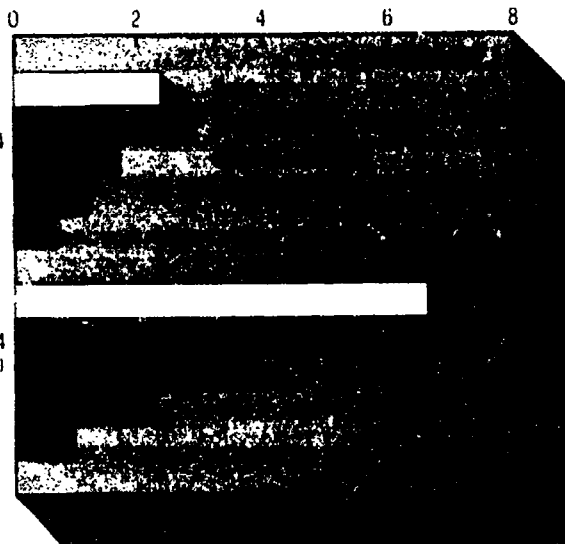
Millions of dollars



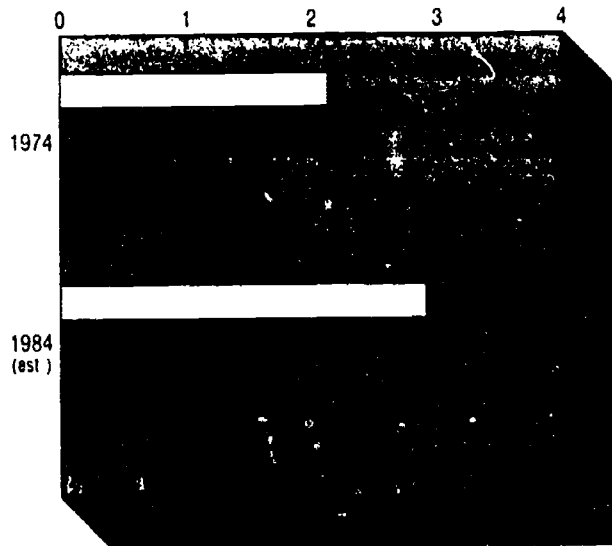
Federal obligations for basic research by major performer

Billions of dollars

Current dollars



Constant (1972) dollars^a

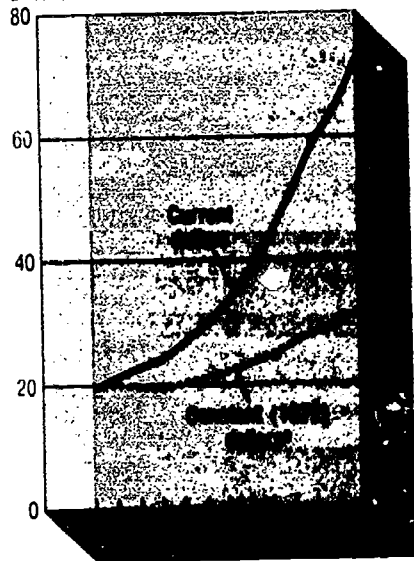


Source: U.S. Department of Education, Office of Education Research and Development, "Federal Obligations for Basic Research by Major Performer, 1974-1984 (est.)"

Industrial R&D expenditures by source of funds

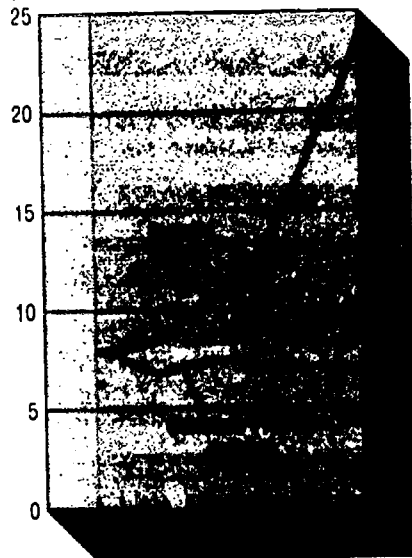
Total funds

Billions of dollars



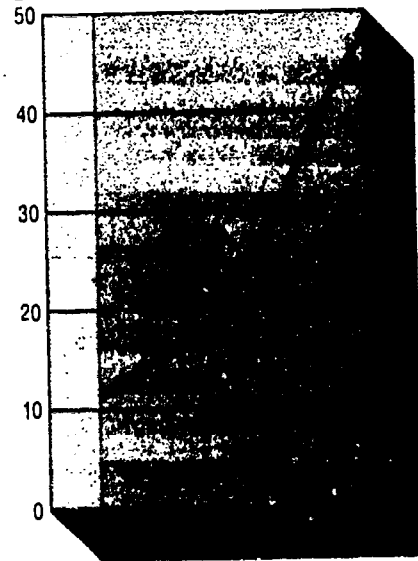
Federal funds

Billions of dollars



Company funds

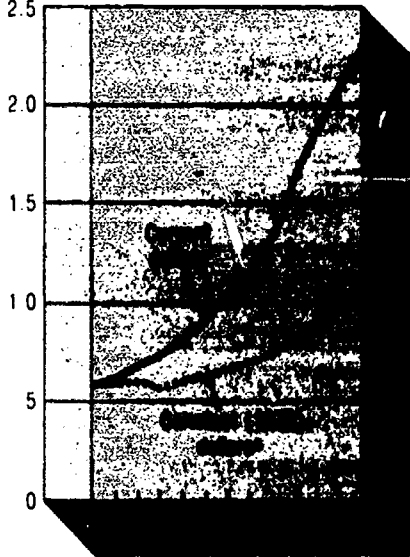
Billions of dollars



Industrial R&D expenditures by character of work

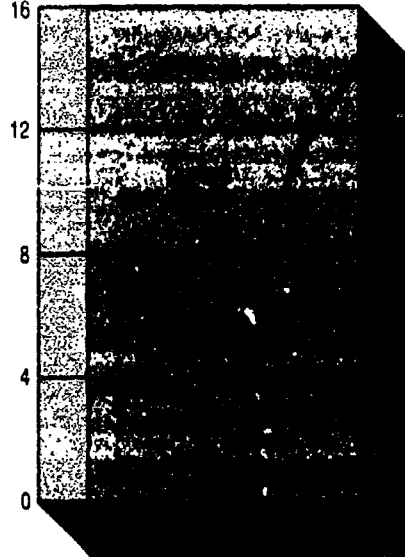
Basic Research

Billions of dollars



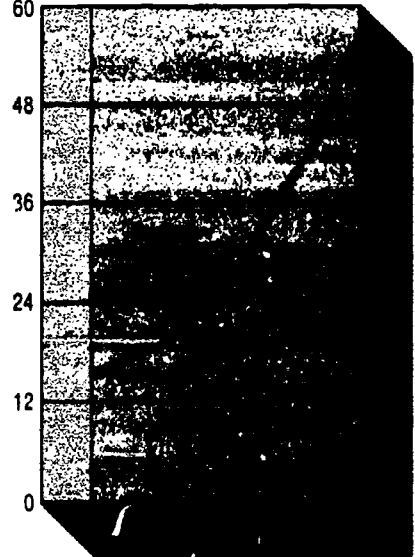
Applied Research

Billions of dollars



Development

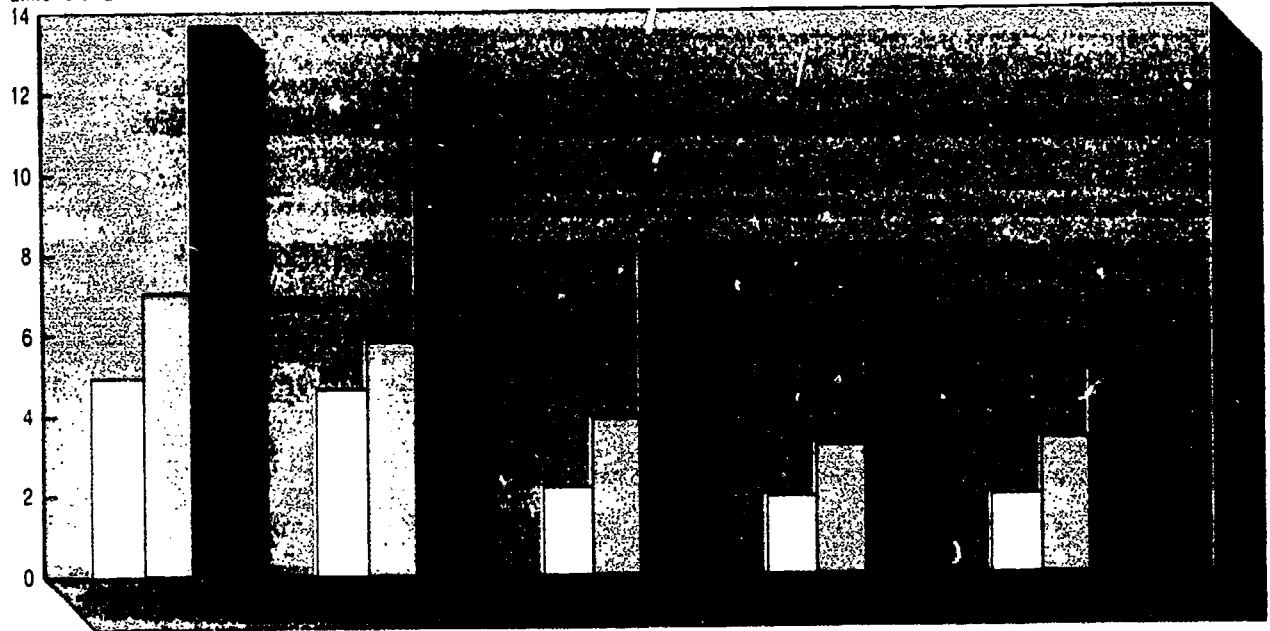
Billions of dollars



*Based on GNP implicit price deflator
 †ACE: National Science Foundation

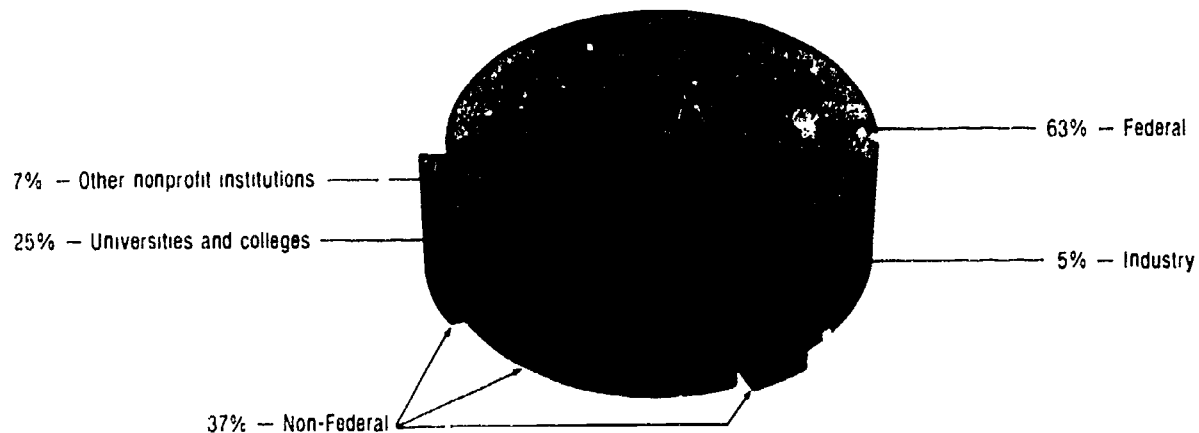
Total R&D expenditures of five leading industries

Billions of dollars



Academic R&D expenditures by source: FY 1984

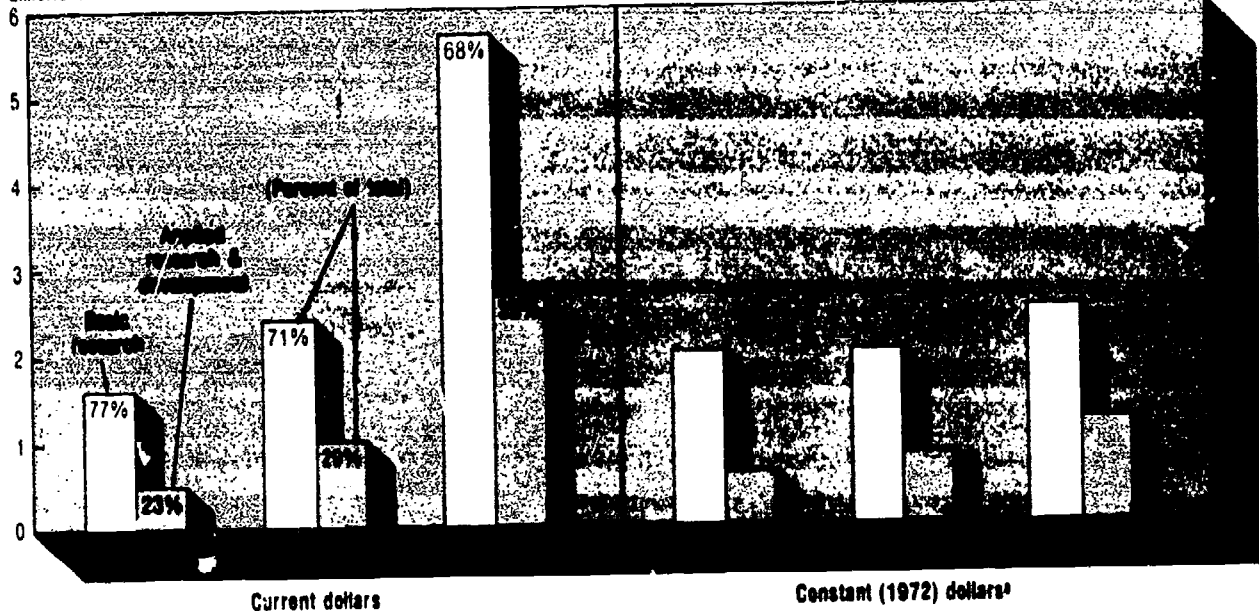
Total: \$8.4 billion



The Federal portion of academic R&D expenditures has ranged between 63 percent and 69 percent during the 1970-84 period.
National Science Foundation

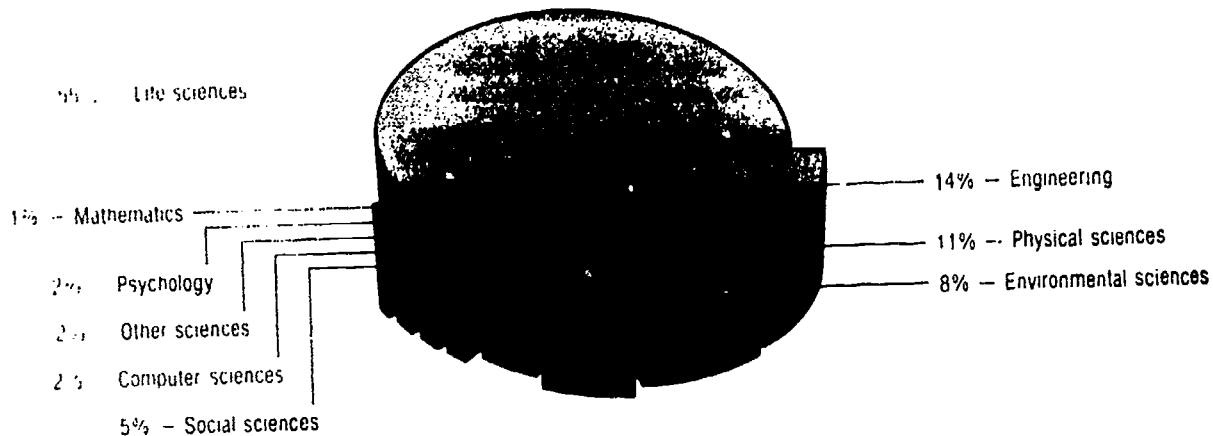
Academic R&D expenditures by character of work

Billions of dollars



Academic R&D expenditures by field: FY 1982

Total: \$7.3 billion



23

Federal obligations to universities and colleges by type of activity¹

[Dollars in millions]

| Fiscal year | Total obligations | Academic science/engineering | | | | | |
|-------------|-------------------|------------------------------|---------------------------------------|-----------|--|-----------|-------------------------|
| | | Total | Research and development ² | R&D plant | Fellowships, traineeships, and training grants | All other | Non-science/engineering |
| 1968 | \$3,387 | \$2,350 | \$1,398 | \$96 | \$441 | \$414 | \$1,037 |
| 1976 | 5,403 | 2,960 | 2,431 | 24 | 175 | 330 | 2,443 |
| 1980 | 8,298 | 4,803 | 4,160 | 38 | 223 | 383 | 3,495 |
| 1981 | 7,720 | 5,088 | 4,410 | 44 | 215 | 419 | 2,632 |
| 1982 | 8,702 | 5,277 | 4,584 | 31 | 234 | 428 | 3,425 |

¹Data may not add to total because of rounding.

²Academic research and development is estimated at \$5.0 billion for 1983 and \$5.3 billion for 1984. Separate data for the other components of academic science, engineering, and non-science/engineering are not available.

SOURCE: National Science Foundation.

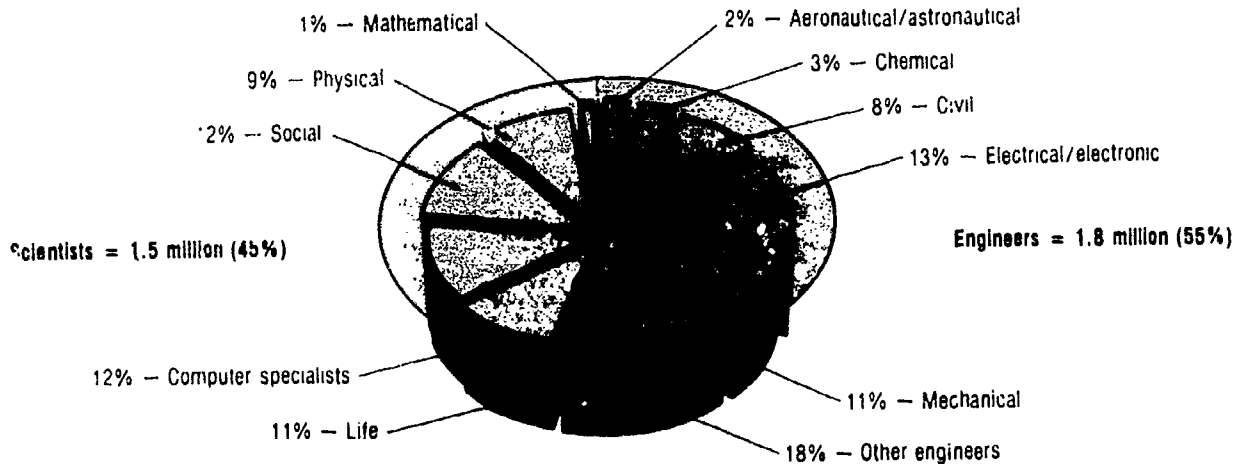
HUMAN RESOURCES

25



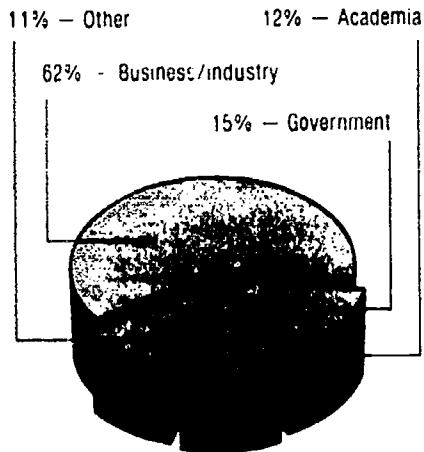
Employed scientists/engineers by field: 1982^a

Scientists/engineers
total = 3.3 million

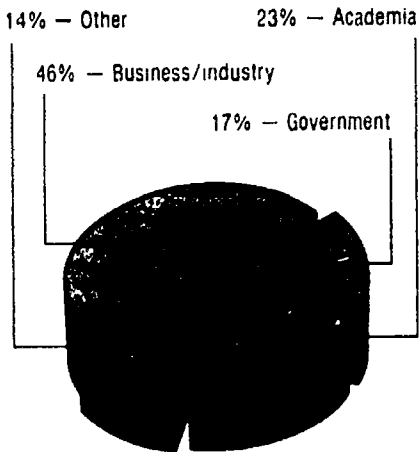


Employed scientists and engineers by sector: 1982^a

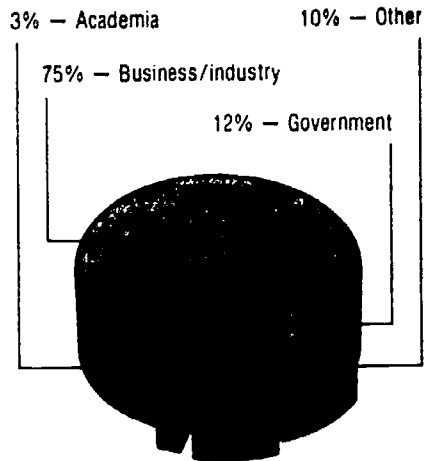
Scientists/engineers,
total = 3.3 million



Scientists = 1.5 million



Engineers = 1.8 million

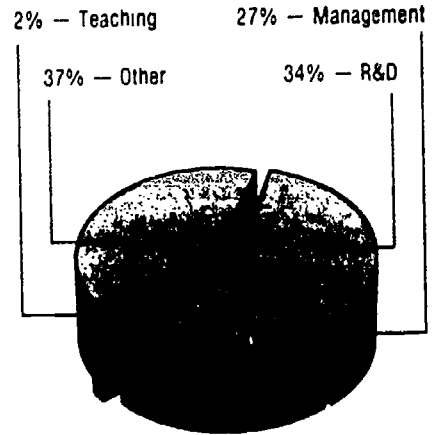
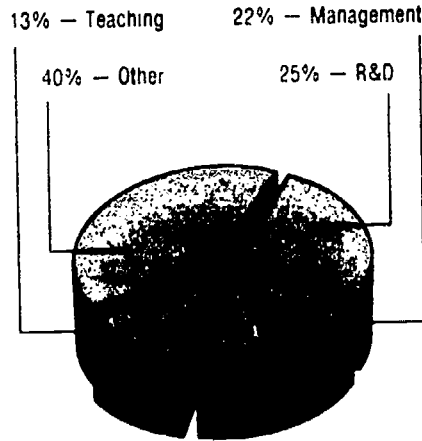
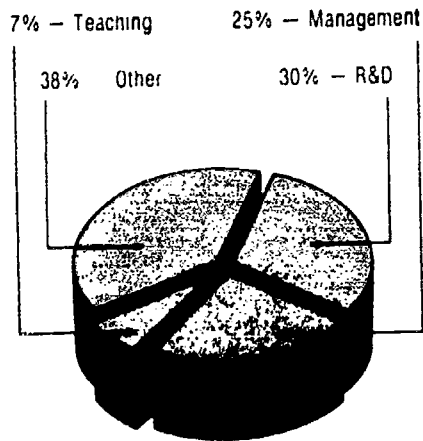


Employed scientists and engineers by primary work activity: 1982^a

Scientists/engineers,
total = 3.3 million

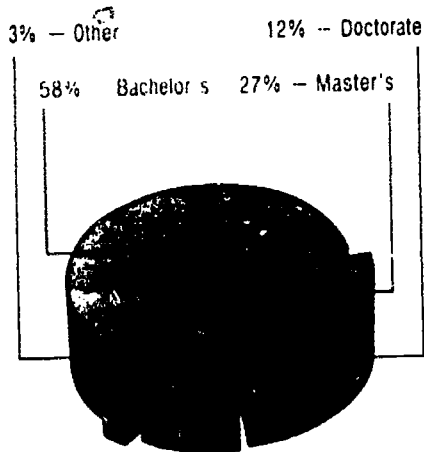
Scientists = 1.5 million

Engineers = 1.8 million

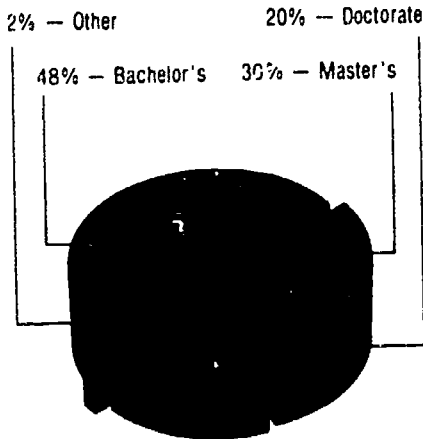


Employed scientists and engineers by highest degree: 1982*

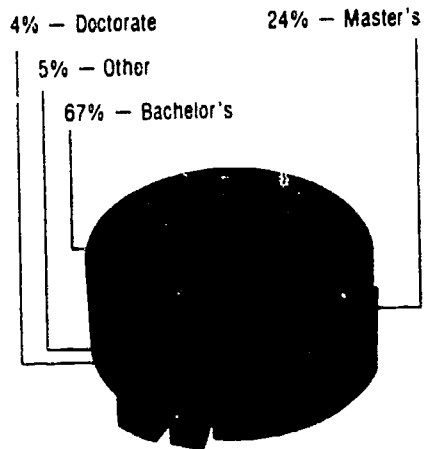
Scientists/engineers,
total = 3.3 million



Scientists = 1.5 million



Engineers = 1.8 million

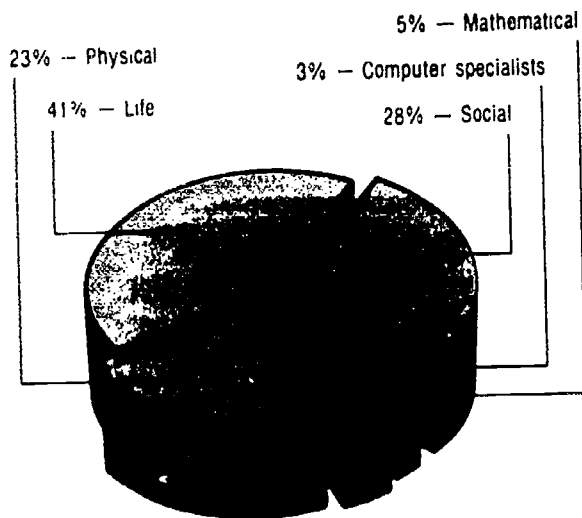


29

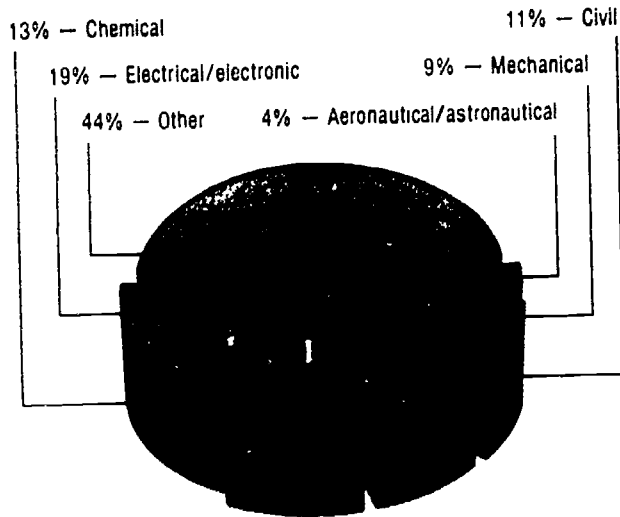
Employed doctorates in science and engineering by field: 1981

Scientists/engineers, total = 363,900

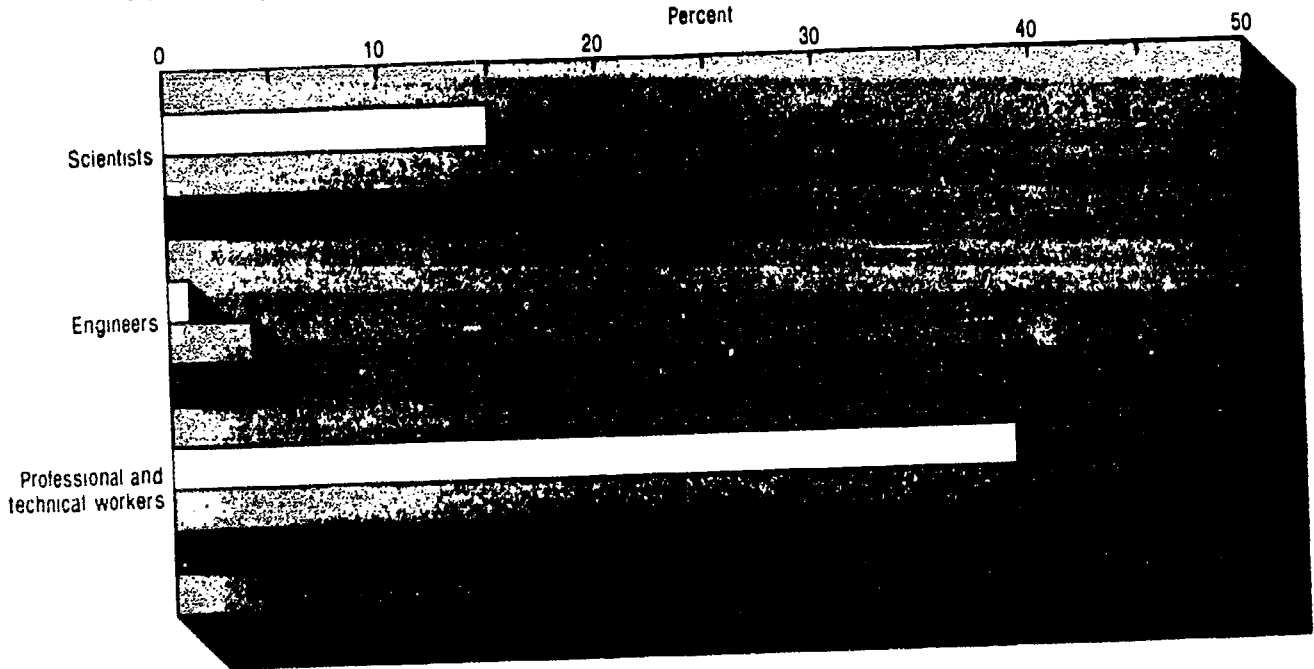
Scientists = 305,600



Engineers = 58,300



Women as a proportion of all employed scientists, engineers, and professional and technical workers



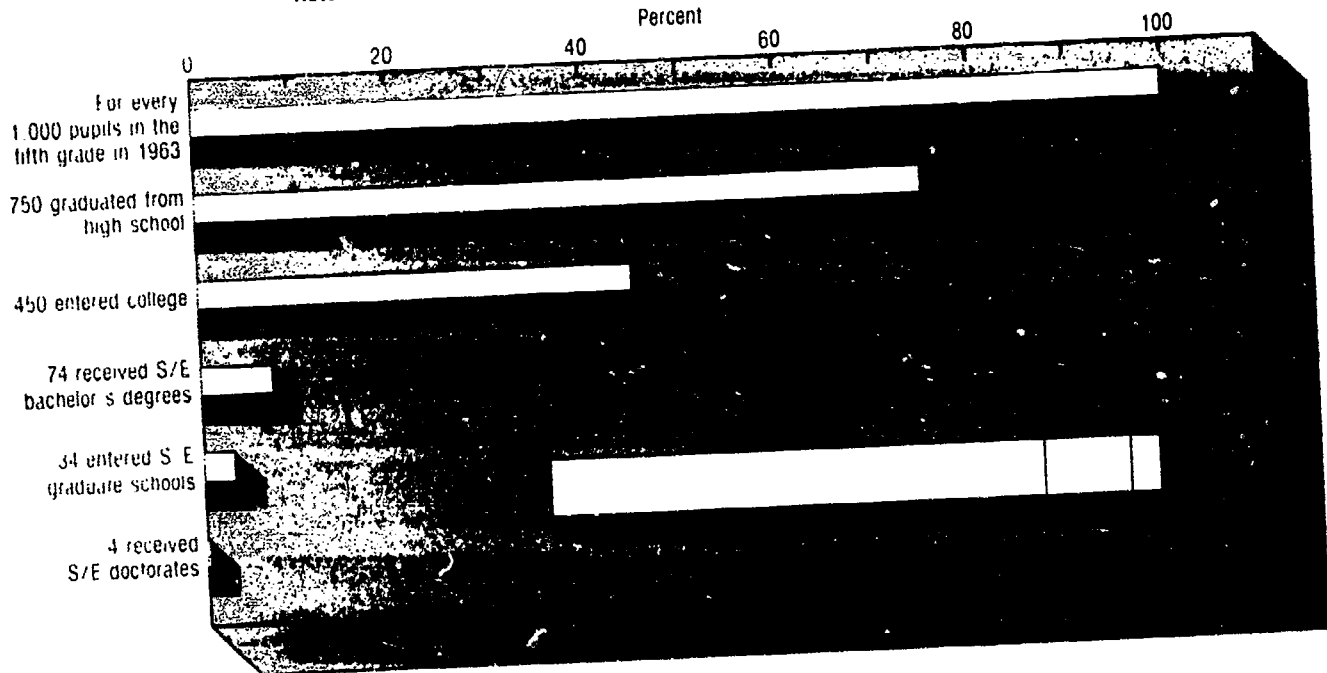
SOURCES: National Science Foundation and Department of Labor

Racial minorities as a percent of technical work force

| Technical work force | 1972 | | 1982 | |
|------------------------------------|--------------------|--------------------|--------------------|--------------------|
| | Black | Asian | Black | Asian |
| | (Percent of total) | (Percent of total) | (Percent of total) | (Percent of total) |
| Professional and technical workers | 6 | NA | 6 | NA |
| Total scientists and engineers | 1 | 3 | 3 | 5 |
| Scientists | 2 | 2 | 3 | 4 |
| Engineers | 1 | 2 | 2 | 5 |

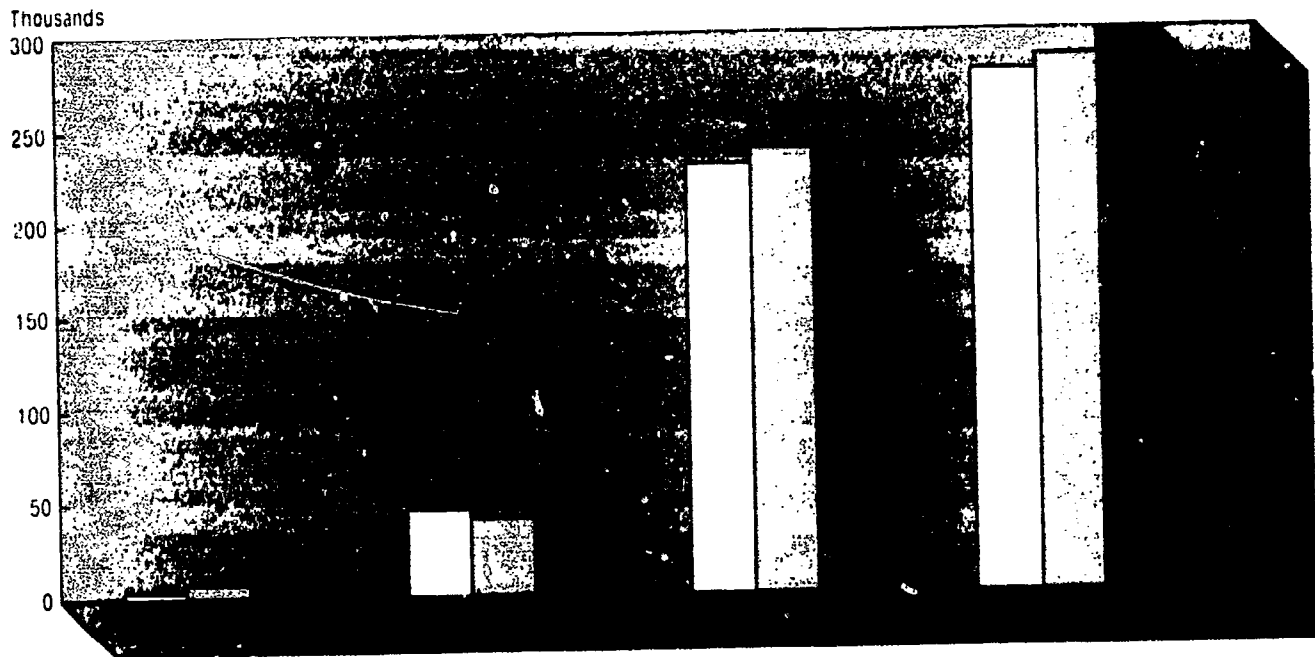
NOTE: NA = Not available
 SOURCE: National Science Foundation

Retention Rates, fifth grade through receipt of S/E doctorate: 1963-82



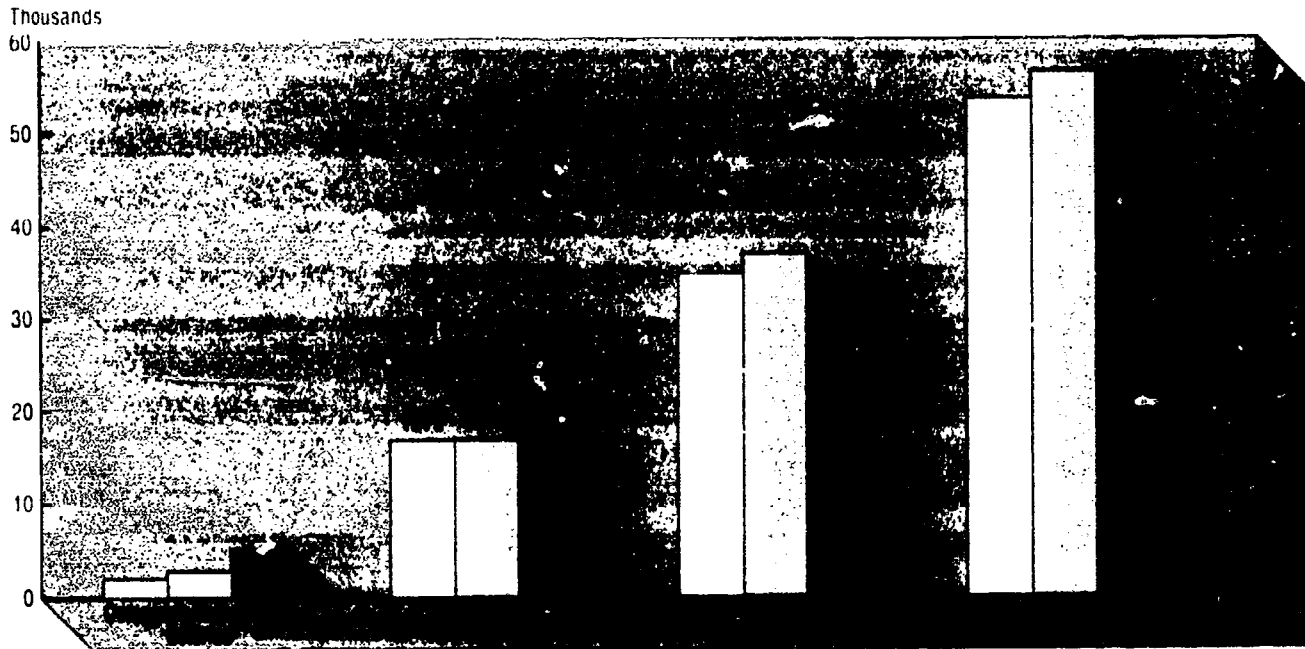
U.S. National Science Foundation, National Center for Education Statistics, and National Research Council

Bachelor's degrees awarded in major science and engineering (S/E) fields



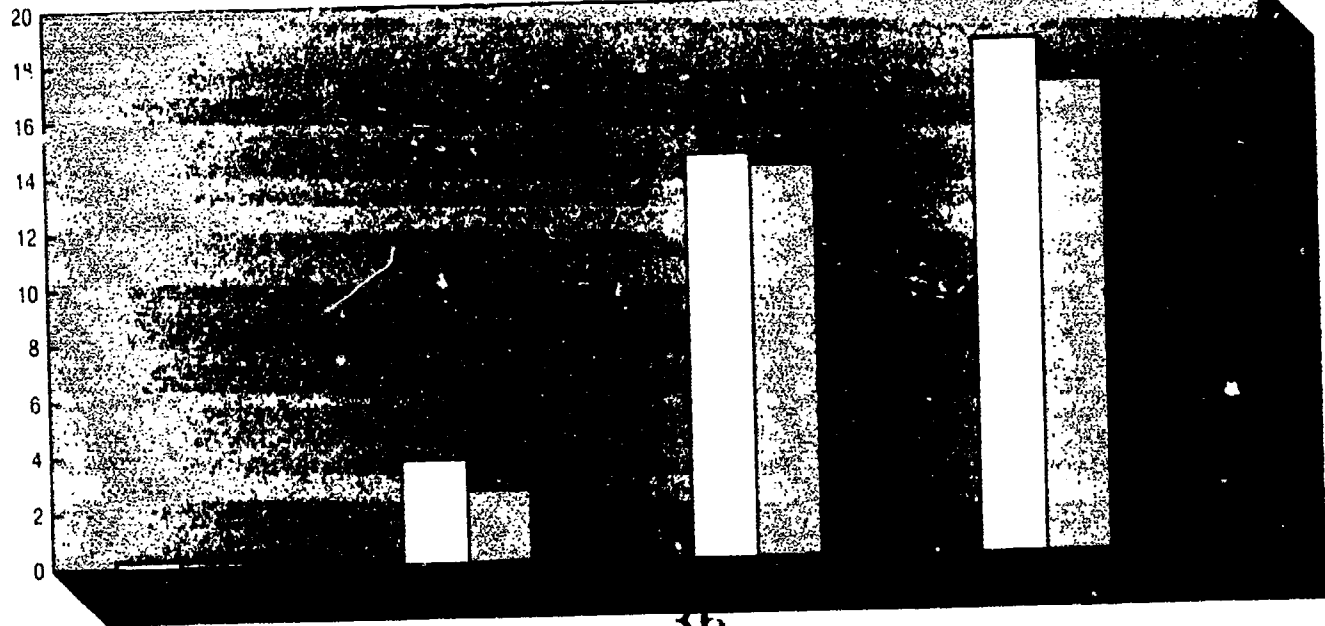
ERIC National Science Foundation

Master's degrees awarded in major science and engineering (S/E) fields



Doctoral degrees awarded in major science and engineering (S/E) fields

Thousands

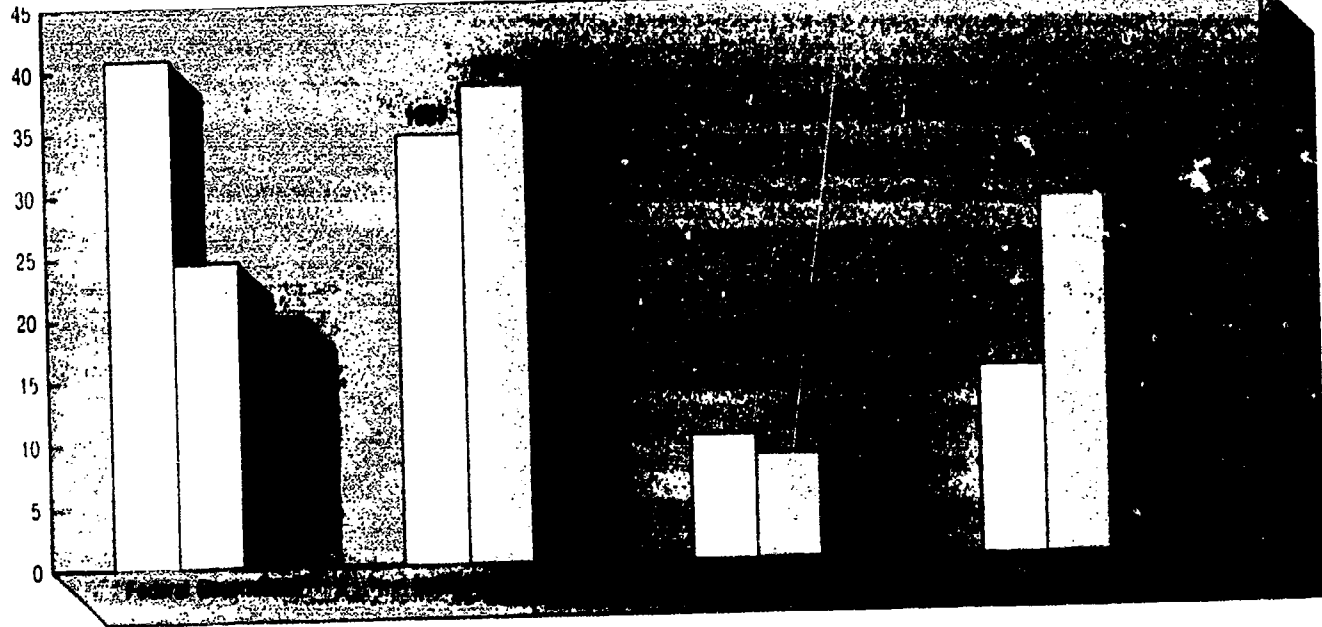


36

35

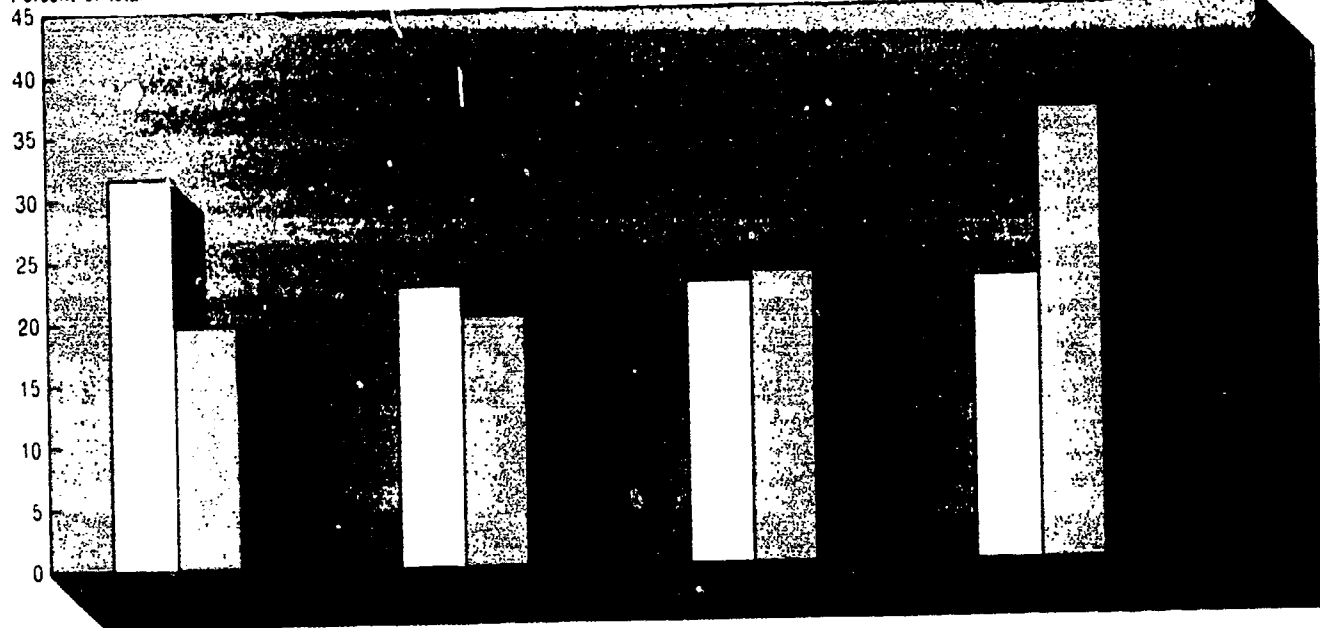
Full-time science and engineering graduate students in doctorate-granting institutions by source of major support

Percent of total



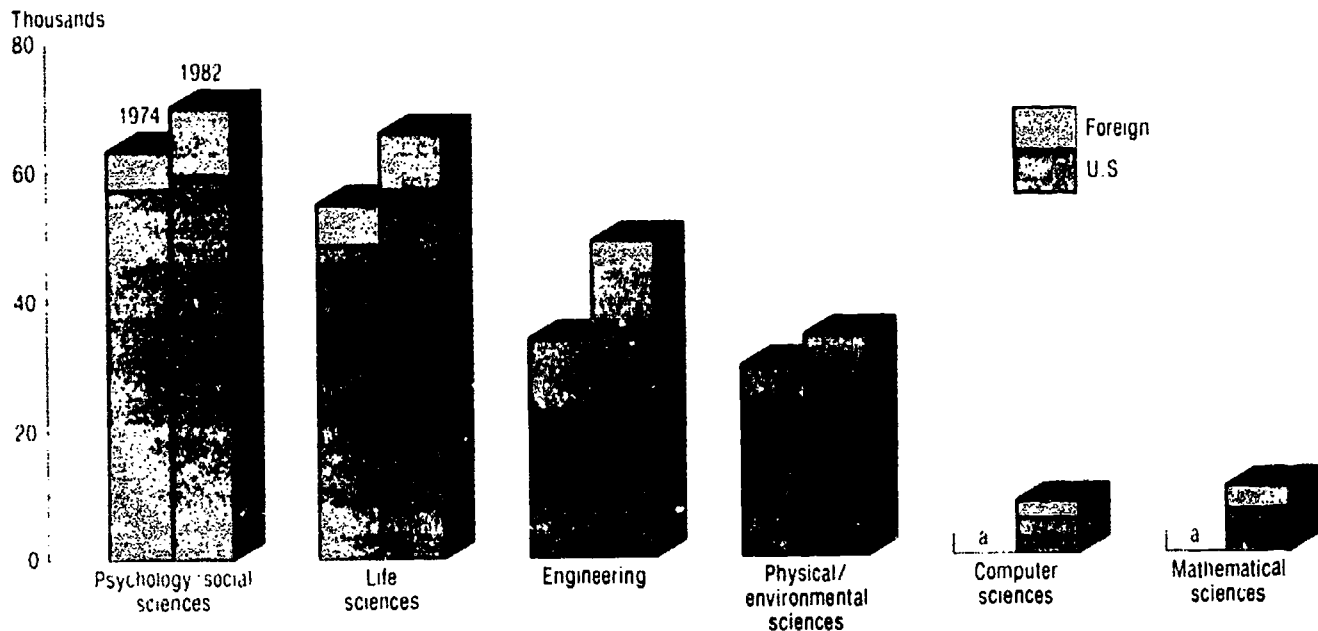
Full-time science and engineering graduate students in doctorate-granting institutions by type of major support

Percent of total



Source: National Science Foundation

Full-time science and engineering graduate students in doctorate-granting institutions by field and citizenship



INTERNATIONAL S/T INDICATORS

40

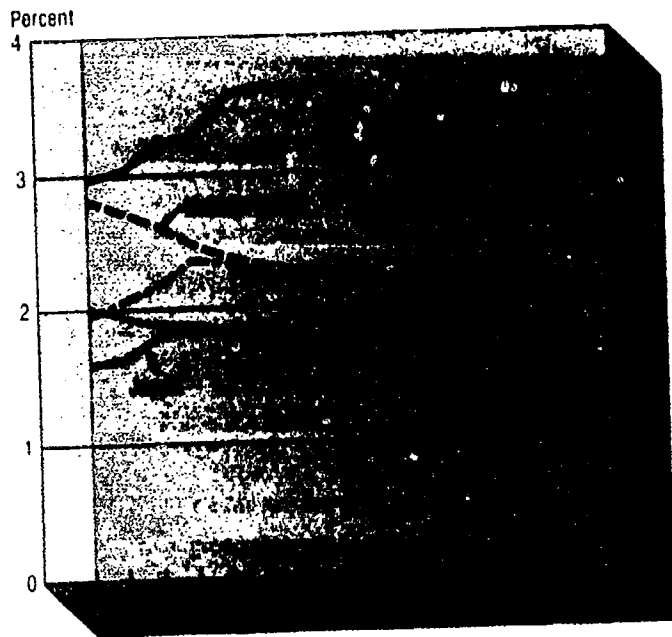
Scientists and engineers engaged in R&D per 10,000 labor force by country

Per 10,000 labor force

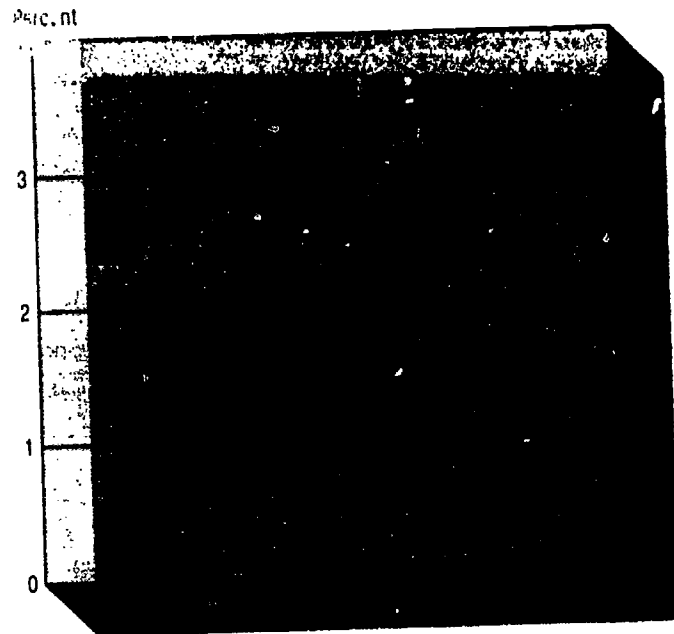


Note: A range has been provided for the U.S.S.R. because of the difficulties inherent in comparing Soviet scientific personnel data with U.S. National Science Foundation, Organisation for Economic Cooperation and Development and D. Robert Campbell (Indiana University)

R&D/GNP ratios by country

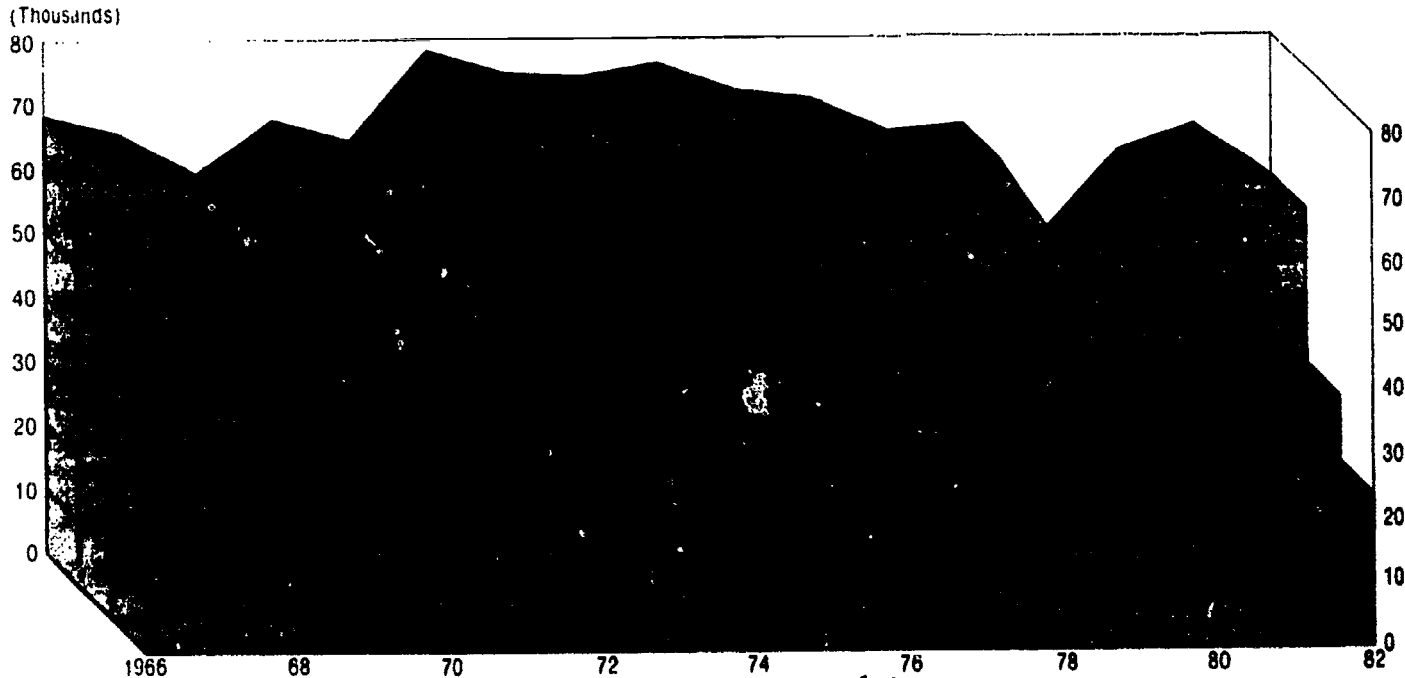


Nondefense R&D/GNP ratios by country*



* The data for nondefense R&D in the U.S. is from NSF 22-14016
 H. S. National Science Foundation, Organisation for Economic Cooperation and Development, and Dr. Robert Campbell (Indiana University)

U.S. patents granted to U.S. and foreign inventors by year of grant

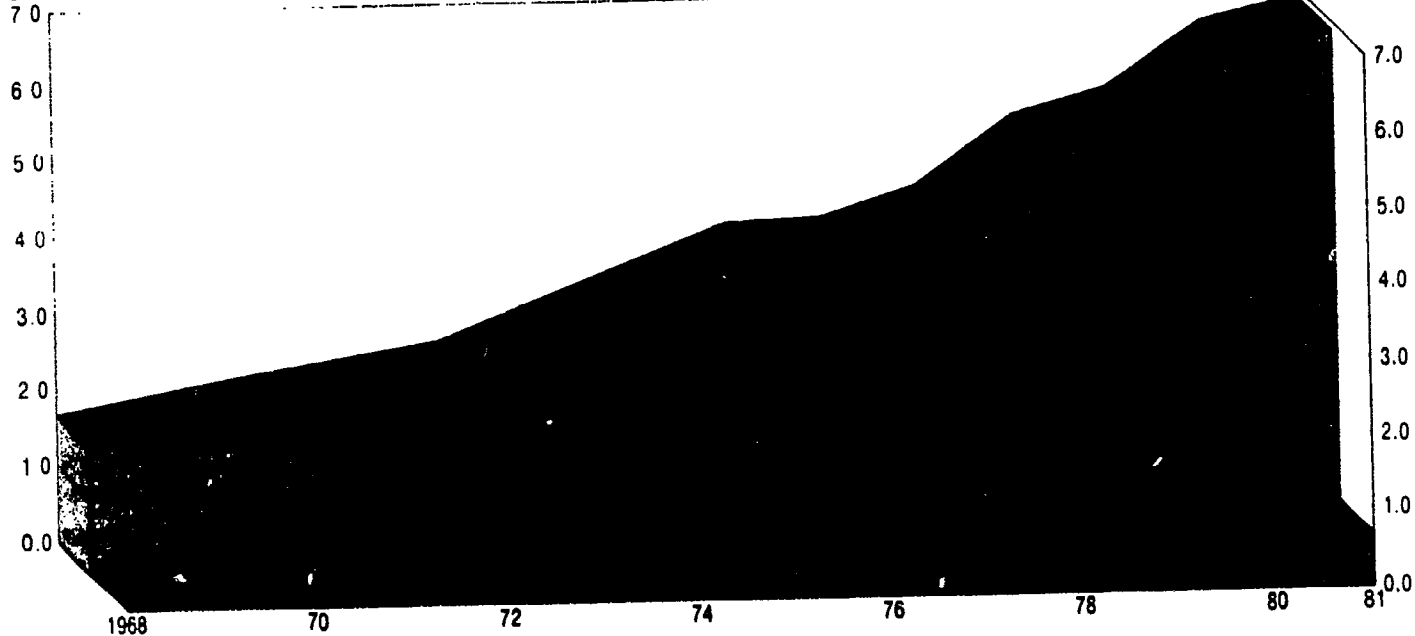


U.S. Patent and Trademark Office

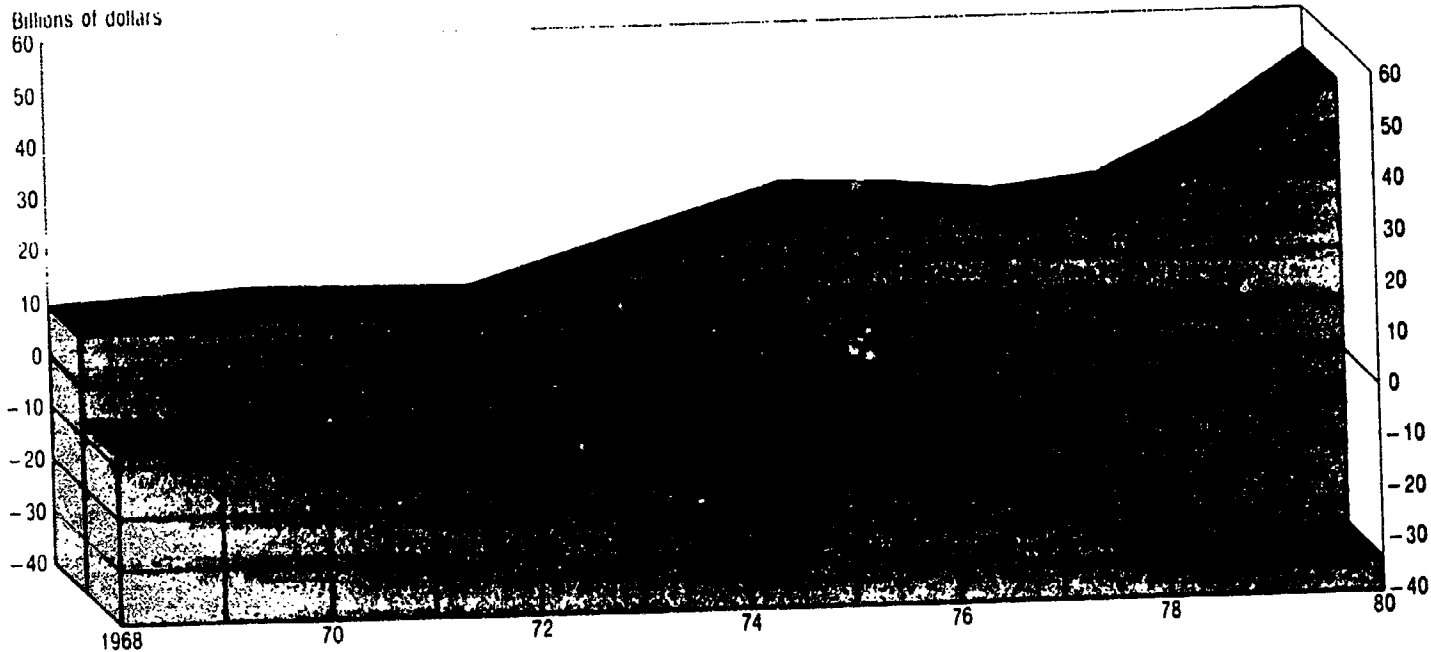
43

U.S. international transactions in royalties and fees^a

Billions of dollars

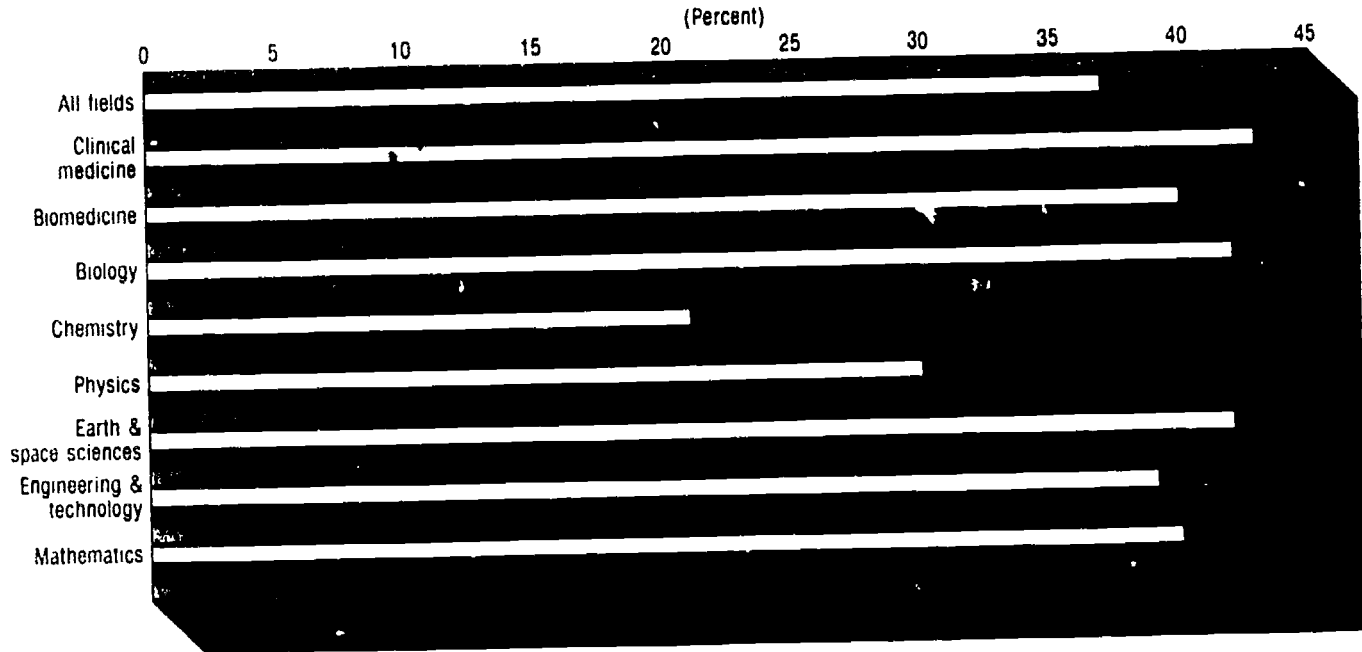


U.S. trade balance* in R&D-intensive manufactured product groups



*Excludes exports
Source: Department of Commerce

U.S. scientific and technical (S/T) publications as a percent of all S/T publications: 1980



Note: These data are based on the articles, notes, and reviews in over 2,100 of the influential journals carried on the 1973 *Science Citation Index* of the Institute for Scientific Information. An article written by researchers from more than one country is prorated across the countries involved.
SOURCE: Computer Horizons, Inc.

Other Science Resources Publications

Science Resources Studies Highlights

R&D Funds

| | NSF No. | Price |
|--|---------|-------|
| "Defense and Economy Major Factors in 7% Real R&D Growth in National Expenditures" | 83-316 | --- |
| "Company and Federal Support Produce 17% Industrial R&D Spending Increase in 1981" | 83-313 | --- |
| "Federal Science/Engineering (S/E) Support To Universities and Colleges Rose by 6% in FY 1981; Non-S/E Support Down 25%" | 83-306 | --- |
| "Real Growth Rate of Academic R&D Expenditures Slowed to 2% in FY 1981" | 83-304 | --- |
| "Significant Increase Expected in Industrial R&D Performance of Federal R&D Programs in FY 1983" | 82-329 | --- |
| "Growth in Federal Basic Research Support in 1980-83 Moves at Slower Rate than in Previous Four Years" | 82-325 | --- |
| "Companies Plan R&D Expenditure Increases for 1983; Growth Rate Down" | 82-324 | --- |
| "Defense Leads R&D Growth in FY 1983 — Energy and Natural Resources and Environment Fall Sharply" | 82-322 | --- |
| "National R&D Expenditures Expected to Reach \$85 Billion in 1983" | 82-311 | --- |

S/E Personnel

| | | |
|--|--------|-----|
| "Technical Employment Growth Accelerates in Selected Nonmanufacturing Industries" | 83-321 | --- |
| "Academic Employment of Scientists Continued to Grow in 1982, But Slower than for Other Economic Sectors" | 83-317 | --- |
| "Growth in Neuroscience May be Leveling Off" | 83-314 | --- |
| "Graduate Science/Engineering Enrollment Rose 2% in 1981, Mostly in 'High-Tech' Fields" | 83-310 | --- |
| "Projected Employment Scenarios Show Possible Shortages in Some Engineering and Computer Specialties" | 83-307 | --- |
| "Manufacturing Employment Becoming Increasingly More Technological" | 83-303 | --- |
| "Growth in Science and Engineering Employment Accelerated in 1980 to 1981—But Demand May Have Slackened in 1982" | 83-300 | --- |
| "Labor Market Slackens for New Science and Engineering Graduates" | 82-331 | --- |

| | | |
|--|--------|-----|
| "Growth in Employment of Science and Engineering Doctorates Continues, Led By Computer Scientists" | 82-328 | --- |
| "Science/Engineering Doctorate Production Increases in 1981; More New Doctorates Seek Nonacademic Positions" | 82-323 | --- |
| "Employment of Recent Science and Engineering (S/E) Graduates in S/E Fields Increased" | 82-320 | --- |
| "Labor Markets for New Science and Engineering Graduates in Private Industry" | 82-310 | --- |
| "Growth in Scientific and Engineering Employment Slows Between 1978-80" | 82-303 | --- |
| "Engineering Colleges Report 10% of Faculty Positions Vacant in Fall 1980" | 81-322 | --- |
| "Trends in Science and Engineering Degrees, 1950 Through 1980" | 81-320 | --- |
| "Science and Engineering Faculty With Recent Doctorates Fell to One-Fifth of Total in 1980" | 81-318 | --- |
| "University S/E Faculty Spend One-Third of Professional Time in Research" | 81-317 | --- |
| "Tenure Practices in Universities and 4-Year Colleges Affect Faculty Turnover" | 81-300 | --- |

Detailed Statistical Tables

R&D Funds

| | | |
|---|--------|-----|
| Academic Science/Engineering: R&D Funds, Fiscal Year 1981 | 83-311 | --- |
| Federal Funds for Research and Development, Fiscal Years 1981, 1982, and 1983, Volume XXXI | 82-326 | --- |
| Research and Development in Industry, 1980. Funds, 1980, Scientists and Engineers, January 1981 | 82-317 | --- |

S/E Personnel

| | | |
|---|--------|-----|
| Academic Science/Engineering: Scientists and Engineers, January 1982 | 83-311 | --- |
| Academic Science/Engineering: Graduate Enrollment and Support, Fall 1981 | 83-305 | --- |
| Characteristics of Doctoral Scientists and Engineers in the United States: 1981 | 82-332 | --- |
| U.S. Scientists and Engineers: 1980 | 82-314 | --- |
| Scientists, Engineers, and Technicians in Private Industry: 1980 | 81-329 | --- |
| Federal Scientific and Technical Personnel: 1976, 1977, and 1978 | 81-309 | --- |

Reports

R&D Funds

| | | |
|--|--------|----------|
| Federal Funds for Research and Development, Fiscal Years 1981, 1982, and 1983, Volume XXXI | 83-320 | In Press |
| Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1981 | 83-315 | \$6.50 |
| Trends to 1982 in Industrial Basic Research | 83-302 | \$3.50 |
| Federal R&D Funding for Energy, Fiscal Years 1971-83 | 83-301 | -- |
| 1990 R&D Funding Projections | 82-315 | \$3.50 |
| Problems of Small, High-Technology Firms | 81-305 | -- |

S/E Personnel

| | | |
|---|--------|--------|
| Science and Engineering Doctorates: 1980-81 | 83-309 | -- |
| Changing Employment Patterns of Scientists, Engineers, and Technicians in Manufacturing Industries: 1977-80 | 82-331 | -- |
| Women and Minorities in Science and Engineering | 82-302 | \$7.00 |
| Activities of Science and Engineering Faculty in Universities and 4-Year Colleges: 1978/79 | 81-323 | -- |
| Young and Senior Science and Engineering Faculty: 1980 | 81-319 | -- |
| Foreign Participation in U.S. Science and Engineering Higher Education and Labor Markets | 81-316 | \$4.50 |
| Science and Engineering Employment: 1970-80 | 81-310 | \$2.75 |
| The Stock of Science and Engineering Master's Degree-Holders in the United States | 81-302 | -- |

Composite

| | | |
|--|----------|---------|
| National Patterns of Science and Technology Resources: 1982 | 82-319 | \$5.00 |
| Science and Engineering Personnel: A National Overview | 82-318 | \$5.00 |
| Academic Science 1972-81: R&D Funds, Scientists and Engineers, Graduate Enrollment and Support | 81-326 | -- |
| Science Indicators, 1980 | NSB 81-1 | \$10.00 |