DOCUMENT RESUME

ED 266 934 SE 046 432

TITLE	Project Summaries: FY 1985.
INSTITUTION	National Science Foundation, Washington, D.C. Div. of Science Resources Studies.
REPORT NO	NSF-85-324
PUB DATE	85
NOTE	75p.; For 1984 project summaries see ED 256 608.
PUB TYPE	Reference Materials - General (130) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Degrees (Academic); Employment; *Engineering; Engineering Education; *Federal Aid; *Federal Programs; Higher Education; Industry; Paraprofessional Personnel; *Program Descriptions; Research and Development; Science Education; *Sciences; Scientists; *Technology
IDENTIFIERS	Bibliometrics; National Science Foundation

ABSTRACT

The National Science Foundation's Division of Science Resources Studies (SRS) has a legislatively mandated responsibility to collect, compile, and analyze information related to science and technology resources and the outputs and impacts of those resources. The mandate constitutes a broad charter requiring diverse activities. The products of these activities are useful to a heterogeneous clientele, varying from governmental science and technology policymakers to institutional managers and research analysts. This compilation of project summaries has been prepared to provide various SRS users with a rapid overview of all current and recently completed SRS projects. All projects are either ongoing or completed during fiscal year 1985. The summaries include information on objectives, findings, methodology, authorship, and resulting publications/availability. Projects are organized in the following groups: (1) overview projects; (2) human resources (scientists, engineers, and technicians), subdivided according to characteristics, education, employment, and projections; (3) funding of science and technology, subdivided according to government, industry, universities and colleges and others; (4) outputs and impacts, subdivided according to innovations and inventions, bibliometrics, economic implications, and other areas; and (5) international science and technology. Lists of principal investigators and SRS intramural and extramural publications for 1975-1985 are provided in appendices. (JN)

DIVISION of SCIENCE RESOURCES STUDIES

PROJECT SUMMARIES: FY 1985

Directorate for Scientific, Technological, and International Affairs National Science Foundation

Washington, D.C. 20550
NSF 85-324

Telephonic Device for the Deaf

The National Science Foundation (NSF) has Telephonic Device for the Deaf (TDD) capability which enables individuals with hearing impairment to communicate with the Division of Personnel and Management for information relating to NSF programs, employment, or general information. The TDD number is (202) 357-7492.

Suggested Citation

National Science Foundation, *Project Summaries: FY 1985* (NSF 85-324)(Washington, D.C., 1985).

foreword

The Division of Science Resources Studies (SRS) engages in numerous activities to produce information and analyses pertinent to a fuller understanding of the magnitude, characteristics, and dynamics of the technical resources of the United States and of the other large, industrialized nations that perform research and development. Projects that produce this information either are staffed intramurally or consist of extramural activities supported through grants and contracts. The information generated is intended to be of interest to policymakers in all sectors of the national science and technology enterprise as well as to those who analyze the operation of this technical system. A need has been expressed for a compact reference volume that permits a rapid overview of all of the projects carried out by the Division and that provides a summary of each endeavor. This publication responds to such a need and is the fifth volume of an annual series. It presents an overview of the many facets that are being illuminated by SRS efforts. It also furnishes sufficient information on project objectives, methods, results, and references to facilitate user selection of projects for further investigation. Any constructive criticism or comments from the user community by which the format of this publication might be improved would be greatly appreciated.

Wiliam L. Stewart, Acting Director
Division of Science Resources
Studies
Directorate for Scientific,
Technological, and
International Affairs

September 1985

contents

notes

The Division of Science Resources Studies (SRS) of the National Science Foundation (NSF) has a legislatively mandated responsibility to collect, compile, and analyze information related to science and technology resources and the outputs and impacts of those resources. Such a broad charter requires the pursuit of numerous activities, the products of which are used by a diverse clientele, varying from governmental science and technology policymakers to institutional managers and research analysts. The clientele are interested not only in the actual results of the various surveys and studies, but also in the nature of projects that are still ongoing. This compilation of summaries provides these various users with a rapid overview of all currently ongoing and recently completed SRS projects. Summary publications are issued on an annual basis.

All projects summarized in this publication were either ongoing or completed during FY 1985 (October 1, 1984, through September 30, 1985). The summaries include information on objectives, findings, methodology, authorship, and resulting publications. Projects for which "NA" is given under "Major Findings" and "Availability" are those that are ongoing and for which findings and resulting publications are not yet available. The summaries are organized in major substantive groups. Projects noted as being intramural are those carried out directly by the staff of the Division and may include information developed under SRS sponsorship by other Government agencies and by contractors. Extramural projects are those for which institutions and/or principal investigators are identified, and are supported through NSF grants and contracts. Appendix A is an alphabetical listing of all principal investigators so identified in the project summaries.

Publications are identified in the three formats used by SRS: *Highlights*, Detailed Statistical Tables, and Reports. A *Highlights* is normally restricted to four pages and presents the essence of the analyzed data in brief statements and in graphic and tabular form. As soon as feasible after the *Highlights* has been issued, survey data are released as Detailed Statistical Tables for the reference and convenience of other analysts and researchers. A more complete analysis is then developed and published in a Final Report. When the subject is one of an ad hoc nature, the publication is identified as a Special Report. The SRS Editorial and Inquiries Unit (EIU) maintains a mailing list by which users of SRS publications automatically receive copies of *Highlights*, Detailed Statistical Tables, and Reports. A listing of all SRS publications issued since January 1, 1975, is included as appendixes B and C of this publication.

Written or telephone inquiries concerning the nature and availability of data may be made to any of the following appropriate offices of the Division of Science Resources Studies, 1800 G Street, N.W., Washington, D.C. 20550:

R&D Economic Studies Section, Rm. L602	202-634-4625
Government Studies Group, Rm. L602	202-634-4636
Industry Studies Group, Rm. L602	202-634-4648
Universities, Colleges, and Nonprofit Institutions Studies Group, Rm. L602	202-634-4629
Scientific and Technical Personnel Studies Section, Rm. L611	202-634-4691
Demographic Studies Group, Rm. L611	202-634-4664
Supply and Education Analysis Group, Rm. L611	202-634-4787
Utilization Studies Group, Rm. L611	202-634-4655
Science Indicators Unit, Rm. L611	202-634-4682
International Scientific and Technological Studies, Rm. L611	202-634-4640

Written or telephone inquiries concerning the availability of SRS publications may be directed to EIU, Room L611, 202-634-4622 or 202-634-4623.

section i. overviews

PROJECT:
Academic Science/Engineering, 1972-83

Objective:

To provide consolidated biennial analyses of academic research and development (R&D) expenditures, the utilization of academic scientists and engineers, and the characteristics of the graduate science/engineering (S/E) student population.

Method:

Analyses were based on data selected primarily from three academic surveys: (1) Scientific and Engineering Expenditures at Universities and Colleges, FY 1972 through FY 1982; (2) Scientific and Engineering Personnel Employed at Universities and Colleges, January 1973 through 1983; and (3) Graduate Science/Engineering Students and Postdoctorates, Fall 1975 through 1982.

Major Findings:

One out of every 10 R&D dollars was spent by universities and colleges in 1982 and one-half of the $10 billion devoted to basic research was performed in the academic sector. Between 1972 and 1982 R&D expenditures by universities grew at an average rate of 3% per year in real-dollar terms, and academic employment of scientists and engineers rose at about the same rate. The number of full-time S/E professionals rose 26% in 10 years, but part-timers increased by 77%. R&D involvement of S/E employees rose 29% between 1973 and 1983, accompanied by a similar growth in the number of S/E employees involved in teaching and other activities. Graduate S/E enrollment in doctorate-granting institutions rose 18% during the period 1975-82, with part-time enrollment going up faster than full-time—32% compared to 13%.

Responsible SRS Organizaton:

R&D Economic Studies Section/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Academic Science/Engineering: 1972-83. R&D Funds, Federal Support, Scientists and Engineers, Graduate Enrollment and Support, Final Report, NSF 84-322, available from National Technical Information Service, Springfield, Virginia 22161, PB 85-161800/AS, $11.50 (paper copy), $4.50 (microfiche), and from SRS/Editorial and Inquiries Unit.

PROJECT:
International S/T Data

Objective:

To provide recent quantitative information on science and technology (S/T) investments and activities in the large research and development (R&D) performing industrialized nations such as France, Japan, West Germany, and the United Kingdom, and to make comparisons with information on the United States.

Method:

In order to obtain the most current data possible, data were obtained through direct contacts with foreign organizations. Other data sources analyzed included foreign national reports and information from the Organisation of Economic Co-operation and Development.

Major Findings:

In 1983, the United States funded more research and development than Japan, West Germany, and France combined. Relative to the size of their economies, the United States, West Germany, and Japan are now investing about the same amount in research and development—about 2.6% of GNP in 1983. Japan and West Germany spend more on nondefense research and development as a percent of GNP than does the United States. About half of all U.S. national expenditures for research and development were financed by industry in 1983, compared with 64% of Japanese R&D expenditures, and 58% of West German expenditures.

The United States produces a greater number of doctorate-level natural scientists and engineers than does West Germany or Japan, in terms of both absolute numbers and proportions of total degrees. The United States also grants a much greater number of natural science and engineering baccalaureates than either of these two countries, although Japan graduated more bachelor's-level engineers in 1982 (74,000) than did the United States (67,000).

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

[Intramural]

Availability:

International Science and Technology Data Update (January 1985) is available from SRS/Editorial and Inquiries Unit.

PROJECT:
Resources Supporting S/E Activities at Historically Black Colleges and Universities

Objective:

To report and analyze information on the overall levels of science and engineering (S/E) resources available to historically black colleges and universities (HBC's).

Method:

Data on 107 HBC's in the United States were collected and published by NSF through four annual surveys of academic S/E resources: (1) Survey of Federal Support to Universities, Colleges, and Selected Nonprofit Institutions; (2) Survey of Scientific and Engineering Expenditures at Universities and Colleges; (3) Survey of Graduate Science and Engineering Students and Postdoctorates; and (4) Survey of Scientific and Engineering Personnel Employed at Universities and Colleges. Data utilized on Federal support and R&D expenditures were as of FY 1975 through 1982, data on graduate S/E enrollment were as of Fall 1975 through Fall 1982, and data on academic S/E employment were as of January 1976 through January 1983.

Major Findings:

Federal obligations to HBC's totaled $515 million in FY 1982, a 22% growth over 1981 in current dollars and a 9% average annual growth over the 1975 level. About five-sixths of the increase in Federal funding of HBC's during the 1975-82 period was for non-S/E programs, mostly for direct student financial assistance. Federal R&D obligations to HBC's totaled $40 million in 1982, up from $24 million in 1975. Separately budgeted R&D expenditures for S/E programs at HBC's totaled $58 million in 1982, a 16% growth in current terms over 1981 and a 15% per-year increase throughout the 1975-82 period. Between 1975 and 1982, graduate S/E enrollment at HBC's grew by 4% per year to a total of 3,500 (less than 1% of the national total). The 7,800 scientists and engineers employed by HBC's in January 1983 accounted for only 2% of the total employed in all academic institutions. Between January 1976 and January 1983, S/E employment at HBC's grew at an average annual rate of 4%.

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Resources Supporting Scientific and Engineering Activities at Historically Black Colleges and Universities, Special Report, NSF 84-332, available from National Technical Information Service, Springfield, Virginia 22161, PB 85-162162/AS, $50.50 (paper copy). $11.50 (microfiche), and from SRS/Editorial and Inquiries Unit. Access to the public-use tapes and documentation for their use are described in the December 1984 Addendum to the *Data User Guide*, available from the RDESS/Universities and Nonprofit Institutions Studies Group.

PROJECT:
S/E Personnel

Objective:

To provide a comprehensive overview of current employment, supply patterns, and the dynamics of the labor market for all U.S. scientists and engineers.

Method:

Analysis is based on data from a coordinated set of SRS surveys and other primary and secondary data sources. The SRS surveys include the Postcensal Survey of Scientists and Engineers, the New Entrants Survey, and the Survey of Doctoral Scientists and Engineers. The report generally is descriptive, with some analytical treatment of data.

Major Findings:

Employment of scientists and engineers increased by 45% between 1976 and 1983, reaching almost 3.5 million. This rate was about three times that for the total U.S. work force and almost twice that for all professional workers. Over this period, employment of scientists increased more rapidly than that of engineers (5.8% versus 3.6%). Computer specialists led the increase among scientists and accounted for almost two-fifths of total growth in scientific employment. Women scientists and engineers made significant employment gains over the 1976-83 period, when employment of women increased more than three times as rapidly as men. Despite the increase, women continue to be underrepresented in science and engineering. In 1983, they represented 13% of all employed scientists and engineers, but 44% of all employed persons and 48% of all those in professional occupations. Blacks also made significant employment gains over the 1976-83 period, with employment of black scientists and engineers increasing more than twice as rapidly as whites. Blacks, however, continued to be underrepresented in science and engineering: in 1983, blacks represented 2.4% of scientist and engineer employment, but 9% of total U.S. employment and 6% of total professional employment.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Demographic Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Science and Engineering Personnel: A National Overview, Report, NSF 85-302, available from National Technical Information Service, Springfield, Virginia 22161, PB 85-219285/AS, $16.00 (paper copy), $4.50 (microfiche), and from SRS/Editorial and Inquiries Unit.

PROJECT:
S/T Data Book

Objective:

To present annually a graphic overview of the funding, staffing, and impacts of the Nation's scientific and technological activities through a presentation that facilitates rapid comprehension in a convenient format.

Method:

Based on data from SRS surveys and other primary and secondary data sources. Report presents information primarily by graphic means in a pocket-sized publication.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section

Institution/Principal Investigator:

[Intramural]

Availability:

The *Science and Technology Data Book*, Report, NSF 84-331, is available from SRS/Editorial and Inquiries Unit. The next issue will be published early in 1986.

PROJECT:
S/T Resources

Objective:

To present an annual overview of U.S. science and technology resources based on the most current information available to NSF.

Method:

Research and development (R&D) funding information originates from a series of systematic, regularly recurring surveys of institutions. The data are then aggregated by the four major sectors of the economy and include funding by sources of funds and performer, character of work (basic research, applied research, and development), and international comparisons.

Personnel data are derived mainly from recurring surveys of individuals. Topics concerning science and engineering (S/E) personnel include women and minorities, employment trends, S/E labor market balance, and sources of new S/E personnel.

Major Findings:

R&D expenditures in the United States are expected to total an estimated $106.6 billion in 1985, an increase of 11% over the previous year (7% in constant dollars). For 1984, the overall increase in the Nation's R&D expenditures is estimated at 11% (7% in constant dollars).

S/E employment between 1976 and 1983 increased at an annual average rate of 6% in contrast with the 2% rate for total civilian employment. The S/E unemployment rate decreased to nearly 2% by 1983, but was still substantially below the 9% rate for all workers.

Responsible SRS Organization:

R&D Economic Studies and Scientific and Technical Personnel Studies Sections

Institution/Principal Investigator:

[Intramural]

Availability:

"7% Real Growth Expected in 1985 National R&D Expenditures: Defense and Economy Major Factors," *Highlights*, NSF 85-304, January 31, 1985, available from SRS/Editorial and Inquiries Unit, and *National Patterns of Science and Technology Resources: 1986*, expected to become available from SRS/Editorial and Inquiries Unit in 1986.

PROJECT:
Science Indicators

Objective:

To present quantitative indicators of the state of science and technology in the United States, supplementing but not supplanting the judgment of policymakers who are faced with specific science and technology issues.

Method:

The report draft was prepared in the SRS/Science Indicators Unit for review by a special committee of National Science Board members. Chapters were reviewed by technical experts, by research and development (R&D) executives of other Federal agencies, and by officials from the President's Office of Science and Technology Policy and the Office of Management and Budget. The completed report is issued by the full National Science Board.

Major Findings:

Science Indicators—The 1985 Report is the seventh in a series of similar reports by the National Science Board. It presents statistical indicators with relevant interpretation and explanation. It is organized into eight chapters:

1. The International Science and Technology System
2. Support for U.S. Research and Development
3. Science and Engineering Personnel
4. Industrial Science and Technology
5. Academic Science and Engineering
6. Precollege Science and Mathematics Education
7. Public Attitudes Toward Science and Technology
8. Advances in Science and Engineering

The chapter on Precollege Science and Mathematics Education was not included in the previous *Science Indicators* reports.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

[Intramural]

Availability:

Science Indicators—The 1985 Report will be available from the Supt. of Documents, U.S. Government Printing Office, Washington, D.C. 20402, and from the Publications Office, Room 232, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550 early in 1986.

PROJECT:
U.S. Scientists and Engineers

Objective:

To provide estimates of the U.S. population of scientists and engineers, as well as of their demographic, education, and employment characteristics.

Method:

The results of several surveys conducted by the NSF Scientific and Technical Personnel Data System were synthesized to produce estimates as of mid-1982.

Major Findings:

Of the 3.1 million employed scientists and engineers in 1982, 1.3 million (41%) were scientists and almost 1.8 million (59%) were engineers. Among scientists, about one-half were either life scientists or computer specialists. A majority of both scientists (52%) and engineers (77%) were employed in business and industry in 1982; educational institutions employed almost 25% of the scientists but only 5% of the engineers. In 1982, about 12% (360,000) of all employed scientists and engineers were women. About 1 in 5 scientists was female compared to about 1 in 20 engineers. Blacks (70,000) represented over 2% and Asians (125,000) about 4% of all employed scientists and engineers. In addition, about 70,000 Hispanic scientists and engineers were employed in 1982 (2% of the total). The baccalaureate was the highest degree earned by over three-fifths of the engineers and slightly less than one-half of the scientists. About 23% of the scientists and 3% of the engineers held the doctorate.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Demographic Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

"Science and Engineering Jobs Grew Twice as Fast as Overall U.S. Employment with Industry Taking the Lead," *Highlights*, NSF 84-319, June 25, 1984, and, *U.S. Scientists and Engineers: 1982*, Detailed Statistical Tables, Volumes 1 and 2, NSF 84-321 and NSF 85-307, available from the National Technical Information Service, Springfield, Virginia 22161, Volume 1, PB 85-155166/AS, $13.00 (paper copy), $4.50 (microfiche), and Volume 2, PB 85-219301/AS, $11.50 (paper copy), $4.50 (microfiche), and from the SRS/Editorial and Inquiries Unit.

PROJECT:
Women and Minorities in Science and Engineering

Objective:

To present a factual picture of the current situation and recent trends in the participation of women and minority group members in science and engineering (S/E) employment and training. The report, the third in a biennial series, is required under Public Law 96-516.

Method:

Based on data from SRS surveys and other primary and secondary data sources. Report is primarily factual, with some analytical treatment of the data.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Demographic Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Women and Minorities in Science and Engineering, Report, will be available from the SRS/Editorial and Inquiries Unit in early 1986. For availability of reports already published, see appendix B.

section ii. human resources

a. characteristics

PROJECT:

Comparative Trends in Academic Abilities of Doctorates in Science, Engineering, and Other Professions

Objective:

To determine if persons of high academic ability and potentially high productivity are choosing careers in professions at the expense of the sciences or engineering.

Method:

Scholastic Aptitude Test (SAT) and American College Testing scores of persons who received science and engineering doctorates during the past 15 years are compared to those for persons receiving doctorates in the humanities, or degrees in business, law, and medicine. The 15-year time frame of the study allows for the analysis of data reflecting a variety of labor market conditions for new doctorates.

Major Findings:

Between 1966 and 1976, mean mathematics and verbal SAT scores of arts and sciences doctorates increased; during the 1976-81 period they declined. During the latter period, the growth in the percentage of low-scorers outpaced the growth in the percentage of individuals achieving high scores. The same pattern of scores was evident for those earning professional degrees. Similar magnitudes in declining test scores support the hypothesis that the arts and sciences have not suffered from a shift in talent to the professions in spite of the increased popularity of law, medicine, and business degrees.

These data reflect the characteristics of people who entered graduate and professional schools in the midseventies at the latest. The results do not necessarily characterize individuals who are in advanced degree programs in the eighties.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Rutgers State University/Rodney T. Hartnett

Availability:

The report, *Trends in Student Quality in Doctoral and Professional Education*, is available from the project on Trends in Academic Talent, Geology Hall, Queens Campus, Rutgers University, New Brunswick, New Jersey 08903. Enclose $2.00 payable to Rutgers University for postage and handling.

PROJECT:

Comparisons, by Sex, Tasks, and Earnings of Scientists and Engineers

Objective:

To determine the extent to which differences in gender and other measured characteristics explain earnings differentials of new entrants and experienced science and engineering (S/E) personnel. In addition, the study investigates gender differences in the choice of college major and in the transition from school to work.

Method:

The study examines the entrants to the labor market during the 1970's using survey data collected for NSF. It compares the earnings of women with those of their male counterparts by age, employment, and education, identifying the reasons women opt to enter these fields; and it examines the differences in job activities of women and men working as scientists and engineers.

Major Findings:

Persistent, gender-related earnings differentials are identified in the S/E labor market. Among both experienced and new entrant scientists and engineers, females are paid less than their male counterparts. For experienced S/E personnel, one-half of the gender differential is due to differences in worker characteristics; the remaining one-half of the differential, accounting for almost 20% of female earnings, remains unexplained. Among new labor force entrants, one-fourth to one-third of the differential is accounted for by gender differences in income-producing characteristics (primarily differences in field concentration).

Although it has become more common for women to select an S/E field, their field distribution remains significantly different from that of men. Women are less likely, for example, to select engineering as a major. Among recent labor force entrants, field-specific, education-occupation transitions do not differ by gender. Actual work tasks do not differ strikingly by sex. Men, however, are slightly more likely to be engaged in management activities.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Center for Naval Analyses/Aline Quester

Availability:

The report, *Utilization of Men and Women in Science and Engineering Occupations: Tasks and Earnings Comparability*, CRS 524, July 1984, is available from the the Public Research

Institute, Center for Naval Analyses, 2000 North Beauregard Street, Alexandria, Virginia 22311, and also is available from National Technical Information Service, Springfield, Virginia 22161, PB 85-137990, $14.50 (paper copy), $4.50 (microfiche).

PROJECT:
The Doctorate Survey

Objective:

To collect information on characteristics and work plans of new science and engineering (S/E) doctorates through the Survey of Earned Doctorates and to maintain the computerized Doctorate Records File, which is virtually a complete listing of about 787,000 students who have received their doctorates since 1920.

Method:

Questionnaires are distributed to all individuals receiving doctorates, and are completed by them near the time of graduation. In recent years, response rates have been better than 95%. Nonrespondents to the questionnaires are represented in the data base through information obtained from public records such as official commencement programs. Information is collected on demographic characteristics, educational history, sources of financial support for graduate study, and plans for postdoctoral study or employment.

Major Findings:

About 17,900 S/E doctorates were awarded in 1984, just 140 more than in 1983. Although there were 5% fewer degrees in 1984 than in the peak year of 1973, the increase over 1983 continues the slow uptrend that began in 1979 and indicates a reversal of the pattern of declines that occurred between 1973 and 1978. The number of S/E doctorates was 875 greater in 1984 than in 1978; the growth was attributable to an increase of 1,255 in degrees earned by women and by an increase of 1,100 degrees awarded by non-U.S. citizens with temporary visas. Women received about 4,570 S/E degrees in 1984, 25% of the total. Engineering doctorate production increased for the fourth consecutive year, with an increase from 2,780 in 1983 to 2,915 in 1984, but was still well below the 1972 peak of 3,500. The number of engineering doctorates awarded to U.S. citizens increased for the first time in 5 years. The share of engineering doctorates awarded to U.S. citizens declined from 67% in 1972 to 44% in 1983 and remained constant through 1984. In 1984, S/E doctorates accounted for 58% of total doctorate production.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group

Institution/Principal Investigator:

National Academy of Sciences/Peter D. Syverson

Availability:

Science and Engineering Doctorates: 1960-82, Detailed Tables and Charts, NSF 83-328, available from National Technical Information Service, Springfield, Virginia 22161, PB 85-161321/AS, $4.50 (paper copy) $4.50 (microfiche), and from SRS/Editorial and Inquiries Unit, *Summary Report, 1984. Doctorate Recipients From United States Universities* is available from the Office of Scientific and Engineering Personnel, National Research Council, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, D.C. 20418, and from the National Technical Information Service, Springfield, Virginia 22161.

PROJECT:
Foreign Citizens in U.S. Science and Engineering

Objective:

To provide information on the participation of foreign citizens in U.S. higher education and in the science and engineering (S/E) labor force.

Method:

Data were assembled from surveys conducted by SRS and other Federal and non-Federal agencies and organizations. Data indicate trends in foreign participation and the distribution of foreign scientists and engineers by S/E field and geographic location; projection scenarios of foreign participation based on assumptions regarding U.S. demographic trends are provided.

Major Findings:

Foreign enrollments in U.S. higher education at all degree levels and in all fields have nearly doubled since 1964 but still constitute less than 3% of the total. There has been substantial growth, however, in S/E fields, particularly at the graduate level. In 1983, about one-quarter of all graduate S/E students were foreign citizens; in engineering, foreign students numbered over 40% and were concentrated in civil, mechanical, and electrical engineering. In full-time graduate science programs, foreign students accounted for 40% of the enrollments in mathematics, 38% in computer sciences, and 29% in the physical sciences.

The proportion of all science doctorates awarded to foreigners has risen from 14% to 19% between 1960 and 1983; in engineering, it doubled to 56%. Increasing proportions of these foreign doctorate recipients are staying in the United States after completing their degree reaching nearly one-half in 1983. The number of foreigners holding postdoctorate appointments at U.S. universities has been stable during the early eighties, at about 7,500. Nearly 3% of the S/E labor force in 1982 were foreign citizens.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group

Institution/Principal Investigator:

[Intramural]

Availability:

Foreign Citizens in U.S. Science and Engineering: History, Status, and Outlook, will be available in late 1985 from Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group.

PROJECT:
Foreign National Scientists and Engineers in the U.S. Labor Force

Objective:

To analyze data about foreign nationals who study science and engineering in the United States and remain to work as well as those who enter the United States after receiving their degrees in other countries. Since the late 1960's, many foreign nationals migrated to the United States to study and work as scientists and engineers, but no definitive data about the trends or levels of this migration exist.

Method:

Results from a variety of surveys will be used to examine this question: NSF Surveys of Doctorate Recipients, the NSF Postcensal Surveys of Scientists and Engineers, and the NSF Surveys of Recent Science and Engineering Graduates. Information will also be obtained from Social Security Administation records to determine the extent of continuing employment of foreign nationals who earned doctorates in the United States.

Major Findings:

The proportion of the science and engineering (S/E) work force who were foreign nationals or naturalized U.S. citizens increased from 10% in 1972 to 17% in 1982. The naturalized citizen component of those from abroad increased from 50% to almost 80% during that period.

The proportion of foreigners in the S/E work force varies by type of employer, ranging from about 20% of medical school and hospital work forces to 11% of Federal Government S/E personnel.

Nearly 62% of the foreign nationals receiving U.S. doctorates in engineering or computer science in 1980-81 were employed in the United States as scientists or engineers a year later; comparable figures for the physical and life sciences were 56% and 40%, respectively. Foreign nationals made up 36% of the new Ph. D. engineering and computer science labor force entrants, 15% of those in the physical sciences, and 8% of those in life sciences.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Oak Ridge Associated Universities/Michael G. Finn

Availability:

Foreign National Scientists and Engineers in the U.S. Labor Force, 1972-82, June 1985 is available from Labor and Policy Studies Program, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, Tennessee 37821-0117.

PROJECT:
New Entrants to Science and Engineering

Objective:

To obtain the educational and employment characteristics of bachelor's- and master's-degree recipients in science and engineering (S/E) classes of 1981/82 and 1982/83.

Method:

A two-stage sampling plan was utilized to obtain a sample of S/E bachelor's- and master's-degree recipients. The first stage selected a subset of institutions from the universe of higher education institutions that grant S/E degrees. The second stage sampled graduates from the institutions selected in the first stage. Questionnaires were mailed to sample participants during the summer and fall of 1984.

Major Findings:

The average unemployment rate for all bachelor's degree holders was 6%; for master's degree holders, 2%. Nearly 62% of bachelor's-degree holders who were employed had S/E jobs; the comparable figure for master's-degree holders was 80%. In 1984, new graduates in mathematics, computer science, and engineering continued to experience the lowest unemployment rates (2%-4%) and highest levels of employment in S/E occupations (75%-90%). At the master's-degree level, unemployment rates were only 1%-3% with almost 95% in S/E jobs. Demand for graduates in other fields was substantially lower. These rates at both the bachelor's and master's levels have shown little change since 1980 despite fluctuations in economic conditions.

Continued growth in computer science job opportunities provided a high level of employment for computer science graduates as well as for graduates in other S/E fields. About 65% of the bachelor's graduates employed as computer scientists had computer science degrees. Mathematics and engineering fields provided about three-fifths of the other graduates working in this field.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Demographic Studies Group

Institution/Principal Investigator:

Institute for Survey Research, Temple University/Allan Walters

Availability:

It is expected that Detailed Statistical Tables will be available from SRS/Editorial and Inquiries Unit in early 1986. For availability of reports already published, see appendix B.

PROJECT:
Scientists and Engineers: Changes Over a Decade

Objective:

To describe changes in the science and engineering (S/E) population over the 1972-82 decade. The report focuses on individual characteristics and their relation to changes in field distribution, sectoral and regional employment, and primary work activities.

Method:

Samples of individuals with science, engineering, and related occupations were drawn from the 1970 and 1980 Decennial Censuses forming the basis of the 1972 and 1982 NSF Postcensal Surveys. Data collection focused on education, employment, demographic, and professional characteristics of the respondents.

Major Findings:

All major S/E fields increased in number over the decade. Computer science, psychology, and the biological sciences were the fastest growing fields; engineering the slowest. Growth in the employment of women outpaced average employment growth in all S/E fields. Over the decade, female S/E employment grew fastest in biological, behavioral, and social sciences, thereby increasing their concentration in these fields. Industry was the fastest growing sector of employment; about 35% of the S/E personnel were employed in this sector in 1982, compared to 23% in 1972. The proportion of S/E personnel involved primarily in basic research declined over the decade and became more concentrated in academe. Compared to the overall labor force, the S/E work force remained more concentrated in the New England, Middle Atlantic, and Pacific regions over the decade.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group

Institution/Principal Investigator:

[Intramural]

Availability:

A report is expected to be published in spring 1986, which will be available from SRS/Editorial and Inquiries Unit. For availability of reports already published, see appendix B.

PROJECT:
Survey of Doctorate Recipients

Objective:

To obtain the professional, employment, and education characteristics of the Nation's science and engineering (S/E) doctorate population.

Method:

A sample (50,000) of S/E doctorate holders who received their degrees during the period 1940-82 was drawn from the Doctorate Roster. The resulting individuals received a mail questionnaire during the spring of 1983.

Major Findings:

In 1983, the number of employed doctoral scientists and engineers in the United States reached 369,000. Employment of doctoral scientists and engineers in industry increased sharply between 1981 and 1983 (about 15% versus 7.5% for all sectors combined), continuing a trend that began in the early 1970's. Academic employment grew at little more than half the rate of industrial employment during the 1973-83 decade, and Federal Government employment grew even more slowly. As a result, by 1983 industry's share of the doctoral employment of scientists and engineers was 31%, the academic share was 53%, and the Federal Government share was 7%. Employment of computer specialists increased at three times the average rate (16.3% per year versus 5.3% per year) between 1973 and 1983. The social sciences and psychology grew at higher than average rates during this period, while physical and mathematical sciences grew at slower rates. Women and minority doctoral scientists and engineers showed strong employment gains between 1973 and 1983, an average annual growth rate of 11.2% for women and 9%-13% for blacks, Asians, and Hispanics.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Demograhic Studies Group

Institution/Principal Investigator:

National Academy of Sciences/Betty D. Maxfield

Availability:

"Ph. D. Scientists and Engineers Shift to Industrial Employment and Related Activities," *Highlights*, NSF 85-301, February 22, 1985, available from SRS/Editorial and Inquiries Unit, and *Characteristics of Doctoral Scientists and Engineers in the United States: 1983*, Detailed Statistical Tables, NSF 85-303, available from National Technical Information Service, Springfield, Virginia 22161, PB 85-219193/AS, $13.00 (paper copy), $4.50 (microfiche), and from SRS/Editorial and Inquiries Unit.

section ii. human resources

b. education

PROJECT:
Attributes of Successful Engineering Students

Objective:

To determine whether engineering students' precollege attributes, including aptitudes, attitudes, and experiences, can be used as a basis for predicting the likelihood of their success in completing academic programs. Should the findings be positive, knowledge of such attributes would then be used to identify those applicants who are most likely to complete their education and those most likely to require tutorial aid.

Method:

This study will link data from two prior surveys that examined the experiences, aptitudes, interests, and other attributes of engineers and of engineering students. These data on the characteristics of recent graduates will be applied to survey data about the precollege interests, activities, career plans and abilities of beginning engineering students to ascertain the characteristics of students most likely to complete engineering programs. The study will control for sex and race factors, and will develop profiles of those students who are most likely to become engineers.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Utilization Studies Group

Institution/Principal Investigator:

Purdue University/William K. LeBold

Availability:

Results are expected in spring 1986. For further information, contact STPSS/Utilization Studies Group.

PROJECT:
Departmental Quality Ratings and Changes in Graduate Student Enrollment and Support

Objective:

To determine whether there have been differential changes in patterns of enrollment, sources of student support, and doctoral output among research doctorate departments of varying quality. In addition to an examination of trends in sources and types of support, particular attention will be given to trends in Federal vis-a-vis the availability of alternative sources.

Method:

This project linked for the first time the NSF Survey of Graduate Science Students and Postdoctorates and the National Research Council's (NRC's) Survey of Earned Doctorates with the NRC Assessment of Quality-Related Characteristics of Research Doctorate Programs in the United States. Tables were produced to permit the analysis of enrollments and student support for full-time students in doctorate-granting departments by field of science, public and private institutional control, and departmental quality rating. In addition, tables were produced documenting trends in Ph. D. production by field and program quality, length of time between registration and degree conferral, and postdoctoral employment plans. Data were analyzed for the period 1974-82.

Major Findings:

Little change has occurred in the distribution of full-time graduate enrollments in science and engineering among quality groups. The top 25% of the rated S/E doctoral programs lost only 1.3% of their share of total full-time enrollments between 1974 and 1982. A decline occurred, however, in the proportion of full-time students enrolled for graduate studies in top-rated mathematics and computer science departments as enrollments in nonrated departments outstripped growth in rated departments. Significant variations exist among fields with respect to their share of Federal support. In the biological sciences, the top rate departments increased their share of Federal support compared to departments in lesser-rated or nonrated institutions. In psychology and the social sciences, however, the situation was reversed. There was an overall decline in the share of Federal support reported by the top 25% of the rated departments compared to departments in lesser-rated or nonrated institutions. Furthermore, psychology and the social sciences were the only fields that recorded a decline in Ph. D. production from top-rated programs between 1974 and 1982, accompanied by a substantial increase in Ph. D. production from lesser-rated or nonrated institutions.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Council of Graduate Schools in the United States/Robert G. Snyder

Availability:

Graduate Science and Engineering Enrollment and Support by Departmental Quality: 1974-82, Final Report, available for inspection in the SRS/Science Indicators Unit.

PROJECT:
Engineering Programs in Emerging Areas

Objective:

To obtain information about doctoral programs in emerging engineering areas, which include biotechnology, computers, robotics, microelectronics, materials, and manufacturing. Data were requested on the number of emerging programs in each college of engineering, the number of faculty by academic rank, faculty recruitment efforts, and number of graduate students pursuing doctorates in the emerging areas.

Method:

The survey was conducted by the Higher Education Panel of the American Council on Education. The Panel includes a stratified sample of universities and colleges. The questionnaire was mailed in June 1984 to 135 institutions that award the doctorate in engineering; an 80% response rate was obtained.

Major Findings:

About 75% of the 470 operational programs in the emerging engineering areas recruited faculty during the 1983/84 academic year and, of these, one-third failed to fill all their vacancies. The primary source of qualified applicants was new doctorate recipients from U.S. institutions, followed by faculty from other U.S. institutions. Recruitment activity was heaviest, and most successful, in computers and microelectronics. These two areas, in addition to materials, accounted for the majority of the programs, faculty, and doctoral students. Over 4,000 faculty and 7,500 doctoral engineering students were involved in emerging area programs. Over 20% of the faculty had earned foreign baccalaureates and over 45% of the students were foreign citizens.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group

Institution/Principal Investigator:

American Council on Education/Frank J. Atelsek

Availability:

The survey report is expected to be available in late 1985 from the Higher Education Panel, American Council on Education, One Dupont Circle, N.W., Washington, D.C. 20036.

PROJECT:
Foreign Students and U.S. Engineering Education

Objective:

To examine the impact of foreign graduate students in four major engineering disciplines on the teaching and research programs of engineering schools and to examine the policies that departments and schools adopt toward these students.

Method:

Information will be collected from engineering department chairpersons and faculty members to determine the volume and type of research completed, faculty perceptions of foreign students, special problems arising from the presence of large numbers of foreign students, and financial aid provided to foreign students. Opinions as well as facts will be obtained.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group

Institution/Principal Investigators:

Institute of International Education/Elinor G. Barber; Washington University/Robert P. Morgan

Availability:

Final report expected in late 1986.

PROJECT:
Graduate S/E Enrollment

Objective:

To provide quantitative information by discipline on the characteristics of graduate science and engineering (S/E) students and postdoctorates, with emphasis on their sources of support.

Method:

All graduate S/E departments in 323 doctorate-granting institutions and 18 master's-granting historically black colleges (HBC's), as well as a sample of 58 master's-granting institutions, received the annual questionnaire for fall 1984 data. There were several elements: Major sources and types of full-time graduate students' suppport, graduate enrollment status (full- or part-time), level of study, citizenship, sex, and racial/ethnic origin. Data were also collected on support patterns of postdoctorates and on nonfaculty doctoral research staff and on full-time S/E faculty by rank and tenure status with new hires and departures during the previous academic year. The survey was closed out in June 1985.

Major Findings:

NA

Responsible SRS Organization:

R&D Economics Studies Section/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Information on the availability of *Highlights* and Detailed Statistical Tables can be obtained from SRS/Editorial and Inquiries Unit. For availability of reports already published, see appendix B.

PROJECT:
On-The-Job Training of Scientists and Engineers

Objective:

To determine how scientists and engineers and their employers adjust to changing technology and deal with skill obsolescence.

Method:

Using data from the surveys of experienced scientists and engineers for 1972-78, the study measured the frequency of in-house training (on-the-job and formal training in employer-owned facilities). It sought to determine if there were measurable differences in the levels or progressions of earnings between those who received training versus other workers.

Major Findings:

About 40% of scientists and engineers engage in in-house training, but training is highly concentrated by occupation, industry, and demographic factors.

By occupation, computer specialists were the personnel most likely to have had both on-the-job training and formal training at an employer facility (38% and 35%, respectively). At the other extreme, physicists had the lowest incidence of on-the-job training (8%), and biological scientists the lowest incidence of formal training at an employer facility.

Within industries, the highest incidence of training occurred for employees of electronics/computer firms (over 30%) and the lowest, in primary metals and fabricated metals (less than 13%).

Insofar as personal characteristics are concerned, age, years of professional experience, and degree level are negatively associated with the incidence of in-house training.

Evidence indicates that employed scientists and engineers who receive training are slightly more job-mobile (any change—either within or across firms) than those who do not. Also, those who were trained received higher salaries than those who were not. Such salary differentials preceded the training, however, suggesting that there may have been an implicit requirement that higher salaried workers would engage in training subsequent to being hired.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Purdue University/William N. Cooke

Availability:

Market Adjustments by Scientists and Engineers: A Longitudinal Analysis, available from William N. Cooke, University of Michigan, School of Business Administration, Ann Arbor, Michigan 48109.

PROJECT:
The Relation Between Education and Professional Practice in Science, Engineering, and Public Policy

Objective:

To determine (1) if education for the emerging fields of science, engineering, and public policy (SEPP) is relevant and adequate; and (2) how this education can be made more responsive to employer requirements.

Method:

The project will identify and survey SEPP departments in approximately 35 universities, their graduates, and others employed in SEPP positions. It will seek information about the relationship between course offerings and job content of workers in the SEPP fields.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS) / Utilization Studies Group

Institution/Principal Investigators:

American Association for the Advancement of Science/Albert H. Teich/Barry Gold

Availability:

A final report is expected in the fall of 1985. For information on obtaining the report, contact STPSS/Utilization Studies Group.

PROJECT:

The Relation of Precollege Education in Mathematics and Science to Achievement and College Major

Objective:

To determine if there is a correlation between precollege education in science and mathematics, and the choice of a major and academic performance in college.

Method:

This study will relate precollege achievement-score data from the National Assessment of Educational Progress to data on characteristics of students and their schools that were collected from the high school classes of 1972 and 1980. The samples queried by the latter surveys, the National Longitudinal Survey of 1972 and the High School and Beyond Survey of 1980, have been resurveyed periodically to obtain information on education and employment following high school graduation.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS) / Utilization Studies Group

Institution/Principal Investigator:

University of North Carolina/Lyle Jones

Availability:

Results are expected in fall, 1985. For further information, contact STPSS/Utilization Studies Group.

PROJECT:

Selected Indicators from the Annual Survey of American College Freshmen

Objective:

To produce a set of summary tables from the Higher Education Research Institute's annual survey of first-time, full-time freshmen in four-year colleges and universities.

Method:

Survey information was provided for a selected number of questions drawn from the annual survey of American college freshmen using weighted national norms for all first-time, full-time freshmen attending 4-year colleges and universities. Tables drew on student responses by sex and by racial/ethnic group to questions addressing probable major, high school grade-point averages, anticipated need for tutoring/remedial work, parental education, and importance of certain life goals. Comparisons were made across probable fields of study.

Major Findings:

In 1983, just over 1 million students registered for the first time as freshmen in 4-year colleges and universities. This represented an increase of about 7% over the level observed in 1974. Student interest in science and engineering remained stable during that time, at about one-third of total freshmen in 1974 and again in 1983. What has changed, however, is the mix of intended S/E majors. In 1983, engineering surpassed the social sciences and biological sciences as the most popular selection of probable major field among the sciences and engineering. Furthermore, student interest has shifted away from the basic science areas, and a substantial decline has occurred in the proportion of probable S/E majors planning to work in the health professions.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Higher Education Research Institute, UCLA/Kenneth C. Green

Availability:

Tabulations are available for inspection in the SRS/Science Indicators Unit.

section ii. human resources

c. employment

PROJECT:
Academic Employment of Scientists and Engineers

Objective:

To provide annual quantitative information on professional science and engineering (S/E) personnel employed in universities and colleges.

Method:

Coordinators in a sample of 1,100 institutions with S/E programs received the questionnaire for the January 1985 survey. Data elements were level of educational attainment, discipline of employment, employment status (full- or part-time), sex, and total and R&D full-time equivalents.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Information on the availability of *Highlights* and Detailed Statistical Tables can be obtained from SRS/Editorial and Inquiries Unit. For availability of reports already published, see appendix B.

PROJECT:
Analysis and Dissemination of Data on Supply/Demand Balances of Engineering College Faculty

Objective:

To provide information on the current shortages in engineering faculty. To explore the effectiveness of various initiatives by industry, government, and academe to increase the pool of engineering doctorate candidates and to make teaching more attractive than it has been to the young doctorate.

Method:

A fall 1983 survey of a representative sample of engineering deans at schools offering bachelor's or higher degrees in engineering collected data on unfilled faculty positions. This information was compared to similar data collected during 1981 and 1982 to determine trends in faculty shortages by engineering discipline. The information was broken down by geographic region and public versus private institutions.

Major Findings:

Faculty shortages continue to be a problem for engineering colleges. The number of vacancies was greater in 1983 than in 1982 primarily because of an increase in authorized positions of full-time, tenure-track engineering faculty. In the fall of 1983, 1,550 or 8.4% of the 18,440 authorized positions were unfilled. This compares to 1,400 vacancies or 7.9% of 18,000 authorized positions in 1982. Another indicator of the faculty shortage situation, the proportion of vacancies unfilled for a year or more, declined slightly from 4.4% in 1982 to 4.0% in 1983.

The faculty shortage situation was most severe for computer science faculty with over 16% of the positions vacant in 1983, down slightly from 19% in 1982. Civil engineering continued to have the lowest proportion of unfilled positions, less than 6% in 1983. In five of seven major fields, faculty shortages were greater in 1983 than in 1982, most notably in electrical/electronics engineering (10%) and aeronautical/astronautical engineering (8%).

In fall 1983, most vacancies continued to be for assistant professors. Although comprising only 25% of total authorized positions, assistant professorships accounted for over 60% of total engineering faculty vacancies.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Utilization Studies Group

Institution/Principal Investigator:

American Society for Engineering Education/Edward Lear

Availability:

Results were published in the article, "ASEE Survey of Engineering Faculty and Graduate Students, Fall 1983," *Engineering Education*, October 1984. For further information contact STPSS/Utilization Studies Group.

PROJECT:
Demographic and Economic Determinants of Scientific Productivity

Objective:

To study (1) the factors determining individual scientific productivity of doctoral scientists by isolating separately the effects of age, lapse of time since degree receipt or entry into the field's labor market ("vintage"), and cumulative outside influences during the passage of time; and (2) the ramifications of these trends upon potential productivity in science fields vital to the national defense and the economy.

Method:

Econometric modeling will be used to sort the separate effects of age, time of degree receipt, and calendar time on productivity.

The study uses pooled cross-section, time-series data from the National Research Council's 1973-81 National Surveys of Doctorate Recipients. These surveys contain information on date doctorate was received, age, tenure status, race, sex, identity of doctorate-granting institution, and characteristics of the current employer. Productivity will be measured by the output of publications and will be ascertained by matching the sample population with the *Science Citation Index*.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Utilization Studies Group

Institution/Principal Investigator:

Georgia State University/Paula Stephan

Availability:

Results are expected in the fall 1986. For further information, contact STPSS/Utilization Studies Group

PROJECT:

A Description of Federal Data on the Supply and Demand of S/E Personnel

Objective:

Population and employment estimates for science and engineering (S/E) personnel derived from various surveys differ due to differences in concepts and survey methodology, as well as both sampling and nonsampling errors. These differences have posed problems to various users of S/E personnel who are unfamiliar with the characteristics of various Federal surveys that provide information on these personnel. The purpose of this report is to review major sources of Federal data on the supply and demand of S/E personnel, explaining the principle uses of various surveys as well as the concepts and definitions that underlie their data estimates.

Method:

Characteristics of the following seven major sources of Federal S/E personnel data are summarized: the Scientific and Technical Personnel Data System (NSF), the Occupational Employment Statistics Matrix (Bureau of Labor Statistics (BLS)), the 1980 Decennial Census (Bureau of the Census), the Current Population Survey (BLS), the Survey of Academic Scientists and Engineers Employed at Universities and Colleges (NSF), Central Personnel Data File (Office of Personnel Management), and the Industrial Research and Development Survey (NSF). Where appropriate, data estimates are compared to indicate the magnitude and sources of discrepancies.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section

Institution/Principal Investigator:

[Intramural]

Availability:

Final report is expected spring 1986 and will be available from SRS/Editorial and Inquiries Unit.

PROJECT:

Developing New Indicators of Input into Science and Technology

Objective:

To test the utility of state-of-the-art survey research methods to generate indicators of the participation of university and college science and engineering (S/E) faculty in paid, private, off-campus consulting and R&D work. Another issue to be explored is the hypothesis that college university S/E faculty who engaged in off-campus consulting and research and development play a particularly strong role in small, innovative industrial firms.

Method:

The study will be limited to full-time S/E faculty at doctoral/ research institutions and comprehensive colleges and universities (as classified by the Carnegie Council in 1976 and as updated by the National Center for Education Statistics in 1980). A total of 1,200 scientists and engineers will be interviewed by telephone regarding the nature and extent of paid, private, on-campus consulting and R&D work during 1984. A subsample of these scientists and engineers will be interviewed in person to validate the findings from the telephone interviews. In addition, a limited number of interviews with off-campus employers of faculty consultants is planned to generate additional information regarding the validity of faculty respondents' statements about the nature of their contributions.

Major Findings:

NA

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Foundation of California State University, Sacramento/Frank Darknell

Availability:

Final report is expected in summer 1986 and will be available from the SRS/Science Indicators Unit.

PROJECT:
Graduate S/E Faculty

Objective:

To provide quantitative information on science and engineering (S/E) faculty composition, new appointments, and departures from graduate institutions.

Method:

In fall 1983, coordinators at 617 graduate institutions from 8,242 S/E departments provided information on faculty size, rank and tenure status, new appointments, and departures (by reason for leaving) on the Survey of Graduate Science Students and Postdoctorates conducted by NSF. This response represents 85% of total departments.

Major Findings:

Of the approximately 138,000 S/E faculty at graduate institutions, almost 45% held positions in life sciences departments or programs; about 15% were in engineering. Over 40% of the full-time S/E faculty were full professors; assistant professors accounted for almost 25%. The distribution of assistant professors by fields ranged from 30% in computer science to 15% in the physical sciences.

Almost 21,500 full-time S/E faculty were newly appointed in the 1982/83 academic year, representing 15% of the S/E faclty in 1983. About 7,400 S/E faculty left their employers in the 1982/83 academic year. Almost 60% of the departures were from non-tenured positions.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Supply and Education Analysis Group

Institution/Principal Investigator:

[Intramural]

Availability:

Tabulations are available for inspection in STPSS/Supply and Education Analysis Group.

PROJECT:
The Qualities of Occupationally Mobile Scientists and Engineers

Objective:

Employers of scientists and engineers historically fill many vacancies with in-mobile workers rather than with new graduates whose degrees are in a field directly related to the occupation. This study seeks answers to questions about the qualitative functioning of the mobility process, including the extent of upgrading or transfer of workers from other occupations, the rate at which workers with previous experience in the occupation return, and the education and training necessary for each such group.

Method:

The study will present the results of tabulations, as well as correlation and regression analysis of the various measures by occupation and mobility status. Three data sources will be examined: the NSF Experienced Sample Surveys for 1972, 1974, 1976, and 1978; the 1982 Postcensal Survey; and data from the Current Population Surveys for 1973, 1978, 1981, and 1983.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Utilization Studies Group

Institution/Principal Investigator:

Oklahoma State University/Robert DauffenBach

Availability:

Results are expected in FY 1986. For further information contact STPSS/Utilization Studies Group

PROJECT:
A Rapid Industry Limited-Response Survey Panel on S/E Personnel Resources

Objective:

To acquire and disseminate information on the industrial labor market for S/E personnel so that policy can be formulated rapidly to meet urgent needs.

Method:

A survey based on an industry panel of company representatives for several hundred large Fortune 500 and medium-sized firms representing approximately 16% of U.S. S/E personnel. The survey is designed to obtain qualitative and quantitative infor-

mation that is not readily available on a timely basis from any other sources.

Major Findings:

Five surveys were conducted between 1981 and 1985. Four of these surveys were designed to monitor labor market conditions of S/E personnel by field, degree level, and work experience; one survey obtained information on the industrial utilization of foreign national scientists and engineers.

The four labor market surveys traced the trends in supply/demand balance. Shortages were reported for chemistry, computer science, and for electrical, electronics, petroleum, and computer engineering in 1981; shortages declined from 1982 to 1983 because of the economic recession; then increased for electrical, computer, electronics, and nuclear engineering in 1984.

The survey on the industrial utilization of foreign S/E personnel found that significant proportions of S/E employers hired foreign personnel during the 1984-85 recruiting period.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Market Facts, Inc./Carol Rice

Availability:

"Shortages Increase for Engineering Personnel in Industry," *Highlights*, NSF 85-309, March 29, 1985, "Industry Reports Shortages of Scientists and Engineers Down Substantially From 1982 to 1983," *Highlights*, NSF 84-303, February 17, 1984, and "Labor Markets for New Science and Engineering Graduates in Private Industry," *Highlights*, NSF 82-310, June 9, 1982; available from SRS/Editorial and Inquiries Unit.

PROJECT:
S/T Personnel Employed by the Federal Government

Objective:

To describe the patterns of employment of scientists, engineers, and technicians (SET) in the Federal Government and to provide information on trends in their utilization within Government over the 1973-83 decade. Federal SET-personnel characteristics analyzed include occupation, sex, race, age, educational attainment, agency of employment, salary, and work activity.

Method:

The Federal Office of Personnel Management maintains a Central Personnel Data File that contains personnel records for individuals employed in all Federal agencies. Each year NSF examines data for the month of October, obtaining information on individuals who are employed in SET occupations, as well as on individuals who have science and engineering (S/E) degrees but are employed in non-S/E jobs.

Major Findings:

The Federal Government is the Nation's largest single employer of scientists and engineers. In 1983, the 318,000 Federal civilian SET personnel comprised approximately 8% of the U.S. total. The Department of Defense employs nearly one-half of Federal S/E employees, including nearly one-fourth of scientists (excluding computer specialists), two-thirds of engineers, and three-fifths of computer specialists. Between 1973 and 1983, the Federal component of the S/E work force grew at an average annual rate of 2%, and national S/E employment grew at an annual rate of 4%.

Federal employment is more technologically intensive than the total U.S. work force. In 1983, about 15% of Federal white-collar employees were S/E personnel, compared to only 6% of total white-collar employment. One-quarter of the Federal S/E personnel were engaged in research and development.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Federal Scientific and Technical Workers: Numbers and Characteristics, 1973 and 1983, Final Report, NSF 85-312, is available from the SRS/Editorial and Inquiries Unit.

PROJECT:
Scientists, Engineers, and Technicians in Private Industry

Objective:

To provide data on employment of scientists, engineers, and technicians in the private sector by occupation and industry of employment.

Method:

Data are based on the Occupational Employment Statistics (OES) Survey of industrial establishments conducted by State Employment Security Agencies in cooperation with the Bureau of Labor Statistics. The State data are combined into national employment estimates for Standard Industrial Classification (SIC) codes. This is an ongoing survey that began in 1977. Each year one of three subsectors covering manufacturing, trade and regulated, or other nonmanufacturing industries is surveyed.

Major Findings:

The 1977-83 surveys show that the U.S. workplace is increasing in technological sophistication. Increases in the number of science, engineering, and technician (SET) personnel have outpaced labor force growth in manufacturing and nonmanufacturing industries. Even during the 1980-83 period, during which a recession took place and total manufacturing employment dropped by 9%, the number of SET personnel grew 6%.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Bureau of Labor Statistics/Brian MacDonald

Availability:

Scientists, Engineers, and Technicians in Manufacturing and Nonmanufacturing Industries: 1980-81, Detailed Statistical Tables, NSF 83-324; "Technical Employment Growth Accelerates in Selected Nonmanufacturing Industries" *Highlights*, NSF 83-321, October 17, 1983; *Scientific and Technical Work Force in Trade and Regulated Industries Shows Major Shift in Occupational Composition: 1979-82*, Report, NSF 84-323, May 1984, available from National Technical Information Service, Springfield, Virginia 22161, PB 85-163210/AS, $8.50 (paper copy), $4.50 (microfiche), and from SRS/Editorial and Inquiries Unit; and *Changing Employment Patterns of Scientists, Engineers, and Technicians in Manufacturing Industries: 1977-80*, Final Report, NSF 82-331, October 1982, National Technical Information Service, Springfield, Virginia 22161, PB 83-210690, $10.00 (paper copy), $4.00 (microfiche), also available from SRS/Editorial and Inquiries Unit.

PROJECT:

Short-term Labor Market Adjustments by Scientists and Engineers

Objective:

To determine how employment patterns of scientists and engineers respond to changing labor market conditions. Using data from the seventies, it will differentiate behavior between men and women, among minority groups, and between experienced workers and new entrants to the labor force.

Method:

Using econometric methods and data from NSF surveys of new entrants and experienced workers, the project will trace work activities, occupations, and other career choices made by scientists and engineers. Labor market conditions, as they were both before and at the time the choices were made, will be related to each other.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Utilization Studies Group

Institution/Principal Investigator:

University of Wisconsin, Madison/W. Lee Hansen

Availability:

Results are expected in fall 1986. For further information contact STPSS/Utilization Studies Group.

section ii. human resources

d. projections

PROJECT:
Computer Model Estimates of the S/E Population

Objective:

To develop and implement a computer model for the production of national estimates of the demographic and employment characteristics of scientists and engineers in the United States using the results of several SRS-sponsored surveys of science and engineering (S/E) personnel resources.

Method:

The computer model (SETAB) consists of the three sets of routines. The first extracts information from the raw files and creates smaller microdata files that may be processed economically and rapidly. A second set manipulates the survey data by "aging" the data collected in one year to represent a population in a later year or to impute missing information. The third set produces a series of tables consistent in format with previously published NSF data. Data files and methods thus developed are being used to trace changes in the geographic, demographic, and employment characteristics of scientists and engineers. The employment characteristics include labor force status, sector of employment, and primary work activity.

Major Findings:

SETAB is being used to produce tabulations for scientists and engineers for 1984. Estimates for prior years have been revised on the basis of data from the 1982 Postcensal Survey.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section (STPSS)/ Demographic Studies Group

Institution/Principal Investigator:

Mathematica Policy Research, Inc./David Edson

Availability:

The 1982 Composite Estimates of Scientists and Engineers: Documentation of Methodology, Report, available from STPSS/ Demographic Studies Group.

PROJECT:
The Engineering Degree-Conferral Process—Analysis and Projections

Objective:

To develop a series of econometric models that project the supply of new engineering graduates by field of engineering, race, and sex.

Method:

The projections will be both short term (up to 5 years) and long term, and will be closely related to projections of the economic conditions that affect the market place for engineers, comparing them to past occupational-choice patterns of students.

Major Findings:

The report provides projections of engineering degrees based on trends in the relationship between enrollments and degrees. Bachelor's degree production is projected to continue to rise through 1987. By 1987, total B.S. degrees are projected to be in the range of 78,000 to 79,000, up from a level of 72,500 in 1983. The bulk of the projected increase in degrees occurs in the electrical/electronics engineering field, which is projected to increase to 22,500 degrees in 1987 from the 1983 level of 18,600. Some fields are constant or show projected declines; these include civil and industrial engineers.

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Utilization Studies Group

Institution/Principal Investigator:

Engineering Manpower Commission/Patrick Sheridan

Availability:

The report, *The Engineering Degree Conferral Process: Analysis, Monitoring, and Projections*, is available from Dr. Robert DauffenBach, College of Business Administration, Room 345, Oklahoma State University, Stillwater, Oklahoma 74074.

section iii. funding of science and technology

a. government

PROJECT:
Federal R&D Funding

Objective:

To develop comprehensive data and analyses of funding levels for R&D and R&D plant programs of Federal agencies. To present data and analyses based on a survey of all agencies sponsoring R&D programs, covering such categories as basic research, applied research, development, performing sectors, fields of science, and geographic (State) distribution.

Method:

The survey is a recurring one, using a questionnaire that is sent annually to all Federal agencies that support R&D programs. Agency subdivisions that respond to the survey are, for the most part, budget offices where records are maintained of past and ongoing program levels and latest budget request levels. Responses to the 1984-86 (Volume XXXIV) survey were received and reviewed by NSF by mid-July 1985. They were processed by computer in the form of 133 detailed statistical tables.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Government Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Information on the availability of *Highlights* and Detailed Statistical Tables can be obtained from the SRS/Editorial and Inquiries Unit; *Federal Funds for Research and Development, Historical Tables: Fiscal Years 1967-86* is unpublished and will be available gratis by December 1985 from RDESS/Government Studies Group, upon request.

PROJECT:
Federal R&D Programs by Budget Function

Objective:

To provide a complete annual overview of Federal R&D program planning and to offer a record of amounts requested in the President's latest budget. Also to afford a view of R&D amounts as shares of total budget function amounts, and to provide a means of quickly assessing relative priorities given to various R&D functional areas and various R&D programs within the Federal R&D total. To provide a basis for keeping track of subsequent congressional appropriation actions subsequent to the budget presentation. The report groups approximately 600 R&D programs included in the Federal budget by budget function. Tables are accompanied by brief descriptions of funding changes for specific programs.

Method:

Sources of funding data were reports provided by the agencies to the Office of Management and Budget for "Special Analysis K: Research and Development" in the 1986 budget, presented in February 1985, plus agency budget justification documents prepared for the Congress, and some information provided informally by some of the smaller R&D support agencies. The data were developed and arranged by budget function by NSF/SRS staff, and descriptions of budget changes were produced from budget documents.

Major Findings:

Total R&D budget authority for all R&D programs, as proposed in the 1986 budget, is $58,257 million, 15% higher than the 1985 total of $50,479 million, allowing for considerable real growth. This increase contrasts with the .5% decrease in 1986 budget authority in the overall Federal budget. The 1986 budget continues to place high priority on research and development relevant to the Nation's long-term well-being. Federal R&D support was targeted especially at national defense and space research and development. At the same time, the 1986 budget continues to propose reductions in nearer-term R&D programs that are not considered an appropriate Federal responsibility. These reductions occur in a number of programs and agencies, including nearer-term, technology-development programs within energy and natural resources and environment. R&D priorities, measured in terms of shares of the total held by various functional areas, have continued to shift over the 1984-86 period, with the most dramatic change occurring in national defense. This functional area accounted for 66% of the total in 1984, then grew to 68% in 1985 and 73% in the 1986 budget.

Responsible SRS Organization:

R&D Economic Studies Section/Government Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

"15% Increase in Federal R&D Funds Proposed in 1986 Budget, Mostly for Defense," *Highlights*, NSF 85-322, July 31, 1985, and *Federal R&D Funding by Budget Function: Fiscal Years 1984-86*, Report, NSF 85-319, March 1985, available from SRS/Editorial and Inquiries Unit.

PROJECT:
Federal Support to Academic and Nonprofit Sectors

Objective:

To develop annual data from the Federal agencies believed to fund the largest programs in support of academic and selected nonprofit institutional S/E and non-S/E activities, particularly research and development.

Method:

Fifteen agencies received instruction booklets and institutional Code Books defining the activities and disciplines concerned for FY 1984. There were four data elements: Agency, name of institution, discipline, and activity (research and development, R&D plant, instructionaal facilities/equipment, fellowships/ traineeships/training grants, general S/E support, and other S/E and non-S/E activities). The survey was closed out June 1985.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Highlights and Detailed Statistical Tables will be published in 1986 and will be available from SRS/Editorial and Inquiries Unit. For availability of reports already published, see appendix B.

section iii. funding of science and technology

b. industry

PROJECT:
Biotechnology Research and Development in Industry

Objective:

To provide estimates of industry's financing of biotechnology research and development and employment of scientists and engineers working on biotechnology R&D projects during 1984 and 1985.

Method:

The report will be based on information obtained from a survey of approximately 150 companies involved in biotechnology research and development. The proposed survey instrument has been sent to the Office of Management and Budget for approval.

Major Findings:

NA

Responsibile SRS Organization:

R&D Economic Studies Section

Institution/Principal Investigator:

[Intramural]

Availability:

This report is expected to become available in summer 1986 from SRS/Editorial and Inquiries Unit.

PROJECT:
Development of a Mechanism for Linking NSF Industrial R&D Data to Other Data Bases

Objective:

To provide a historical company-level R&D data file, and a linking mechanism to other economic data that can be used by researchers in analyzing the relationships between R&D funding and other economic variables.

Method:

The Census Bureau will create a linking mechanism and demonstrate the system developed by which researchers can better utilize the NSF/Census Bureau industrial R&D data base for the years 1972-83, which were collected on an enterprise basis, in conjunction with economic data sets that were collected on an establishment basis. To date, the different collection units for various data files have been the major constraint in accessing these data. During the current phase of the project, the Census Bureau will undertake two pilot test studies to demonstrate the use of the data base management system that has been developed.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Industry Studies Group

Institution/Principal Investigator:

Bureau of the Census/John R. Norsworthy

Availability:

The R&D data file and the demonstration studies will be completed by spring 1986. Researchers interested in accessing these data files should contact the RDESS/Industry Studies Group.

PROJECT:
Estimates of Company-funded Industrial R&D Expenditures

Objective:

To provide estimates of companies' own financing of research and development in major industries for 1985-86 and to outline the factors such as the Economic Recovery Tax Act (ERTA) of 1981 that are or will be affecting the funding of these activities.

Method:

The report is based on information obtained from two sources: (1) mail responses to an inquiry sent to members of the NSF Industrial Panel on Science and Technology, and (2) interviews with R&D officials representing firms in the major R&D-performing industries. Of the 89 company representatives contacted during April-June 1985, replies were received from 74. The respondents were asked to estimate the growth, if any, in company-funded R&D expenditures over the previous year for 1985 and 1986, and to provide the factors they believed to be responsible for any changes. They were also asked to assess the effect on their R&D budgets of R&D tax credits from ERTA, which are scheduled to expire in December 1985.

Major Findings:

Total company-funded expenditures for research and development in the United States are estimated to be $53 billion in 1985, an increase of about 12% over 1984. As of mid-1985, company R&D officials were anticipating about 9% growth in research and development for 1986. Reasons given for the lower growth rate in 1986 included expectations of less profit growth by some companies and the completion of major R&D projects by others.

Less than one-third of the respondents said that their R&D tax credits had favorably influenced their pre-1986 budgets. Over 40% of the company responses mentioned that they were involved in R&D funding at universities and about 45% said they

were working on joint research projects with other companies or with consortia.

Responsible SRS Organization:

R&D Economic Studies Section/Industry Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

A report is expected to become available in fall 1985 from SRS/ Editorial and Inquiries Unit.

PROJECT:
Impact of Foreign R&D Funding on U.S. Private R&D Spending

Objective:

To examine the impact of foreign expenditures on industrial research and development. It is hypothesized that industrial research and development in Japan and in Europe will elicit a competitive response in the United States.

Method:

Expenditures on industrial research and development in Japan and in Europe are included in regression equations in which private R&D expenditure in the United States is the dependent variable. Data on scientists and engineers engaged in research and development in industry are used to confirm the results of the first phase.

Major Findings:

The ability of regression models to predict private industrial R&D expenditures tends to improve when foreign R&D expenditures are included: Japanese industrial research and development appears to elicit a stronger reaction from U.S. firms than does European R&D expenditures. There is evidence that industrial R&D expenditures by different countries are interdependent.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

National Planning Association/Nestor Terleckyj

Availability:

A final report is expected in late 1985 and will be available from SRS/Science Indicators Unit.

PROJECT:
Industrial R&D Expenditures by State and Geographic Region

Objective:

To examine R&D spending by industrial firms by State or region.

Method:

Geographic data from the annual survey of industrial research and development will be analyzed to determine the magnitude of R&D spending by the major R&D performing industries by State.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section/Industry Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

It is expected that this report will become available in 1986 from SRS/Editorial and Inquiries Unit.

PROJECT:
R&D Expenditures in the Service Industries

Objective:

To develop better estimates of current service-sector research and development (R&D) expenditures, and to recommend methodology for continued improvement in the measurement of service-sector R&D activitics. In addition, some insight will be gained into how R&D funding levels are determined by service-sector managers.

Method:

The research will be conducted in three stages: (1) Service-industry managers in five service industries will be interviewed in an attempt to understand their decision process with respect to R&D expenditures; (2) using extant data, 100 manufacturing companies will be analyzed to estimate the proportion of their R&D expenditures spent by their service-sector components; and (3) the results will be integrated and studied to determine if methodology might be revised to improve data collection on the R&D activities of service industries.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Industry Studies Group

Institution/Principal Investigator:

Cooper and Company/Gershon Cooper

Availability:

Final report will be available for inspection in fall 1985 in the RDESS/Industry Studies Group.

PROJECT:
Research and Development in Industry

Objective:

To provide data on the resources allocated to research and development by domestic firms. These statistics are published annually and present historical trend information in addition to current survey-year data.

Method:

The annual survey of industrial research and development is conducted by the Bureau of the Census for NSF. Companies surveyed are selected from a sample of 15,000 companies. All manufacturing and selected nonmanufacturing companies with 500 or more employees are surveyed every year; those with fewer than 500 employees are surveyed at rates depending on the industry and on the amount spent on research and development. When companies do not provide the requested data, the Census Bureau estimates their expenditures on the basis of earlier reports and/or industry averages.

Major Findings:

Industrial R&D expenditures totaled $62.8 billion in 1983, a constant-dollar increase of 4% over the previous year's level. Industry's R&D performance has grown steadily since 1975: combined company and Federal funding, in real terms, increased at an average annual rate of 5.3% between 1975 and 1983. Federal funding of industrial R&D performance in 1983 amounted to $20.2 billion, 9% more than the 1982 level (5% in constant dollars), whereas industry's own R&D spending—$42.6 billion—increased 8% (4% in constant dollars).

Also in 1983, the electrical equipment industry, with R&D expenditures totaling $13.7 billion, had the largest percentage increase of any major R&D performing industry—17% in current dollars.

The number of full-time-equivalent R&D scientists and engineers in industry rose 3% during 1983 to a total of 538,000.

Responsible SRS Organization:

R&D Economic Studies Section/Industry Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

"Federal Emphasis on Defense is Major Factor in Industrial R&D Performance," *Highlights*, NSF 85-318 (Rev.), June 21, 1985, available from SRS/Editorial and Inquiries Unit. Information on the availability of Detailed Statistical Tables can be obtained from SRS/Editorial and Inquiries Unit. For availability of reports already published, see appendix B.

PROJECT:
Sources of Information on National Industrial R&D Expenditures

Objective:

To compare NSF's national industrial research and development (R&D) data with figures published by seven other organizations: U.S. Securities and Exchange Commission, *Inside R&D*, *Business Week*, McGraw-Hill Publications Company, *Research and Development*, Battelle Memorial Institute, and the Industrial Research Institute; and to explain the reasons for differences among the published data.

Method:

All relevant published reports were examined, instructions and definitions were compared, and all information was verified with original authors. The items compared included surveys' methodologies, frequency of collection, number of firms in sample, definitions of research and development, number of scientists and engineers, and other R&D-related elements.

Major Findings:

The NSF annual survey remains the most comprehensive overall source of industrial R&D data because it uses a statistically weighted sample that represents firms (including those privately held and foreign-owned) in identified R&D-performing industries in the United States. The sample obtains at least 98% coverage of industrial R&D expenditures.

The seven other data sources provide additional R&D data elements, e.g., R&D capital expenditures, and offer different schedules for data availability.

Responsible SRS Organization:

R&D Economic Studies Section/Industry Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

A Comparative Analysis of Information on National Industrial R&D Expenditures, Special Report, NSF 85-311, March 1985,

available from National Technical Information Service, Springfield, Virginia 22161, PB 85-214476/AS, $7.00 (paper copy), $4.50 (microfiche), and from SRS/Editorial and Inquiries Unit.

PROJECT:
Trends in R&D Limited Partnerships

Objective:

To collect data on the extent and structure of R&D limited partnerships (RDLP's), and to evaluate the probable near-term growth characteristics of this funding mechanism. The value of using data on RDLP's to serve as an indicator of technical activity will also be explored. The study will provide valuable data and insight on a new and growing source of R&D funding in the industrial sector, which is the major performer of research and development in the United States.

Method:

The report will be based on interviews with officials both of companies using the RDLP mechanism and of investment houses. The Principal Investigator will also cooperate with other Government agencies concerned with RDLP's and will use their information as appropriate. The data collected will include amount and sources of funds, technical fields supported, source of technical concept, and fractions of funds earmarked for research and development.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section/Industry Studies Group

Institution/Principal Investigator:

New York University/Herbert I. Fusfeld

Availability:

The report is expected to become available in 1985 from SRS/Editorial and Inquiries Unit.

PROJECT:
Venture Capital Investment in Small, High-Technology Companies

Objective:

To estimate total annual funding of small companies by venture capital firms, and to estimate the funding of high-technology companies by field of technology.

Method:

A data base, that covers new financing by venture capital companies, is used to provide statistical summaries.

Major Findings:

A major flow of venture capital into small companies occurred after the 1978 and 1981 reductions in the maximum capital gains tax. There were high levels of investment in computers, software, and computer services.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Venture Economics/Norman D. Fast

Availability:

Venture Capital Investment Trends: 1981-1983, is available for inspection in SRS/Science Indicators Unit.

section iii. funding of science and technology

c. universities and colleges

PROJECT:
NSF Baseline Survey of Major Academic Research Instruments in Academic Settings

Objective:

To develop quantitative indicators of the status of, and need for, equipment for scientific research in U.S. universities and colleges through a nationally representative survey of higher education institutions.

Method:

The contractor conducted a stratified probability sample survey of 43 universities from a universe of the approximately 160 largest academic R&D performers. During Phase I of the survey, departments within universities were subsampled in the physical, computer, and materials sciences and engineering to collect information on equipment costing between $10,000 and $1,000,000. This study is based on the "Instrumentation Indicators Feasibility Study" completed for NSF by Westat, Inc., in early 1982. During phase II of study, departments were subsampled in the biological, agricultural, environmental, and medical sciences.

Major Findings:

University researchers classified about one-fifth of the items in their research equipment inventories as obsolete and no longer in use. More than 90% of the departmental chairpersons in the physical, computer, and materials sciences and engineering reported that the lack of equipment inhibited the conduct of critical research; in contrast, the rate was only about 60% in the biological and environmental sciences. Federal agencies provided 54% of the funds used by academe to acquire scientific apparatus in these fields.

Responsible SRS Organization:

R&D Economic Studies Section/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

Westat, Inc./Lance Hodes

Availability:

Academic Research Equipment in the Physical and Computer Sciences and Engineering, released in January 1985, reports the analytical results of the first phase of this study; the *Highlights*, "Universities Report Research Equipment Shortages Are Most Severe in the Physical Sciences and Engineering," NSF 85-320, June 11, 1985, summarize the comprehensive study covering both phases that will be available in late summer 1985. These reports can be obtained from SRS/Editorial and Inquiries Unit.

PROJECT:
R&D Funds in Academic Science and Engineering

Objective:

To collect annual data from academic institutions spending over $50,000 for separately budgeted research and development.

Method:

A sample of about 400 institutions and 19 affiliated federally financed R&D centers received the questionnaires for the FY 1984 survey. There were several data elements: Source of support, amount allocated to basic research, total and federally financed R&D expenditures by S/E discipline, research equipment expenditures from separately budgeted R&D funds by discipline, and capital expenditures for facilities and equipment for research, development, and construction. The survey was closed out in June 1985.

Major Findings:

NA

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Universities and Nonprofit Institutions Studies Group

Institution/Principal Investigator:

[Intramural]

Availability:

Information on availability of *Highlights* and Detailed Statistical Tables can be obtained from SRS/Editorial and Inquiries Unit. For availability of reports already published, see appendix B.

section iii. funding of science and technology

d. other

PROJECT:

Methodology for the International Comparison of R&D Expenditures

Objective:

To assess and improve techniques for comparing R&D expenditures for different-sized countries.

Method:

There is no widely accepted way of comparing R&D expenditures in different countries. It is difficult to compare measurements in different national currencies: exchange rates reflect monetary phenomena, while currently available purchasing power parities place a low weight on R&D costs in the different economies. Measures of R&D expenditure as a proportion of national economic activity have a common unit of measurement (percentage), and correct for the different size of the economies under study, but require a measurement of the size of the national economy. Two possible measures of national economic size, gross national product and gross domestic product, are evaluated for their theoretical relationship to R&D expenditures, consistency with the methodologies of R&D data collection, availability, and practical impact on the ratios to be analyzed.

Major Findings:

Gross domestic product corresponds best to the definitions used to collect R&D expenditure data, and is available for the major countries studied in *Science Indicators*. The gross national product, however, may be a better measure of the opportunities for R&D expenditure, but comparable R&D data are not available. The choice would have had an impact on the analysis in *Science Indicators—1982*; the difference is insignificant, however, when revised and updated data are used.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

[Intramural]

Availability:

National Economic Activity and the Comparison of R&D Expenditures in Countries of Different Size is available from SRS/ Science Indicators Unit.

section iv. outputs and impacts

a. innovations and inventions

PROJECT:
Aggregate Indicators of Technology and Technology Innovation

Objective:

To extend the investigator's previous study on computers to provide a general method for measuring the advance of an industry's technological performance through time.

Method:

Three industries will be selected from such possibilities as general-purpose assembly robots, logic analyzers, and solar energy. Data on firms will be collected and used in further studies of technology transfer, the effect of firm size on innovativeness, and the relation between R&D expenditure and innovation output.

Cost is regressed against performance and date of introduction for all models of the technology. Performance will be measured in terms of the value of the product to users.

Major Findings:

NA

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

University of Texas/Kenneth E. Knight

Availability:

A final report is expected to become available in November 1985 from SRS/Science Indicators Unit. outputs and impacts

PROJECT:
Development of New Indicators of Industrial Innovation

Objective:

To test the feasibility of expanding the collection, analysis, and dissemination of information that can serve as new indicators of industrial innovative activity.

Method:

The investigator will collect data via a mail survey on new indicators of technological innovation from a large group of firms in the United States. It builds upon two years of work at the Massachussetts Institute of Technology's Center for Policy Alternatives that demonstrated the feasibility of collecting a broader range of data on industrial innovation than is currently available. The need for these data is based on the fact that many activities other than research and development—such as marketing research—contribute to the innovation process in the private sector. The investigator will compile and analyze the data collected, and debrief a subgroup of respondents.

Major Findings:

The results of a mail survey sent to 600 firms indicate that it is possible to collect meaningful data that can serve as the basis for additional indicators of industrial innovation in the United States. The data lead to plausible conclusions about inter-firm and inter-industry differences in the level and character of innovation. Findings from the study include data for 1982 on the number of new products generated per dollar of sales; the percentage of 1982 sales generated by products first marketed in the previous five years; the average number of grants and contracts given to universities; and types of activities in which firms had been involved during the 1980-82 period for the purpose of exploiting a new technological development.

Responsible SRS Organization:

R&D Economic Studies Section (RDESS)/Industry Studies Group

Institution/Principal Investigator:

Boston University/John A. Hansen

Availability:

An executive summary of the findings and a limited number of copies of the final report are available from RDESS/Industry Studies Group.

PROJECT:
Patenting in the United States by Various Countries in Various Fields of Technology

Objective:

To provide current and time-series data on patenting in the United States for 55 product fields and 10 designated technology fields, analyzed by country of origin, sector of patent owner, year of patent application, and year of patent grant.

Method:

Data are based on the computer file of patenting data of the Office of Technology Assessment and Forecast. They are converted from the Patent Office Classification system to the Standard Industrial Classification system for 55 product fields, by a revised concordance.

Major Findings:

Data covering the years 1963-83 show the increasing importance of foreign inventions and some decline in patenting by U.S. industry, with increases since 1979.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Office of Technology Assessment and Forecast, U.S. Patent and Trademark Office/John F. Terapane

Availability:

Patenting Trends in the United States and Other Countries: Fractional Count Report, 1963-1983 and *OTAF Custom Report: Selected Technologies, 1969-1983*, available from the SRS/Science Indicators Unit in microfiche form.

PROJECT:
Patent Office Concordance Review and Workshop

Objective:

To update and improve the "concordance," the computer program developed by the Patent Office to convert patent counts classified in terms of the Patent Office classification system to the Standard Industrial Classification.

Method:

Complete documentation for the concordance will be developed and studied. A workshop of experts in the use of patenting data made criticisms and suggestions. A final report to NSF will summarize these steps and make recommendations for changes in the concordance. Changes agreed upon will be implemented.

Major Findings:

Efforts were made to assess the level of error in the concordance. An update of the concordance in 1984 embodied some recommended changes. Alternatives to the concordance for special purposes are discussed in the report.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Office of Technology Assessment and Forecast, U.S. Patent and Trademark Office/John F. Terapane

Availability:

Review and Assessment of the OTAF Concordance Between the U.S. Patent Classification and the Standard Industrial Classification Systems: Final Report, available for inspection at the SRS/Science Indicators Unit.

PROJECT:
University Patenting in the United States

Objective:

To provide time-series data on patenting in the top 100 R&D universities in the United States, by institution, year of patent application, and year of patent grant.

Method:

Data were drawn from the patent data file of the Office of Technology Assessment and Forecast for the years 1969-83. Analyses include an assessment of patent output by R&D rank of the institution (based on total R&D expenditures in 1982), control of the institution (public versus private), and type of institutional patent policy (e.g., use versus nonuse of patent management organization).

Major Findings:

The U.S. Patent and Trademark Amendments of 1980 have provided a major stimulus to U.S. universities to bring the products of federally funded research to commercial use. Between 1980 and 1984, the number of patents issued to U.S. academic institutions grew by 40%, increasing from a total of about 370 in 1980 to 520 in 1984. About 83% of the patents granted to U.S. colleges and universities in 1984 were issued to institutions ranked among the top 100 R&D universities, with the top 50 institutions accounting for about two-thirds of all U.S. university patenting alone. Between 1980 and 1984, the number of patents issued to the top 50 R&D institutions grew from approximately 245 to 330, or by about 35%. A slightly greater level of growth was observed in patents issued to the next 50 R&D institutions, whose total patent count grew from about 60 in 1980 to 100 in 1984.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Office of Technology Assessment and Forecast, U.S. Patent and Trademark Office/John F. Terapane

Availability:

Tabulations are available for inspection in the SRS/Science Indicators Unit.

PROJECT:
Updating Indicators of Technological Innovation Using Patent Examiners' Citations

Objective:

To measure inventive activity using patent statistics, differentiating between patents that are significant technically and commercially, and those that are less so.

Method:

Each patent is weighted by the number of times it is cited by examiners of subsequent patents. All patents issued during the 1971-80 period are tracked to determine the number of examiner citations received from patents issued in the 1971-82 period. The patents are disaggregated by the country of residence of the inventor and of the assignee, and are grouped into 55 classes corresponding to an arrangement of the U.S. Standard Industrial Classification.

Major Findings:

The major results of this data project appear in the National Science Board's *Science Indicators* reports.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Computer Horizons, Inc./Mark P. Carpenter

Availability:

Data are available for inspection in SRS/Science Indicators Unit

PROJECT:
Use of Computers for Research

Objective:

To collect information on current computer use in U.S. doctorate-granting institutions and to examine the potential for the use of advanced large-scale scientific computers, "supercomputers."

Method:

The survey is being conducted by the Higher Education Panel of the American Council on Education. The Panel includes a stratified sample of universities and colleges. The questionnaire was sent to doctorate-level departments in 10 selected S/E fields at each of 210 doctorate-granting institutions.

Major Findings:

NA

Responsible SRS Organization:

Scientific and Technical Personnel Studies Section/Supply and Education Analysis Group

Institution/Principal Investigator:

American Council on Education/Engin Inel Holmstrom

Availability:

The survey report, *Access to Computers for Research*, is expected to be available in fall 1985 from the Higher Education Panel, American Council on Education, One Dupont Circle, N.W., Washington, D.C. 20056.

section iv. outputs and impacts

b. bibliometrics

PROJECT:
Indicators of the Rate of Advance of Science

Objective:

To create and validate quantitative indicators of the rate of advance of two different fields of science—one rapidly advancing (cyclic AMP) and one relatively slow-moving (photosynthesis). Potential key events in the development of the fields will be identified.

Method:

The most highly cited papers in the fields are identified and then clustered by co-citation methods. The clusters, representing key events, are mapped in two dimensions, by centroid scaling, to distribute them over time and to show their proximity to each other. Published reviews and interviews with experts in the fields will serve to check the key events.

Major Findings:

Papers in fast-moving subfields are cited more often than those in slow-moving subfields. Bibliographic coupling was more successful than co-citation clustering.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Computer Horizons, Inc./Elliott Noma

Availability:

Final report is available for inspection in the SRS/Science Indicators Unit.

PROJECT:
Measuring the Growth of Knowledge in the Biomedical Sciences

Objective:

To develop and test bibliometric techniques for measuring the growth and decline of scientific specialties in the biomedical field.

Method:

Research grants made by the National Institutes of Health will be divided into subject area specialties within biomedicine. This will be done by cluster analysis of key words appearing in the grant titles and teams assigned by professional indexers. Changes in cluster size will represent changes in the amount of work being done in the corresponding specialty. Interviews with senior scientists will be used to check the results of the cluster analysis.

Major Findings:

NA

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Stanford University/Everett M. Rogers

Availability:

The final report is expected October 1985 and will be available from SRS/Science Indicators Unit.

section iv. outputs and impacts

c. economic and social implications

PROJECT:

The Impacts of Science on Society in the United States

Objective:

To investigate the means by which impacts of science on U.S. society might be observed and measured, thus laying the conceptual and methodological groundwork for a possible expansion of the indicators gathered by NSF.

Method:

This exploratory project will consist of two steps: The commissioning of a set of papers on the project theme, and the holding of a workshop to compare the papers and synthesize their findings. The papers will take as their starting point the "knowledge system in society," which is considered by the Principal Investigators to be the complex of institutions, organizations, groups, and roles that conduct knowledge-related activities. Paper writers may take as their starting point either one area of applied knowledge in society or phenomena that cut across several such areas. The papers will address the conceptual foundation for the proposed indicators as well as practical questions of indicator development and maintenance.

Major Findings:

NA

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigators:

University of Pittsburgh/Burkart Holzner, William Dunn

Availability:

A report is expected to become available from the SRS/Science Indicators Unit in winter 1986.

PROJECT:

Organizational and Strategic Factors Affecting the Distribution of Returns from Innovation and International Technology Transfer

Objective:

To identify, measure, and analyze the factors that affect the ability of firms to profitably exploit innovations abroad.

Method:

The project will proceed in two steps. First, three industries in the United States and in the United Kingdom will be studied qualitatively to identify important influences on the ability of firms to capture the profits that are earned when these innovations are transferred internationally. Second, data on the factors that were found to be important in the first phase will be collected and will be used in a regression model to predict the distribution of the returns from innovation in a fourth industry.

Major Findings:

NA

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

University of California, Berkeley/David J. Teece

Availability:

A report is expected to become available from the SRS/Science Indicators Unit during the summer of 1986.

section v. international science and technology

PROJECT:

A Comparative Study of S/T Personnel in Selected Highly Industrialized Countries

Objective:

To assemble data by which scientific and technical (S/T) personnel in the United States can be compared with those of the United Kingdom, France, and West Germany and to examine significant trends revealed by these comparative data for high technology and critical industries.

Method:

The Principal Investigators visited the selected countries and contacted representatives of industry, educational institutions, and governments in order to identify existing and future sources of data on S/T personnel. Available S/T personnel data were collected from governmental and non-governmental sources, supplemented by information obtained from a wide body of literature on the subject and from officials and recognized authorities in the selected countries and in appropriate international organizations. A special effort was made to evaluate the data bases and to supply background on the comparability of trends among the various countries. Trends in the education, training, and utilization of S/T personnel were analyzed for each of the three European countries. Comparisons were made between these countries and the United States to determine differences in the supply and utilization of S/T personnel.

Major Findings:

Comparative data on the number of natural scientists and engineers showed that in the early 1980's, the United States had 2.6 million natural scientists and engineers in the labor force compared with 621 thousand for West Germany, 633 thousand for France, and 592 thousand for the United Kingdom. Although the United States has more natural scientists and engineers in the labor force than these three countries combined, the U.S. proportion of natural scientists and engineers in the labor force in the early 1980's was about the same as that of other countries.

Experts interviewed in the course of the study agree that scientists and engineers in the United States demonstrate a higher degree of mobility (geographic and occupational) than do their counterparts in the European countries. Engineers in France and West Germany more frequently move into top management positions than do those in the United States and the United Kingdom. Less attention is given in the United States to the systematic training of technicians and establishment of standards than in the European countries. Updating of skills of scientists and engineers is also more systematic in the European countries than in the United States with special tax-supported programs, notably in France. In the United States, larger firms often carry out such training for their staff and, more often than in Europe, it is up to the individual.

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

Horizon Institute for Advanced Design/Joseph Mintzes and William Tash

Availability:

Comparison of Scientific and Technical Personnel Trends in the United States, France, West Germany, and the United Kingdom Since 1970, Report, NSF 84-335, available from SRS/Editorial and Inquiries Unit.

PROJECT:

A Comparative Study of U.S. and Japanese Engineers

Objective:

To develop and analyze indicators of the number, quality, and utilization of U.S. and Japanese engineers.

Method:

Information on U.S. and Japanese engineers will be compiled and catalogued from existing data sources. These data will be critically evaluated and analyzed. New data on the career paths of comparable cohorts of U.S. and Japanese engineers will be gathered and analyzed for the purpose of adding substantive insights into these indicators. An evaluation of a sample of engineering curricula in the two countries will provide additional information on the training and knowledge base of engineers. Research will be conducted in both the United States and Japan.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigators:

Carnegie Mellon University/Henry R. Piehler and Leonard H. Lynn

Availability:

Final report is expected to become available in summer of 1986 from the SRS/Editorial and Inquires Unit.

PROJECT:
An Analysis of Japanese S/T Resources

Objective:

To examine quantitative information on the financial and human resources being invested in Japanese scientific and technological (S/T) activities, and to provide S/T data on Japan that are more detailed and more comparable with U.S. definitions than have been available previously.

Method:

Heretofore underutilized data on Japanese S/T resources will be compiled, evaluated, and analyzed. Various Japanese survey instruments used to collect the data will be examined and compared. New Japanese time series that will be constructed and compared with U.S. data include those on the total number of scientists and engineers cross-classified by subfield and industry group; total Japanese scientists and engineers by occupation, and sector; Japanese expenditures on basic research, and Japanese academic institutions' R&D expenditures. Research will be conducted in both the United States and Japan.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

University of Michigan/Gary Saxonhouse

Availability:

Final report is expected in spring/summer 1986.

PROJECT:
An S/T Resources Profile of Japan

Objective:

To provide quantitative information on science and technology (S/T) resources and activities in Japan.

Method:

S/T data from various sources will be examined, compiled, and analyzed. Japanese national reports, as well as data from the Organisation of Economic Co-operation and Development, will be utilized. Comparisons will be made with data on the United States.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

[Intramural]

Availability:

Report will be available from SRS/Editorial and Inquiries Unit in early 1986.

PROJECT:
An S/T Resources Profile of West Germany

Objective:

To provide quantitative information on science and technology (S/T) resources in West Germany.

Method:

S/T data from various sources were examined, compiled, and presented. West German national reports were utilized, as well as data from the Organisation of Economic Co-operation and Development. Comparisons were made with the United States.

Major Findings:

In 1983, West Germany spent $10.5 billion in constant (1975) U.S. dollars on research and development. Although this amount is much smaller in absolute terms than expended by the United States, the two countries' R&D investments are similarly proportionate to their economies. The ratio of R&D expenditures to the gross national product (GNP) was about 2.6% for both countries in 1983, but West Germany had a higher ratio of nondefense R&D expenditures to GNP than did the United States—2.5% compared with 1.9%. The number of first university diplomas awarded by West Germany in the natural science fields increased 50% from 5,400 in 1973 to 8,100 in 1982. Over the same period, the number of U.S. bachelor degrees in natural sciences increased only 9%. During 1973-83, the number of doctorates awarded in natural sciences and engineering increased in West Germany and declined in the United States. West Germany's share of a set of the world's influential scientific and technical literature appears to be fairly constant and actually increased slightly in the fields of physics and biomedicine. Its competitive edge in many technological areas seems to be decreasing. The West German share of world exports in many high-technology product groups has declined and West Germany has been succeeded by Japan as the foreign leader in U.S. patenting activity in most product groups. In 1980, there were 621,000 natural scientists and engineers in West Germany, representing 2.3% of the labor force, a ratio that is about the same as that of the United States (2.4%).

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

[Intramural]

Availability:

The Science and Technology Resources of West Germany, report will be available from SRS/Editorial and Inquiries Unit in 1986.

PROJECT:
Areas of Leading-edge Japanese Science and Technology

Objective:

To identify specific areas of leading-edge Japanese science and technology and to identify major areas of difference between U.S. and Japanese scientific and technological (S/T) emphases.

Method:

Scientific literature data (based on the Science Citation Index) and U.S. patent data will be refined, compiled, and analyzed. The findings will be presented in a three-dimensional map format, which will allow immediate comprehension of the S/T emphases.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

Computer Horizons, Inc./Francis Narin

Availability:

Final report is expected in fall of 1986.

PROJECT:
International Comparisons of Innovation Indicators

Objective:

To collect available empirical studies of industrial innovation conducted in the United States and in a number of foreign countries. The project will summarize and compare the methodologies and definitions employed in these studies and compare their output and results.

Method:

Recorded information concerning recent and ongoing innovation indicator projects will be identified, collected, compared, and analyzed. Onsite interviews will be conducted with researchers of a significant number of these projects in order to obtain additional information concerning the definitions used, response rates, follow-up techniques, and other characteristics and procedures used that led to successful survey results. Information concerning recent results that may not have been reported in written form will also be sought and analyzed.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

State University of New York, College at Fredonia/John A. Hansen

Availability:

Final report is expected in spring of 1986.

PROJECT:
R&D Expenditures in Selected Industrialized Countries

Objective:

To expand the R&D expenditure data base for selected industrialized countries, namely Japan, West Germany, France, and the United Kingdom.

Method:

Onsite data teams will identify foreign data sources. Data will be collected through direct contacts with officials from various sectors including government, industry, higher education, and nonprofit institutions. Reports, surveys, and other literature published in the national language will be examined. An examination of the comparability of the foreign data will be done in terms of U.S. definitions and concepts. Analytical analyses will be conducted on the foreign R&D data and comparisons will be made with U.S. R&D data trends.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigators:

SRI International/Catherine P. Ailes, and Francis W. Rushing

Availability:

Report is expected to become available from SRS/Editorial and Inquiries Unit in spring 1986. Also see *Performer Organizations and Support Strategies for Fundamental Research: United*

States, France, West Germany, United Kingdom, Japan, Soviet Union, Vols. I and II.

PROJECT:
S/T Education and Personnel in the Soviet Union

Objective:

To examine and evaluate the education and utilization of scientists, engineers, and technicians in the Soviet Union.

Method:

Quantitative and qualitative assessments will be made using a number of rare Soviet sources on education and manpower, many of which have not been utilized by Western analysts to date. The researchers have an impressive collection of such materials and will augment this collection with additional reports and data, including unpublished statistical and sociological material appearing in Soviet dissertations. The project will also analyze data collected by the U.S.-U.S.S.R. joint working group on science and technology as well as two emigre interview projects on Soviet science and technology. Appropriate comparisons will be made with other industrialized nations, particularly the United States.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigators:

Georgetown University/Harley D. Balzer and Murray Feshbach

Availability:

Final report is expected in late 1988.

PROJECT:
Soviet R&D Statistics

Objective:

To provide updated statistics on R&D investments with particular attention paid to R&D science and engineering (S/E) personnel in the Soviet Union.

Method:

Official Soviet data are analyzed at a disaggregated level and made compatible with U.S. data. Soviet S/E personnel data are adjusted to conform to the NSF concept of scientists and engineers employed in research and development. High and low estimates of the numbers of Soviet R&D scientists and engineers are provided.

Major Findings:

Soviet R&D investments rose through the late seventies and were considerably larger than U.S. investments—both in absolute numbers and in terms of the size of the economy. In 1984, the Soviet Union expended about 27 billion rubles on research and development. This represented 3.65% of their gross national product. Attempts were made to present Soviet S/E personnel data in accordance with U.S. definitions. There were between 1.4 and 1.6 million Soviet scientists and engineers engaged in research and development in 1984. The concentration of R&D scientists and engineers in the labor force was the highest of any country: 9-10 R&D scientists and engineers for every 1,000 persons in the labor force in 1984.

Responsible SRS Organization:

Science Indicators Unit

Institution/Principal Investigator:

Indiana University/Robert W. Campbell

Availability:

Robert W. Campbell, *Soviet R&D Statistics, 1970-1983*, National Technical Information Service, Springfield, Virginia 22161, PB 85-216661/AS, $10.00 (paper copy), $4.50 (microfiche). Previous reports by Robert Campbell also have useful information and data. See *Soviet R&D Statistics, 1975-1982*, National Technical Information Service, Springfield, Virginia 22161, PB 84-223015, $10.00 (paper copy) and $4.50 (microfiche); *Soviet R&D Statistics, 1977-1980*, National Technical Information Service, Springfield, Virginia 22161, PB 82-207408, $7.50 (paper copy), $4.00 (microfiche), and *Reference Source on Soviet R&D Statistics, 1950-78*, also available from SRS/Editorial and Inquiries Unit.

PROJECT:
Stock and Employment of Scientists and Engineers in Selected Countries

Objective:

To assist NSF in establishing a systematic data base that can be updated periodically on the stock and employment of scientists and engineers in France, West Germany, Japan, and the United Kingdom. Information will be sought on each country's approach to the classification of technicians and computer specialists and on data sources for these occupations.

Method:

Foreign census data will be used to prepare estimates of the number of scientists and engineers by detailed occupation. National classifications of scientists and engineers will be adjusted to conform to the classification system used by NSF. Differences in data collection and taxonomies will be analyzed.

Major Findings:

NA

Responsible SRS Organization:

International S/T Studies

Institution/Principal Investigator:

U.S. Bureau of the Census/Peter Way

Availability:

Final report is expected in spring/summer of 1986.

appendixes:

a. principal investigators
b. intramural publications, 1975-85
c. extramural publications, 1975-85

appendix a

principal investigators

appendix b

intramural publications, 1975-85

overviews

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Academic Science/Engineering: R&D Funds, Federal Support, Scientists and Engineers, Graduate Enrollment and Support			
1972-83	-----	-----	84-322
Academic Science: R&D Funds, Scientists and Engineers, Graduate Enrollment and Support			
1972-81	-----	-----	81-326
1972-77	-----	-----	80-313
Comparison of Scientific and Technical Personnel Trends in the United States, France, West Germany, and the United Kingdom Since 1970	-----	-----	84-335
A Guide to NSF Science/ Engineering Resources Data	-----	-----	84-301
International Science and Technology Data Update			
January 1985	-----	-----	Unnumbered
January 1984	-----	-----	Unnumbered
National Patterns of R&D Resources: Funds & Manpower in the United States			
1953-77	77-306	-----	77-310
1953-76	76-309	-----	76-310
1953-75	-----	-----	75-307
National Patterns of R&D Resources: Funds & Personnel in the United States			
1953-78-79	78-304	-----	78-313
National Patterns of Science and Technology Resources			
1985	85-304	-----	85-325
1984	83-316	-----	84-311
1983	82-311	-----	-----
1982	81-314	-----	82-319
1981	80-310	-----	81-311
1980	79-309	-----	80-308
Project Summaries			
FY 1985	-----	-----	85-324
FY 1984	-----	-----	84-334
FY 1983	-----	-----	83-326
1982	-----	-----	82-327
1980-81	-----	-----	81-328
Resources Supporting Scientific and Engineering Activities at Historically Black Colleges and Universities	-----	-----	84-332
Science and Engineering Personnel: A National Overview	-----	-----	85-302 82-318 80-316
Science Indicators			
1985	-----	-----	**NSB 85-1
1982	-----	-----	**NSB 83-1
1980	-----	-----	**NSB 81-1
1978	-----	-----	**NSB 79-1
1976	-----	-----	**NSB 78-1
1974	-----	-----	**NSB 75-1
Science and Technology Data Book	-----	-----	85-323 84-331 83-318

Reviews of Data on Science Resources.

**Prepared in the Division of Science Resoures Studies for the National Science Board.*

human resources

	NSF Number		
	Highlights/ Full	RDSR*	Tables
U.S. Scientists and Engineers			
1982, Volume 2	84-319	85-307	-----
1982, Volume 1	84-319	84-321	-----
1980	82-303	82-314	-----
1978	80-305	80-304	-----
1976	-----	79-305	-----
1974	76-312	-----	76-329
Characteristics			
Characteristics of Doctoral Scientists and Engineers in the United States			
1983	85-301	85-303	-----
1981	82-328	82-332	-----
1979	81-312	80-323	-----
1977	78-316	79-306	-----
1975	76-326	-----	77-309
1973	76-302 75-310	75-312A	75-312
Characteristics of Experienced Scientists and Engineers			
1978	-----	79-322	-----
1976	77-322	78-305	-----
Characteristics of the National Sample of Scientists and Engineers			
1974			
Part 1. Demographic and Educational	75-305	-----	75-333
Part 2. Employment	75-317	-----	76-323
Part 3. Geographic	75-312	-----	76-330
The 1972 Scientist and Engineer Population Redefined			
Volume 1. Demographic, Educational, and Professional Characteristics	75-305	-----	75-313
Volume 2. Labor Force and Employment Characteristics	75-326	76-306	75-327
Characteristics of Recent Science/ Engineering Graduates			
1984	85-334		
1982	84-310	84-318	-----
1980	82-320	82-313	-----
Immigrant Scientists and Engineers			
1982-84	-----	85-326	-----
The 1982 Postcensal Survey of Scientists and Engineers	-----	84-330	-----
Racial Minorities in the Scientist and Engineer Population	75-314	-----	-----
Scientists and Engineers From Abroad			
1976-78	-----	80-324	-----
1966-75	77-305	-----	-----
The Stock of Science and Engineering Master's Degree-Holders in the United States	-----	-----	81-302
Women and Minorities in Science and Engineering	-----	-----	84-300 82-302 77-304
Education			
Academic Science/Engineering: Faculty, Fall 1983	-----	85-327	-----
Academic Science/Engineering: Graduate Enrollment and Support			
Fall 1983	85-313	85-300	-----
Fall 1982	84-313	84-306	-----
Fall 1981	83-310	83-305	-----
Academic Science: Graduate Enrollment and Support			
Fall 1980	82-306	81-330	-----
Fall 1979	-----	80-321	-----
Fall 1978	79-321	79-316	-----
Academic Science/Engineering: Scientists and Engineers			
January 1984	85-317	85-316	-----
January 1983	84-317	84-309	-----
January 1982	83-317	83-311	-----
Academic Science: Scientists and Engineers			
January 1981	82-312	82-305	-----
January 1980	81-315	81-307	-----
January 1979	80-309	79-328	-----
Activities of Science and Engineering Faculty in Universities and 4-Year Colleges: 1980/81	81-317	-----	81-323
Aptitude Test Scores of Prospective Graduate Students in Science Remained Essentially the Same From 1970 to 1975	77-318	-----	-----
Characteristics of the National Sample of Scientists and Engineers			
1974			
Part 1. Demographic and Educational	75-305	-----	75-333
Foreign Participation in U.S. Science and Engineering Higher Education and Labor Markets.	-----	-----	81-316
Graduate Science Education: Student Support and Postdoctorals			
Fall 1977	78-307	78-315	-----
Fall 1976	77-302	77-319	-----
Fall 1975	75-335	76-318	77-313
Fall 1974	74-321 75-328	75-322	76-313
Growth in Neuroscience May Be Leveling Off	83-314	-----	-----
No Change in Science and Engineering Student Quality Seen by 60% of Academic Officials: At Least 25% Perceive Improvement	83-322	-----	-----

Reviews of Data on Science Resources.

*Reviews of Data on Science Resources.

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Participation of Foreign Citizens in US Science and Engineering	-----	-----	85-315
Science and Engineering Degrees: 1950-80. A Source Book	81-320	-----	82-307
Science and Engineering Doctorates			
1960-83	84-328		
1960-82	83-330	83-328	-----
1960-81	82-323	-----	83-309
Employment			
General			
Characteristics of the National Sample of Scientists and Engineers 1974			
Part 2 Employment	75-317	-----	76-323
Characteristics of Recent Science/ Engineering Graduates			
1984	85-334		
1982	84-310	84-318	-----
1980	82-320	82-313	-----
Employment Attributes of Recent Science and Engineering Graduates	80-311	-----	80-325
Employment Patterns of Recent Entrants into Science and Engineering	78-310	-----	-----
Growth in Science and Engineering Employment Accelerated in 1980 to 1981—But Demand May Have Slackened	83-300	-----	-----
Occupational Mobility of Scientists and Engineers	-----	-----	80-317
Projected Response of the Science, Engineering, and Technical Labor Market to Defense and Nondefense Needs: 1982-87	83-307	-----	84-304
Science and Engineering Doctorates			
1960-83	84-328	-----	-----
1960-82	83-330	83-328	-----
1960-81	82-323	-----	83-309
Science and Engineering Employment: 1970-80	-----	81-310	-----
S/E Jobs Grew Twice as Fast as Overall US Employment with Industry Taking the Lead	84-319	-----	-----
Government			
Federal Scientific and Technical Personnel 1976, 1977, and 1978	-----	81-309	-----
Federal Scientific and Technical Personnel: Numbers and Characteristics 1973 and 1983	-----	-----	85-312
Federal Scientific, Technical, and Health Personnel 1974	76-308	-----	-----

Reviews of Data on Science Resources.

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Industry			
Changing Employment Patterns of Scientists, Engineers, and Technicians in Private Industry, 1977-80		-----	82-331
Labor Markets for New Science and Engineering Graduates in Private Industry	84-303	-----	-----
	82-310	-----	-----
	82-330	-----	-----
Scientific and Technical Personnel in Private Industry			
1978-80	-----	80-320	-----
1975	78-302	-----	-----
1970	77-312	-----	-----
Scientists, Engineers, and Technicians in Manufacturing Industries			
1983	-----	85-328	-----
1977	79-307	80-306	-----
Scientists, Engineers, and Technicians in Manufacturing and Nonmanufacturing Industries			
1980-81	83-321		
	83-303	83-324	-----
Scientists, Engineers, and Technicians in Private Industry			
1984	85-309	-----	-----
1980	-----	81-329	-----
Scientists, Engineers, and Technicians in Trade and Regulated Industries			
1982	-----	-----	84-323
		84-320	
Utilization of Science and Engineering Doctorates in Industrial Research and Development	78-301	-----	-----
Universities and Colleges			
Academic Science/Engineering: Scientists and Engineers			
January 1984	85-317	85-316	-----
January 1983	84-317	84-309	-----
January 1982	83-317	83-311	-----
Academic Science: Scientists and Engineers			
January 1981	82-312	82-305	-----
January 1980	81-315	81-307	-----
January 1979	80-309	79-328	-----
Employment Patterns of Academic Scientists and Engineers, 1973-78	-----	-----	80-314
Engineering Colleges Report 10% of Faculty Positions Vacant in Fall 1980	81-322	-----	-----
Foreign Participation in US Science and Engineering Higher Education and Labor Markets	-----	-----	81-316
Hiring of Science and Engineering Faculty by 2- and 4-Year Colleges	78-309	-----	-----

Reviews of Data on Science Resources.

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Human Resources for Scientific Activities at Universities and Colleges			
January 1978	79-315	78-318	-----
Manpower Resources for Scientific Activities at Universities and Colleges			
January 1977	77-327	77-321	-----
January 1976	76-328	76-321	77-308
January 1975	75-331	75-329	76-311
January 1974	74-315	75-300A	-----
Participation of Foreign Citizens in US Science and Engineering	-----	-----	85-315
Young and Senior Science and Engineering Faculty			
1980	81-318	-----	81-319
1978	79-301	-----	-----
1974	-----	-----	75-302
Projections			
Current and Future Utilization of Scientific and Technical Personnel in Energy-Related Activities	77-315	-----	-----
Projected Response of the Science, Engineering, and Technical Labor Market to Defense and Nondefense Needs: 1982-87	83-307	-----	84-304
Projections of Degrees and Enrollment in Science and Engineering Fields to 1985	-----	-----	76-301
Projections of Science and Engineering Doctorate Supply and Utilization			
1982 and 1987	-----	-----	79-303
1980 and 1985	-----	-----	75-301
Scientists and Engineers From Abroad			
Foreign Participation in US Science and Engineering Higher Education and Labor Markets	-----	-----	81-316
Immigrant Scientists and Engineers 1982-84	-----	85-326	-----
Participation of Foreign Citizens in US Science and Engineering	-----	-----	85-315
Scientists and Engineers From Abroad			
1976-78	-----	80-324	-----
1966-75	77-305	-----	-----
Women and Minorities			
Racial Minorities in the Scientist and Engineer Population	75-314	-----	-----
Women and Minorities in Science and Engineering	-----	-----	84-300 82-302 77-304

Reviews of Data on Science Resources.

funding of science and technology

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Federal Government			
An Analysis of Federal R&D Funding by Function			
FY 1984-86	85-322	-----	85-319
FY 1983-85	84-333	-----	84-316
FY 1982-84	83-323	-----	Unnumbered
FY 1981-83	82-322	-----	Unnumbered
FY 1980-82	81-321	-----	Unnumbered
FY 1979-81	80-319	-----	Unnumbered
FY 1969-80	79-314	-----	Unnumbered
FY 1969-79	78-317	-----	78-320
FY 1969-78	77-320	-----	77-326
FY 1969-77	76-319	-----	76-325
FY 1969-76	75-320	-----	75-330
Energy and Energy-Related R&D Activities of Federal Installations and Federally Funded Research and Development Centers: Funds, FY 1973-75 (est) and Manpower, Jan 1973-75 (est)	76-304	-----	-----
Federal Funds for Research and Development			
FY 1983, 1984, and 1985, Volume XXXIII	-----	84-336	-----
FY 1982, 1983, and 1984, Volume XXXII	84-302	83-319	84-326
FY 1981, 1982, and 1983, Volume XXXI	82-329	82-326	83-320
FY 1980, 1981, and 1982, Volume XXX	81-321	81-325	82-321
FY 1979, 1980, and 1981, Volume XXIX	80-322	80-318	81-306
FY 1978, 1979, and 1980, Volume XXVIII	79-319	79-318	80-315
FY 1977, 1978, and 1979, Volume XXVII	79-300	78-312	79-310
Federal Funds for Research, Development, and Other Scientific Activities			
FY 1976, 1977, and 1978, Volume XXVI	77-323	77-317	78-300
FY 1975, 1976, and 1977, Volume XXV	76-317	76-315	77-301
FY 1974, 1975, and 1976, Volume XXIV	75-321	75-323	75-334
Federal R&D Funding: The 1975-85 Decade	-----	-----	Unnumbered
Federal R&D Funding for Energy: Fiscal Years 1971-83	-----	-----	83-301
Growth in Federal Basic Research Support in 1980-83 Moves at Slower Rate Than in Previous Four Years	82-325	-----	-----

Reviews of Data on Science Resources.

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Industry			
A Comparative Analysis of Information on National Industrial R&D Expenditures	-----	-----	85-311
A Comparison of National Industrial R&D Estimates With Actual NSF/ Census Data	78-303	-----	-----
Companies Plan Increases in R&D Spending Through 1984	83-327	-----	-----
Companies Plan R&D Expenditure Increases for 1983: Growth Rate Down	82-324	-----	-----
Dollar Value of US R&D Expenditures Overseas Declined in 1982	83-329	-----	-----
Plans for Company-Funded Research and Development Show 12% Annual Increases Through 1985	84-329	-----	-----
Problems of Small, High-Technology Firms	-----	-----	81-305
Research and Development in Industry			
1983	85-318	85-325	-----
1982	84-313	84-325	-----
1981	83-313	83-325	-----
1980	81-331	82-317	-----
1979	81-313	81-324	82-304
1978	80-300	80-307	-----
1977	79-302	79-313	79-325
1976	78-306	78-314	-----
1975	76-324	-----	77-324
1974	76-300	-----	76-322
1973	74-319	-----	75-315
Trends to 1982 in Industrial Basic Research	-----	-----	83-302
Trends in Small Companies' R&D Expenditures	-----	-----	84-324
U.S. Industrial R&D Spending Abroad	79-304	-----	-----
Universities and Colleges			
Academic Science/Engineering: R&D Funds			
FY 1983	85-306	85-308	-----
FY 1982	84-307	84-308	-----
FY 1981	83-304	83-308	-----
Academic Science: R&D Funds			
FY 1980	82-309	82-300	-----
FY 1979	81-304	81-301	-----
FY 1978	80-301	79-320	-----

Reviews of Data on Science Resources.

	NSF Number		
	Highlights/ Full	RDSR*	Tables
Expenditures for Scientific Activities at Universities and Colleges			
FY 1977	78-319	78-311	-----
FY 1976	77-314	77-316	-----
FY 1975	76-307	76-316	77-307
Expenditures for Scientific and Engineering Activities at Universities and Colleges			
FY 1974	75-306	75-318	76-303
FY 1973	74-306	-----	75-316
Federal Support to Universities, Colleges, and Selected Nonprofit Institutions			
FY 1983	85-314	-----	85-321
FY 1982	84-305	-----	84-315
FY 1981	83-306	-----	83-315
FY 1980	82-301	-----	82-308
FY 1979	81-303	-----	81-308
FY 1978	80-303	-----	80-312
FY 1977	79-312	79-311	79-317
FY 1976	78-308	77-325	-----
FY 1975	76-327	77-303	77-311
FY 1974	75-324	75-325	76-305
FY 1973	74-307	-----	75-304
1983 Plant Biology Research Expenditures Totaled $200 Million and Were Concentrated in Land-grant Institutions	84-327	-----	-----
One-fourth of Academic Research Equipment Classified Obsolete	84-312	-----	-----
Universities Report Research Equipment Shortages Are Most Severe in the Physical Sciences and Engineering	85-220	-----	-----
Other			
R&D Activities of Independent Nonprofit Institutions			
1973	74-309	-----	75-308
R&D Funding Projections			
1990	-----	-----	82-315
1985	-----	-----	76-314
Research and Development in State Government Agencies			
FY 1972 and 1973	74-311 75-311	-----	75-303
Research and Development in State and Local Governments			
FY 1977	80-302	79-327	-----

Reviews of Data on Science Resources.

appendix c

extramural publications, 1975-85

The following list of articles and reports are available from the author, publisher, or journal. Those with an asterisk are available from the National Technical Information Service, Springfield, Virginia 22161. See identifying number at end of citation.

human resources

1985

"Access to Computers for Research," Engin Inel Holmstrom, *Higher Education Panel Report*, No. 69. Washington, D.C.:American Council on Education, Dec. 1985.

"Campus Trends, 1984," Elaine El-Khawas, *Higher Education Panel Report*, No. 65. Washington, D.C.: American Council on Education, Feb. 1985.

"Conditions Affecting College and University Financial Strength," Charles J. Andersen, *Higher Education Panel Report*, No. 63. Washington, D.C.: American Council on Education, Sept. 1985.

"Engineering Programs in Emerging Areas, 1983-84," Engin Inel Holmstrom and Janice Petrovich, *Higher Education Panel Report*, No. 64. Washington, D.C.: American Council on Education, Oct. 1985.

Foreign National Scientists and Engineers in the U.S. Labor Force, 1972-82. Oak Ridge, Tenn.: Oak Ridge Associated Universities, Jun. 1985.

"General Education Requirements in the Humanities," Nancy Suniewick and Elaine El-Khawas, *Higher Education Panel Report*, No. 66. Washington, D.C.. American Council on Education, Sept. 1985.

Labor Certifications and the Distribution of Immigrant Scientists and Engineers. J.L. Barries and M.G. Finn, paper presented at the Eastern Economics Association Meeting, Mar. 1985.

"Recent Changes in Teacher Education Programs," Engin Inel Holmstrom, *Higher Education Panel Report*, No. 67. Washington, D.C.: American Council on Education, Oct. 1985.

"Student Financial Aid to Full-time Undergraduates, Fall 1984," Charles Andersen, *Higher Education Panel Report*, No. 68. Washington, D.C.: American Council on Education, Dec. 1985.

Trends in Student Quality in Doctoral and Professional Education. Rodney T. Hartnett. New Brunswick, N.J.: Rutgers Univ., 1985.

Summary Report, 1984. Doctorate Recipients from United States Universities. Washington, D.C.: National Research Council, 1985.

1984

The Engineering Degree Conferral Process. Robert C. DauffenBach and Jack Fiorito. Washington, D.C.: Engineering Manpower Commission, Dec. 1984.

Extending the Educational Ladder: The Changing Role of Postdoctoral Education in the United States. William Zumeta, Lexington Books. Lexington, Mass.: D.C. Health & Company, 1984.

"Financial Aid for Full-Time Undergraduates," Charles J. Andersen. *Higher Education Panel Report*, No. 60. Washington, D.C.: American Council on Education, Apr. 1984.

"Full-Time Humanities Faculty, Fall 1982," Irene Gomberg and Frank J. Atelsek. *Higher Education Panel Report*, No. 61. Washington, D.C.: American Council on Education, Aug. 1984.

Guide to Data on Scientists and Engineers. Betty M. Vetter and Susan Jensen-Fisher. Washington, D.C.: Scientific Manpower Commission, 1984.

Issue of Quality in the Engineering Work Force. Robert C. DauffenBach and Michael G. Finn. Oak Ridge, Tenn.: Oak Ridge Associated Universities, Dec. 1984.

Men and Women in Science and Engineering Occupations. Aline O. Quester. Alexandria, Va.: Center for Naval Analysis, 1984.

Occupational Employment in Mining, Construction, Finance, and Services. Bulletin 2186. Washington, D.C.: Bureau of Labor Statistics, Department of Labor, Feb. 1984.

Occupational Employment in Transportation, Communications, Utilities, and Trade. Bulletin 2220. Washington, D.C.: Bureau of Labor Statistics, Department of Labor, Dec. 1984.

"Plant Biology Personnel and Training," Charles J. Andersen. *Higher Education Panel Report*, No. 62. Washington, D.C.: American Council on Education, Oct. 1984.

"Projected Labor-Market Balance in Engineering and Computer Specialty Occupations, 1982-87," Jean E. Vanski. *Labor-Market Conditions for Engineers: Is There a Shortage?* Washington, D.C.: National Research Council, National Academy Press, 1984.

Science, Engineering, and Humanities Doctorates in the United States: 1983 Profile. Betty D. Maxfield. Washington, D.C.: National Research Council, 1984.

"Selected Characteristics of Persons in Computer Specialties: 1978," *Current Population Reports*, Series P-23, No. 134. Washington, D.C.: Bureau of the Census, Department of Commerce, 1984.

"Selected Characteristics of Persons in Engineering: 1978," *Current Population Reports*, Series P-23, No. 135. Washington, D.C.: Bureau of the Census, Department of Commerce, 1984.

"Student Quality in the Humanities: Opinions of Senior Academic Officials," Charles J. Andersen. *Higher Education Panel Report*, No. 59. Washington, D.C.: American Council on Educuation, Feb. 1984.

"Student Quality in Science and Engineering: Opinions of Senior Academic Officials," Frank J. Atelsek. *Higher Education Panel Report*, No. 58. Washington, D.C.: American Council on Education, Feb. 1984.

Summary Report, 1983. Doctorate Recipients from United States Universities. Washington, D.C.: National Research Council, 1984.

"Survey of Engineering Faculty and Graduate Students, Fall 1983," *Engineering Education*, 1984.

1983

"The Demand for Engineers—Projections Through 1987," F. Landis and Joseph Svestka. *Management Science*, Vol. 29, No. 4, Apr. 1983, pp. 455-464.

Departing The Ivy Halls, Changing Employment Situation for Recent PhD's. Betty D. Maxfield and Susan Henn. Washington, D.C.: National Research Council, 1983.

*"Financial Support for the Humanities: A Special Methodological Report," Irene L. Gomberg and Frank J. Atelsek. *Higher Education Panel Report*, No. 56. Washington, D.C.: American Council on Education, Jan. 1983. PB 83-179671

*"Neuroscience Personnel and Training," Irene L. Gomberg and Frank J. Atelsek. *Higher Education Panel Report*, No. 57. Washington, D.C.: American Council on Education, Jun. 1983. PB 83-242172

"Part-Time Postschool Investments in Education and Their Impact on Earnings Growth for Engineers," Bill Cooke and Morris Cobern. *Human Resources, Employment and Development. Volume 3: The Problems of Developed Countries and the International Economy*, edited by Burton A. Weisbrod and Helen Hughes. London, England: Macmillan, Summer 1983.

"Programmable Automation: Its Effect on the Scientific-Engineering Labor Market," Bill Cooke. *Automation and the Workplace: Selected Labor, Education, and Training Issues*, A Technical Report, Office of Technology Assessment, Congress of the United States. Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, Mar. 1983, pp. 80-88.

Projections of Supply of Scientists and Engineers to Meet Defense and Nondefense Requirements, 1981-1987. Robert C. DauffenBach and Jack Fiorito. Stiliwater, Okla.: Oklahoma State Univ., College of Business Administration, 1983.

Science, Engineering, ond Humanities Doctorates in the United States, 1981 Profile. Betty D. Maxfield. Washington, D.C.: National Research Council, 1983.

Summary Report, 1982. Doctorate Recipients From United States Univesities. Washington, D.C.: National Research Council, 1983.

"Understanding the Higher Unemployment Rate of Women Scientists and Engineers," Michael G. Finn. *American Economic Review*, Dec. 1983.

1982

*"An Assessment of College Student Housing and Physical Plant," Charles J. Andersen and Frank J. Atelsek. *Higher Education Panel Report*, No. 55. Washington, D.C.: American Council on Education, Oct. 1982. PB 83-136950

"Labor Force Participation of Women Baccalaureates in Science," Betty M. Vetter. *Women and Minorities in Science: Strategies for Increasing Participation*, edited by Sheila M. Humphreys, AAAS Selected Symposium 06. Boulder, Colo.: Westview Press, 1982, Chapter 2, pp. 27-37.

*"Sabbatical and Research Leaves in Colleges and Universities," Charles J. Andersen and Frank J. Atelsek. *Higher Education Panel Report*, No. 53. Washington, D.C.: American Council on Education, Feb. 1982. PB 82-240169

"Selected Characteristics of Persons in Environmental Science: 1978," *Current Population Reports*, Series P-23, No. 119. Washington, D.C.: Bureau of the Census, Department of Commerce, 1982.

The Study of the Employment of Women Scientists and Engineers in Private Industry: Volumes I and II, Final Technical Report. Sally M. Bolus, C. Rose, C. Graesser, and G. Nyre. Washington, D.C.: National Science Foundation, Aug. 1982.

Summary Report, 1981. Doctorate Recipients From United States Universities. Washington, D.C.: National Research Council, 1982.

*"Undergraduate Student Credit Hours in Science, Engineering, and the Humanities, Fall 1980," Frank J. Atelsek and Charles E. Andersen. *Higher Education Panel Report*, No.

54. Washington, D.C.: American Council on Education, Jun. 1982. PB 82-240854

1981

Career Outcomes in a Matched Sample of Men and Women Ph.D.'s, An Analytical Report. Nancy C. Ahern. Washington, D.C.: National Academy of Sciences, 1981.

Career Patterns of Scientists: A Case for Complementary Data. Daryl Chubin and Alan L. Porter. Atlanta, Ga.: Georgia Institute of Technology.

**The Careers of Young Doctorates: Temporal Change and Institutional Effects*. Ted I. K. Youn. New Haven, Conn.: Yale Univ., Apr. 1981. PB 82-180787

**Curriculum Choice and Occupational Attainment in Science and Engineering*, A Report to the National Science Foundation. Jack Fiorito. Washington, D.C., Jun 1981. PB 82-179441.

"The Demand for Doctorate and Master's Degree Holders in Engineering Through 1987," Fred Landis. *Conference Proceedings*, Vol. 1. Los Angeles, Calif.: American Society for Engineering Education, June 1981, pp. 275-78.

Demand Projections for Engineers Through 1987. Fred Landis and Joseph A. Svestka. Milwaukee, Wisc.: Univ. of Wisconsin-Milwaukee, Jan. 1981.

Employment of Minority Ph.D.'s: Change Over Time. Washington, D.C.: National Academy of Sciences/National Research Council, 1981.

"How Many Engineers Will Graduate During the Eighties," Fred Landis. *Engineering Education*, May 1981, pp. 784-788.

**Human Capital Adjustments to Technological Change in the Computer Industry: The Case of Scientists and Engineers*. William N. Cooke. Lafayette, Ind.: Purdue Univ., Jul. 1981. PB 82-180969

Maximizing Returns on Capital Investment in Data Resources: Utilizing Library Structures and Information Networks to Disseminate the National Science Foundation Manpower Data Resources. Alice Robbin. Madison, Wisc.: Univ. of Wisconsin, Nov. 1981.

"Permanent Layoffs: What's Implicit in the Contract," Bill Cooke. *Industrial Relations*, Vol. 20, No. 2, Spring 1981, pp. 196-292.

A Pilot Study of the Utilization of Master's Degree Holders in Private Industry. Howard P. Tuckman. Los Angeles, Calif.: Higher Education Research Institute, Apr. 1981.

"A Possible Difference in Women's Aims in Attaining the Ph. D.," Alan Porter. *American Psychologist*, Mar. 1980.

**Postdoctoral Appointments and Disappointments*. Washington, D.C.: National Academy of Sciences/National Research Council, 1981. PB 82-115841

*"Recruitment and Retention of Full-Time Faculty, Fall 1980," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 52. Washington, D.C.: American Council on Education, Oct. 1981. PB 82-240177

**Report on Changes in the Demand for Scientific and Technical Manpower Induced by Changes in Technology (With Semiconductor Industry as Case Study)*. Ivars Gutmanis. Washington, D.C.: Sterling Hobe Corp., Aug. 1981. PB 82-180548

Research Participation and Other Characteristics of Recent Science and Engineering Faculty. Rockville, Md.: Westat, Inc., May 1981.

"The Returns to the Associate Degree for Technicians," Michael G. Finn with L. M. Blair and W. Stevenson. *The Journal of Human Resources*, Vol. XVI, No. 3, Summer 1981, pp. 449-458.

The Role of the Doctoral Dissertation in Electrical Engineering Education. Terry Connally and Alan L. Porter. Atlanta, Ga.: Georgia Institute of Technology.

*"Selected Characteristics of Full-Time Humanities Faculty," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 51. Washington, D.C.: American Council on Education, Aug. 1981. PB 82-242421

**Summary Report, 1980. Doctorate Recipients From United States Universities*. Washington, D.C.: National Research Council, 1981. PB 82-113960

**Training, Work Experience, and the Earnings of Men and Women Scientists*. Michael G. Finn. Oak Ridge, Tenn.: Oak Ridge Associated Universities, Dec. 1981. PB 82-2007564

"Trends in Financial Indicators of Colleges and Universities," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 49. Washington, D.C.: American Council on Education, Apr. 1981.

"Under the Microscope," Betty M. Vetter. *Working Women*, May 1981, pp. 54-58.

**Why Only a Master's Degree? Its Meaning in a Time of Retrenchment*. Los Angeles, Calif.: Higher Education Research Institute, Jan. 1981. PB 82-181512

1980

**Anthropologists and the Labor Market*. Lewis C. Solmon. Los Angeles, Calif.: Higher Education Research Institute, Apr. 1980. PB 80-209992

A Comparison of NSF Data on Scientific and Technical Fields with Data on Occupation of Employment. Michael G. Finn. Oak Ridge, Tenn.: Oak Ridge Associated Universities, 1980.

The Demand for New Faculty in Science and Engineering. Michael S. McPherson, ed. Washington, D.C.: National Academy of Sciences/National Research Council, 1980.

"The Doctoral Dissertation-How Relevant?" Terry Connolly and Alan L. Porter. *Engineering Education*, Vol. 71, Nov. 1980.

Doctorate Plus a Decade. The Early Careers of U.S. Scientists and Engineers. Daryl Chubin and Alan L. Porter. Atlanta, Ga.: Georgia Institute of Technology.

"Engineering and Science: Outlook for Women," Betty M. Vetter. *Professional Engineer*, Vol. 50, No. 2, Jun. 1980, pp. 28-31.

Engineering Manpower Flow Prediction by Dynamic Simulation Modeling. Fred Landis. Milwaukee, Wisc.: Univ. of Wisconsin-Milwaukee.

Fields Versus Occupations: A Comparison of NSF Data on Scientific and Technical Fields With Data on Occupation. Michael G. Finn. Oak Ridge, Tenn.: Oak Ridge Associated Universities, Mar. 1980.

**Fieid Switching Among Baccalaureate Scientists and Engineers*. Ricki P. Sweet, Steve Niczus, and Paula Polvin. Lowell, Mass.: Univ. of Lowell, Oct. 1980. PB 81-187387

Forecasting the Supply and Utilization of Manpower in the Mathematical Sciences: An Economic Demographic Approach. Roy Radner. Washington, D.C.: Conference Board of the Mathematical Sciences, 1980.

Item Response Analysis: 1979 Survey of Doctorate Recipients. Washington, D.C.: National Academy of Sciences/National Research Council, 1980.

**Labor Market Adjustments by Scientists and Engineers: Probabilities and Outcomes*. William N. Cooke. Orono, Me.: Univ. of Maine, Feb. 1980. PB 80-209679

**Mathematicians in Academia: 1975-2000*. Charlotte V. Kuh and Roy Radner. Washington, D.C.: Conference Board of the Mathematical Sciences, Feb. 1980. PB 80-154016

**Methodological Approach to 1978/79 New Entrants Surveys*. George K. Schueller. Rockville, Md.: Westat, Inc., Mar. 1980. PB 80-157761

Mobility Factors Affecting the Supply and Demand for Ph. D. Scientists and Engineers. Lee Grodzins. Cambridge, Mass.: Massachusetts Institute of Technology.

*"Newly Qualified Elementary and Secondary School Teachers, 1977-78 and 1978-79," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 45. Washington, D.C.: American Council on Education, Feb. 1980. PB 81-180283

**Nonacademic Career Options for Science and Engineering Ph. D.'s*. Lewis Solmon, Laura Kent, and Margo-Lea Hurwicz. Los Angeles, Calif.: Higher Education Research Institute, Jul. 1980. PB 80-212616

Part-Time Faculty and Their Effect on the Academic Labor Market for Scientists and Engineers. Howard P. Tuckman. Tallahassee, Fla.: Florida State Univ., 1980.

*"Refund Policies and Practices of Colleges and Universities." Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 46. Washington, D.C.: American Council on Education, Feb. 1980. PB 81-186041

Response Characteristics of the National Scientific and Technical Manpower System. Norman P. Hummon. Pittsburgh, Pa.: Univ. of Pittsburgh, 1980.

Science, Engineering, and Humanities Doctorates in the United States. Washington, D.C.: National Academy of Sciences/National Research Council, 1980.

"Selected Characteristics of Full-Time Humanities Faculty, Fall 1979," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 51. Washington, D.C.: American Council on Education, Aug. 1981.

"Selected Characteristics of Persons in Physical Science: 1978," *Current Population Reports*, Special Studies, Series P-23, No. 108. Washington, D.C.: Bureau of the Census, Department of Commerce.

A Study of the Master's Degree in Science and Engineering. Lewis C. Solmon. Los Angeles, Calif.: Higher Education Research Institute.

**Summary Report, 1979. Doctorate Recipients From United States Universities*. Washington, D.C.: National Research Council, Mar. 1980. PB 80-209935

*"Tenure Practices at Four-Year Colleges and Universities," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 48. Washington, D.C.: American Council on Education, Jul. 1980. PB 81-185811

"Turnover and Earnings: The Scientist and Engineer Case," William N. Cooke. *The Journal of Human Resources*, Vol. XV, No. 3, Summer 1980, pp. 435-443.

"Women in the Computer Sciences," Sally Bolus and C. Rose. *Computer*, Vol. 13, No. 8, Aug. 1980.

"Women Scientists and Engineers in American Academia," Sally Menninger and C. Rose. *International Journal of Women's Studies*, Vol. 3, No. 3, May/Jun. 1980.

Women Scientists in Industry and Government: How Much Progress in the 1970's? Nancy C. Ahern. Washington, D.C.: National Academy of Sciences, 1980.

"Working Women Scientists and Engineers," Betty M. Vetter. *Science*, Vol. 207, No. 4426, Jan. 4, 1980, pp. 28-34.

1979

Career Patterns of Doctoral Scientists and Engineers, 1973-1977. Lindsey R. Harmon and Betty D. Maxfield. Washington, D.C.: National Academy of Sciences/National Research Council, 1979.

Climbing the Academic Ladder: Doctoral Women Scientists in Academe. Nancy C. Ahern. Washington, D.C.: National Academy of Sciences, 1979.

The Effects of Nonresponse Bias on the Results of the 1975 Survey of Doctoral Scientists and Engineers. Andrew W. Spisak and Betty D. Maxfield. Washington, D.C.: National Academy of Sciences/National Research Council, 1979.

"The Institutional Share of Undergraduate Financial Assistance, 1976-77," Frank J. Atelsek and Irene L. Gomberg. *Higher*

Education Panel Report, No. 42. Washington, D.C.: American Council on Education, May 1979.

**Labor Force Participation of Women Trained in Science and Engineering and Factors Affecting their Participation.* Betty Vetter. Washington, D.C.: Scientific Manpower Commission, Jun. 1979. PB 301257/AS

**Methodological Approach to 1977/78 New Entrants Surveys.* George K. Schueller. Rockville, Md.: Westat, Inc., Apr. 1979. PB 80-131904

Ph. D.'s in Business and Industry. Andrew W. Spisak and Betty D. Maxfield. Washington, D.C.: National Academy of Sciences/National Research Council, 1979.

**Research Excellence Through the Year 2000: The Importance of Maintaining a Flow of New Faculty into Academic Research*. Washington, D.C.: National Academy of Sciences/National Research Council, Aug. 1979. PB 81-114944

*"Shared Use of Scientific Equipment at Colleges and Universities, Fall 1978" Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 44. Washington, D.C.: American Council on Education, Nov. 1979. PB 80-135471

**Studies of the Mobility of Scientists and Engineers*. Lee Grodzins. Cambridge, Mass.: Massachusetts Institute of Technology, Dec. 1979. PB 80-138639

**Summary Report, 1978. Doctorate Recipients From United States Universities*. Washington, D.C.: National Academy of Sciences/National Research Council, Mar. 1979. PB 299353/AS

1978

**Adjustments to the Supply of Engineering and Technical Manpower: Interoccupational Mobility of Engineers and Technicians*. Trevor Bain. University, Ala.: Univ. of Alabama, Apr. 1978. PB 284215/AS

"Attracting Women to Psychology: Effects of University Behavior and the Labor Market," Louis Solmon. *American Psychologist*, Vol. 33, Nov. 1978.

*"New Full-Time Faculty 1976-77: Hiring Patterns by Field and Educational Attainment," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 38. Washington, D.C.: American Council on Education, Mar. 1978. PB 293851/AS

"Nontenure-Track Science Personnel: Opportunities for Independent Research," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 39. Washington, D.C.: American Council on Education, Sept. 1978.

"Programs of Recruitment, Admittance, and Retention in Graduate and Professional Schools," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 41. Washington, D.C.: American Council on Education, Dec. 1978.

Science and Engineering Technicians in the United States: Characteristics of a Redefined Population, 1972. ORAU-138. Michael G. Finn. Oak Ridge, Tenn.: Oak Ridge Associated Universities, 1978.

Science, Engineering, and Humanities Doctorates in the United States. 1977 Profile. Washington, D.C.: National Research Council, Jun. 1978.

**The Study of the Academic Employment and Graduate Enrollment Patterns and Trends of Women in Science and Engineering*. Clare Rose, Sally Ann Menninger, and Glenn F. Nyre. Los Angeles, Calif.: Evaluation and Training Institute, Dec. 1978. PB 293852/AS

**Summary Report, 1977. Doctorate Recipients From United States Universities*. Washington, D.C.: National Research Council, Feb. 1978. PB 293854/AS

"Turnover of Senior Faculty in Departments of Social and Physical Sciences and Engineering," Louis Solmon. *Research in Higher Education*, Vol. 8, pp. 343-355.

*"Young Doctoral Faculty in Science and Engineering: Trends in Composition and Research Activity," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 43. Washington, D.C.: American Council on Education, Feb. 1979. PB 293905/AS

1977

**Career Achievements of NSF Graduate Fellows, Awardees of 1952-1972*. L. R. Harmon. Washington, D.C.: National Academy of Sciences/National Research Council, Jun. 1977. PB 277627/AS

**Career Achievements of the National Defense Education Act Fellows of 1959-1973*. L. R. Harmon. Washington, D.C.: National Academy of Sciences/National Research Council, Jul. 1977. PB 277628/AS

Century of Doctorates. L. R. Harmon. Washington, D.C.: National Academy of Sciences/National Research Council, 1977.

"College and University Services for Older Adults," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 33. Washington, D.C.: American Council on Education, Feb. 1977.

**Doctoral Scientists and Engineers in the United States: 1975 Profile*. Washington, D.C.: National Academy of Sciences, Jan. 1977. PB 262992/AS

**Employment Status of Ph. D. Scientists and Engineers: 1973 and 1975*. Washington, D.C.: National Academy of Sciences, Jan. 1977. PB 262991/AS

"Energy Costs and Energy Conservation Programs in Colleges and Universities: 1972-73 and 1974-75," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 31. Washington, D.C.: American Council on Education, Apr. 1977.

**The Impact of Federal Programs and Policies on Manpower Planning for Scientists and Engineers. Report of a Workshop.*

Washington, D.C.: Scientific Manpower Commission, May 1977. PB 268783/AS

**Scientific and Technical Personnel in Energy-Related Activities: Current Situation and Future Requirements.* Hugh Folk, et. al. Urbana-Champaign, Ill.: Center for Advanced Computation, Univ. of Illinois, Jul. 1977. PB 272884/AS

**Summary Report, 1976. Doctorate Recipients From United States Universities.* Washington, D.C.: National Research Council, Mar. 1977. PB 268836/AS

**Supply and Demand for Scientists and Engineers: A Review of Selected Studies* Betty Vetter. Washington, D.C.: Scientific Manpower Commission, Feb. 1977. PB 268789/AS

**The System of Financing Research and Development in the United States.* Response to Questions Posed by the Union of Soviet Socialist Republics. Arlington, Va.: SRI International, 1977. PB 81-249831

**The System of Financing Research and Development in the United States.* Francis W. Dresch and Robert W. Campbell. Menlo Park, Calif.: Stanford Research Institute, 1977. PB 81-249815

1976

Applicability of AAMC Data to NSF Surveys of Manpower Resources. Gerlandino Agro and Thomas Larson. Washington, D.C.: The Association of American Medical Colleges, Aug. 1976.

*"Faculty Research: Level of Activity and Choice of Area," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 29. Washington, D.C.: American Council on Education, Jan. 1976. PB 263017/AS

*"Health Research Facilities: A Survey of Doctorate-Granting Institutions," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 28. Washington, D.C.: American Council on Education, Feb. 1976. PB 263016/AS

*"Major Field Enrollment of Junior-Year Students, 1973 and 1974," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 26. Washington, D.C.: American Council on Education, Apr. 1976. PB 263069/AS

**Summary Report, 1975. Doctorate Recipients From United States Universities.* Washington, D.C.: National Research Council, May 1976. PB 263047/AS

**Trends in Aptitude of Graduate Students in Science.* R. F. Boldt. Princeton, N.J.: Educational Testing Service, Dec. 1976. PB 263455/AS

*"Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 30. Washington, D.C.: American Council on Education, Aug. 1976. PB 262989/AS

1975

"Careers in Science: A Project Talent Study," Marion F. Shaycoft. Palo Alto, Calif.: American Institute for Research, Oct. 1975.

**The Demand for Scientific and Technical Manpower in Selected Energy-Related Industries, 1970-85: A Methodology Applied to a Selected Scenario of Energy Output.* Washington, D.C.: National Planning Association, 1975. PB 240865/AS

**Field Mobility of Doctoral Scientists and Engineers.* Washington, D.C.: National Academy of Sciences, Dec. 1975.

Impact of Federal Pollution Control and Abatement Expenditures on Manpower Requirements, Bulletin 1836. Washington, D.C.: Bureau of Labor Statistics, Department of Labor, 1975.

*"Non-Federal Funding of Biomedical Research and Development, A Survey of Doctoral Institutions," Frank J. Atelsek. *Higher Education Panel Report*, No. 25. Washington, D.C.: American Council on Education, Jul. 1975. PB 256037/AS

"Selected Characteristics of Persons in Fields of Science or Engineering, 1974," *Current Population Report*, Special Studies, Series P-23, No. 53. Washington, D.C.: Bureau of the Census, Department of Commerce, Jul. 1975.

"Student Assistance: Participants and Programs, 1974-75," Frank J. Atelsek and Irene J. Gomberg. *Higher Education Panel Report*, No. 27. Washington, D.C.: American Council on Education, Dec. 1975.

Summary Report, 1974. Doctorate Recipients From United States Universities. Washington, D.C.: National Research Council, Jun. 1975.

"A Survey of Continuing Education Opportunities Available to Nonacademic Scientists, Engineers, and Mathematicians," Elaine H. El-Khawas and Joan L. Kinzer. *Higher Education Panel Report*, No. 23. Washington, D.C.: American Council on Education, Apr. 1975.

funding of science and technology

1985

Academic Research Equipment in Selected Scientific/Engineering Fields: 1982-83. Prepared for NSF under Contract SRS 80-17873. Rockville, Md.: Westat, Inc., Aug. 1985.

Capital Expenditures for Facilities and Equipment for Research, Development, and Instruction: Data Reporting Practices and Prospects. A Postenumeration Study submitted to NSF under Contract SRS 84-20649. Washington, D.C.: Quantum Research Corp., Jul. 1985.

1984

Academic Research Equipment in the Physical and Computer Sciences and Engineering. Prepared for NSF under Contract SRS 80-17873. Rockville, Md.: Westat, Inc., Dec. 1984.

National Survey of Academic Research Instruments and Instrumentation Needs. Kenneth Burgdorf. Rockville, Md.: Westat, Inc., 1984.

1983

(No reports issued on these subjects.)

1982

**Alternative Strategies for Developing Reliable Estimates of National Academic Basic Research Expenditures by Field of Science and Engineering: Final Report*. David E. Trevett and Jack Moshman. Bethesda, Md.: Moshman Associates, Inc., Jun. 1982. PB 83-132779

An Examination of Possible Linkages Between the National Science Foundation's Industrial R&D Data Set and Other Economic Data Bases, Final Report. John A. Goodman and Elizabeth C. Megna. Washington, D.C.: Technical Assistance Research Program, Apr. 1982.

1981

**Financing at the Leading 100 Research Universities: An Executive Overview*. A Study of Financial Dependency, Concentration, and Related Institutional Characteristics. Marilyn McCoy, Jack Krakower, and David Makowski. Boulder, Colo.: National Center for Higher Education Management Systems, May 1981. PB 82-114992

**Financing of the Leading Research Universities*. A Study of Financial Dependency, Concentration, and Related Institutional Characteristics. Marilyn McCoy, Jack Krakower, and David Makowski. Boulder, Colo.: National Center for Higher Education Management Systems, May 1981. PB 82-242587 and PB 82-242579

1980

*"Expenditures for Scientific Research Equipment at Ph.D.-Granting Institutions, FY 1978," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 47. Washington, D.C.: American Council on Education, Mar. 1980. PB 81-186678

1979

Estimating Industrial R&D Expenditures by National Functional Objective. Bernard N. Samers. Stamford, Conn.: Cooper and Co., Jun. 1979.

**Federally Funded Research and Development at Universities and Colleges. A Distributional Analysis, Volume I*. Final Report. George J. Nozicka. Washington, D.C.: Moshman Associates, Inc., Feb. 1979. PB 294008/AS

**Federally Funded Research and Development at Universities and Colleges. A Distributional Analysis, Volume II*. Appendices. George J. Nozicka. Washington, D.C.: Moshman Associates, Inc., Feb. 1979. PB 294009/AS

Inventory and Analysis of Materials Life Cycle Research and Development in U.S. Industry, 1977. Washington, D.C.: Committee on Materials, Dept. of the Interior, Apr. 1979.

1978

Support of Basic Research by Industry. Howard K. Nason, Joseph A. Steger, and George C. Manners, Jr. St. Louis, Mo.: Industrial Research Institute Research Corporation, Aug. 1978.

1977

(No reports issued on these subjects.)

1976

(No reports issued on these subjects.)

1975

Patterns of Association in Research and Development, Monograph No. 26. Guy Black. Washington, D.C.: Program of Policy Studies in Science and Technology, The George Washington Univ., May 1975.

outputs and impacts

1985

"Foundations of Technometrics," Devendra Sahal. *Technological Forecasting and Social Change*, Vol. 27, pp. 1-37, 1985.

Industrial Innovation in the United States. A Survey of Six Hundred Companies: Executive Summary. John A. Hansen, James I. Stein, Thomas S. Moore. Boston, Mass.: Center for Technology and Policy, Boston Univ., 1985.

"Is Technology Becoming Science?" F. Narin and E. Noma. *Scientometrics*, Vol. 7, Nos. 3-6, pp. 369-384, 1985.

"Measuring the Research Productivity of Higher Education Institutions Using Bibliometrics Techniques." Francis Narin. OECD Workshop on Science and Technology Indicators in the Higher Education Sector. Paris, France: Organisation for Economic Co-operation and Development, 1985.

Patenting by All Universities, 1969-1984. Washington, D.C.: U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast, Apr. 1985.

Review and Assessment of the OTAF Concordance Between the U.S. Patent Classification and the Standard Industrial Classification Systems: Final Report. Washington, D.C.: U.S.

Patent and Trademark Office, Office of Technology Assessment and Forecast, Jan. 1985.

1984

Development of Strategies to Enhance Response to the National Science Foundation Survey of Industrial Research and Development. John A. Goodman. Washington, D.C.: TARP, Inc., 1984.

"Econometric Analysis of Biomedical Research Publishing Patterns," Paul McAllister and Thomas Condon, *Scientometrics* (in press).

Indicators of the Patent Output of U.S. Industry, 1963-1983. Washington, D.C.: U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast, 1984.

Patenting in Selected Technologies, 1963-1983. Washington, D.C.: U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast, 1984.

Proceedings of a Workshop on Technology Measurement, Joseph P. Martino, ed., Held at Dayton, Ohio, October 12-14, 1983. Dayton, Ohio: Univ. of Dayton Research Institute, May 1984.

"Programmatic Evaluation and Comparison Based on Standardized Citation Scores," Paul R. McAllister, Francis Narin, and James G. Corrigan, *IEEE Transactions on Engineering Management*, 1984.

The Relationship of Public Agricultural R&D to Selected Changes in the Farm Sectors. Lawrence Busch, et. al. A Report to the National Science Foundation. Lexington, Ky: College of Agriculture, Univ. of Kentucky, Jun. 1984.

"Technological Performance Assessments Based on Patents and Patent Citations," Francis Narin, Mark P. Carpenter, and Patricia Woolf, *IEEE Transactions on Engineering Management*, 1984.

Venture Capital Investment Trends: 1981-1983. A Report to the National Science Foundation. Wellesley Hills, Mass.: Venture Economics, Inc., Sept. 1984.

1983

The American People and Science Policy: The Role of Public Attitudes in the Policy Process. Jon D. Miller. DeKalb, Ill.: Northern Illinois Univ., University Pergamon Press, 1983.

Further Research into Technology Output Measures. Keith L. Edwards and John W. Alexander, Jr. Glastonbury, Conn.: The Futures Group, 1982.

Development of Indicators of Technological Innovation Using Patent Examers' Citations. Mark P. Carpenter. Cherry Hill, N.J.: Computer Horizons, Inc., 1983.

New Indicators of Industrial Innovation: Executive Summary. Christopher T. Hill, John A. Hansen, James I. Stein. Cambridge, Mass.: Center for Policy Alternatives, Massachusetts Institute of Technology, 1983.

New Indicators of Industrial Innovation: Final Report. Christopher T. Hill, John A. Hansen, James I. Stein. Cambridge, Mass.: Center for Policy Alternatives, Massachusetts Institute of Technology, 1983.

1982

Energy Patenting: 1962-1981. Washington, D.C.: U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast, 1982.

Indicators of the Patent Output of U.S. Industry (1963-81). Washington, D.C.: U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast, 1982.

**Indicators of Scientific Research Instrumentation in Academic Institutions: A Feasibility Study*. Lance Hodes. Rockville, Md.: Westat, Inc., 1982. PB 82-263021

"On Developing Indicators of Quality in Science and Technology." *Science, Technology and Human Values*, Vol. 7, Spring/Winter 1982.

The Relationship of Education, Race, and Gender to Attentiveness to Science and Technology Policy. Jon D. Miller. DeKalb, Ill.: Northern Illinois Univ., 1982.

Small Business Patenting. Washington, D.C.: U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast, 1982.

Venture Capital Investments and Small, High-Technology Companies: A Measure of the High-Technology Small Business Sector. Norman D. Fast. Wellesley Hills, Mass.: Venture Economics, 1982.

1981

"The Adequacy of the Science Citation Index (SCI) as an Indicator of International Scientific Activity," Francis Narin and Mark P. Carpenter. *Journal of the American Society for Information Science*, 32, 430-439, Nov. 1981.

"Administrative Responsibilities and the Conduct of Academic Basic Research," Vol. III. Papers Commissioned as Background for *Science Indicators, 1980*. Washington, D.C.: National Science Foundation.

"Citation Rates to Technologically Important Patents," Mark P. Carpenter, Francis Narin, and Patricia Woolf. *World Patent Information*, Vol. 3(4), 1981, pp. 160-163.

"Computation of Probabilities from Jensen's Bivariate F Distribution," Paul R. McAllister, Ru-Ying Lee, and Burt S. Holland. *Communications in Statistics, BIO(3)*, 249-263, 1981.

"Indirect Mechanisms of Federal Support for Research and Development," Vol. II. Papers Commissioned as Background for *Science Indicators, 1980*. Washington, D.C.: National Science Foundation.

**The Influence of Aeronautical R&D Expenditures Upon the Productivity of Air Transportation*. Ralph C. Lenz, John A.

Machnic, and Anthony W. Elkins. Dayton, Ohio: Univ. of Dayton, Jul. 1981. PB 81-247140

"The Measurement of Industrial Innovation," Vol. IV. Papers Commissioned as Background for *Science Indicators, 1980*. Washington, D.C.: National Science Foundation.

"Patents: Their Evaluation, Their Posture, Their Procurement and Their Function," Irwin M. Aisenberg. *Intersciencia*, Vol. 6, Nov./Dec. 1981, pp. 395-401.

Procedures for the Development of Bibliometric Measures for Use in Science Indicators Reports. Mark P. Carpenter. Cherry Hill, N.J.: Computer Horizons, Inc.

"A Proposed Convention for Measuring the State of the Art of Products or Processes," Theodore J. Gordon and Thomas R. Munson. *Technological Forecasting and Social Change*, Vol. 20, 1981, pp. 1-26.

"Relationship Between R&D Expenditures and Publication Output for U.S. Colleges and Universities," Paul R. McAllister and Deborah Ann Wagner. *Research Into Higher Education*, Vol. 15, 1981, pp. 3-30.

Research Study of the Direct and Indirect Effects of Federally-Sponsored R&D in Science and Engineering at Leading Research Institutions, Volume I, Executive Summary. David J. Bowering and John K. Sheehan. Washington, D.C.: Science Management Corp., Nov. 1981.

Research Study of the Direct and Indirect Effects of Federally-Sponsored R&D in Science and Engineering at Leading Research Institutions, Volume II, Final Report. David J. Bowering and John K. Sheehan. Washington, D.C.: Science Management Corp., Nov. 1981.

1980

The Attentive Public for Science Policy: A Case Study in Issue Specificaiton. Jon D. Miller and Kenneth Prewitt. DeKalb, Ill.: Northern Illinois Univ.

Bibliometric Indicator Series in the U.S. Science Indicators Data Base. Francis Narin and Mark P. Carpenter. Cherry Hill, N.J.: Computer Horizons, Inc.

"Comparison of Peer and Citation Assessment of the Influence of Scientific Journals," Paul McAllister, Richard C. Anderson, and Francis Narin. *Journal of the American Society of Information Sciences*, May 1980, pp. 147-152.

**Data User's Guide to the National Science Foundation's Science Literature Indicators Data Base*. Springfield, Va.: National Technical Information Service, 1980. PB 82-104266

**Development of Refined Indicators of Technical Innovation Using Examiners' Citations in the Patent File—Phase I*. Mark Carpenter. Cherry Hill, N.J.: Computer Horizons, Inc., Feb. 1981. PB 82-101833

Evolution and Status of Bibliometric Data Used in U.S. Science Indicators Reports. Mark P. Carpenter and Francis Narin. Cherry Hill, N.J.: Computer Horizons, Inc.

Indicators of the Patent Output of U.S. Industry (1963-79) and *Energy Patenting* (1963-79) (microfiches), U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast. Washington, D.C.: Division of Science Resources Studies, National Science Foundation, 1980.

**The Measurement of the Attitudes of the U.S. Public Toward Organized Science*. Jon D. Miller and Kenneth Prewitt. Chicago, Ill.: National Opinion Research Center, Univ. of Chicago. PB 81-155079

National Survey of the Attitudes of the U.S. Public Toward Science and Technology. Koray Tanfer, et. al. Springfield, Va.: National Technical Information Service.

"Publication Ratings vs. Peer Ratings of Universities," Richard C. Anderson, Francis Narin, and Paul R. McAllister. *Journal of the American Society for Information Science*, 29, 91-103, March 1978. Reprinted in *Key Papers in Information Science*, Ed. by Belver C. Griffith. Knowledge Industry Publications, Inc., 1980.

**Relationship Between R&D Expenditures—Manpower Resources and Publication Output for U.S. Colleges and Universities*. Paul R. McAllister. Cherry Hill, N.J.: Computer Horizons, Inc., Aug. 1980. PB 82-105180

**Research into Technology Output Measures, Phase I*. Theodore J. Gordon and T. R. Munson. Glastonbury, Conn.: The Futures Group, 1980. PB 81-245300

"Science Indicators: Implications for Research and Policy," *Scientometrics*, Vol. 2, Oct. 1980.

1979

**Current Problems Facing Small R&D Firms*. Frank Piovia. Washington, D.C.: Economic Associates, Dec. 1979. PB 80-127830

**The Meaning of Patent Statistics*. This report contains papers by four experts on the legal and economic aspects of patenting: Dr. James L. Harris, Prof. Mary A. Holman, Prof. Edmund W. Kitch, and Prof. Keith Pavitt. Washington, D.C.: National Science Foundation, 1979. PB 80-137664

"Similarity of Pratt's Measure of Class Concentration to the Gini Index," Mark P Carpenter. *Journal of the American Society for Information Science*, 30, 108-110, Mar. 1979.

1978

"Objectivity vs. Relevance in Studies of Scientific Advance," Francis Narin. *Scientometrics*, 1, 35-41, 1978.

1977

"Bibliometrics," Francis Narin and Joy K. Moll. *Annual Review of Information Science and Technology*, 12, 35-58, Sep. 1977.

The Feasibility of Obtaining Additional Information on Industrial Research and Development. Bernard N. Samers, Morris S. Whitcap, and Dorothy I. Kelly. Stamford, Conn.: Cooper and Company, Aug. 1977.

1976

Attitudes of the U.S. Public Toward Science and Technology. Study III. Princeton, N.J.: Opinion Research Corp., Caravan Surveys, Sept. 1976. PB 287200/AS

Science Literature Indicators Study, 1975. Philadelphia, Pa.: National Federation of Abstracting and Indexing Services, Nov. 1976. PB 278775/AS

1975

Indicators of the Output of New Technological Products from Industry. Herbert S. Kleinman. Columbus, Ohio: Battelle Columbus Labs., Feb. 1975. PB 293072/AS

international science and technology

1985

A Comparative Analysis of Research Policies and Strategies, France, Germany, Japan, Sweden, the United Kingdom, and the United States. Leonard L. Lederman, Rolf Lehming, and Jennifer S. Bond. Prepared for the Government-University Industry Research Roundtable—Working Group 4. Washington, D.C.: National Science Foundation, Jul. 1985.

Comparison of Scientific and Technical Personnel Trends in the United States, France, West Germany, and the United Kingdom Since 1970. Joseph Mintzes and William Tash. Washington, D.C.: National Science Foundation (NSF 84-335), 1985.

"Japanese Government Policy, Labor Markets, and Technological Progress, with Special Reference to Biotechnology," Gary Saxonhouse. Symposium on Creating an Environment for Technological Growth. Washington, D.C.: National Academy of Sciences, Feb. 28, 1985.

"Japanese High Technology, Government Policy and Evolving Comparative Advantage in Goods and Services," Gary Saxonhouse. *Japanese Technology Transfer Public and Private Strategies Supplement IV,* ed. by Gary Saxonhouse. *Research in Economic History.* Greenwich, Conn.: JAI Press, in press.

Joint Japanese R&D Ventures, A Market Analysis. Gary Saxonhouse. Presented to the Technology and Innovation Project. Stanford, Calif.: Stanford Univ., Mar. 12, 1985.

Performer Organizations and Support Strategies for Fundamental Research: United States, France, West Germany, United Kingdom, Japan, and the Soviet Union. Washington, D.C.: SRI International, Apr. 1985.

"Services in the Japanese Economy," Gary Saxonhouse. *Managing the Services Economy, Prospects, and Problems,* Robert Inman, ed. Cambridge, Mass.: Cambridge Univ. Press, in press.

Technology and the Future of the Japanese Economy. Gary Saxonhouse. Workshop on Japan's Domestic Economy sponsored by the Japan Political Economy Research Committee. Honolulu, Hawaii, Jan. 1985.

1984

High Tech Trade Data 1961-82 (tabulations). Data Resources, Inc. Washington, D.C.: Division of Science Resources Studies, National Science Foundation, 1984.

1983

"Highly Cited Soviet Papers: An Exploratory Investigation," Francis Narin, J. Davidson Frame, and Mark P. Carpenter, *Social Studies of Science,* 13, 307-319, 1983.

"Validation Study: Patent Citations as Indicators of Science and Foreign Dependence," Mark P. Carpenter and Francis Narin. *World Patent Information,* 5, 180-185, 1983.

1982

Soviet R&D Statistics, 1975-82. Robert W. Campbell. Washington, D.C.: National Science Foundation, 1982.

1981

*"An Analysis of Travel by Academic Scientists and Engineers to International Scientific Meetings in 1979-1980," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Research Report,* No. 50. Washington, D.C.: American Council on Education, Feb. 1981. PB 82-180977

"Indicators of International Technology and Trade Flows," Vol. 1. Papers Commissioned as Background for *Science Indicators, 1980.* Washington, D.C.: National Science Foundation.

The Science Race: Training and Utilization of Scientists and Engineers, US and USSR. Catherine P. Ailes and Francis W. Rushing. New York, N.Y.: Crane Russak, Aug. 1981.

1980

"The Adequacy of the *Science Citation Index (SCI)* as an Indicator of International Scientific Activity," Mark P. Carpenter and Francis Narin. *Journal of The American Society of Information Sciences,* Mar. 1980.

Indicators of the Patent Output of Industrialized Countries (tabulations), U.S. Patent and Trademark Office, Office of Technology Assessment and Forecast. Washington, D.C.: Division of Science Resources Studies, National Science Foundation, 1980.

"Measuring Scientific Activity in Lesser Developed Countries," J. Davidson Frame. *Scientometrics,* Vol. 2, Mar. 1980, pp. 133-145.

Soviet R&D Statistics, 1977-1980. Robert W. Campbell. Washington, D.C.: National Science Foundation. PB 82-207408

"The Subject Composition of the World's Scientific Journals," Mark P. Carpenter and Francis Narin. *Scientometrics*, Vol. 2, Jan. 1980, pp. 53-63.

"Technology and the Changing Positions of U.S. Firms Among the World's Largest Companies," Nestor E. Terleckyj. *New International Realities*, Vol. V, No. 1, Jul. 1980, pp. 1-6. Washington, D.C.: National Planning Association, Jul. 1980.

1979

**The Financing of Science in the USSR*. Edited translation of Answers to the Questions of the American Experts on the Draft of the Soviet Report, translated by SRI International. Arlington, Va., 1979. PB 81-249823

"International Research Collaboration," J. Davidson Frame and Mark Carpenter. *Social Studies of Science*. Vol. 9, Nov. 1979, pp. 481-497.

**International Science Indicators—Development of Indicators of International Scientific Activity Using the Science Citation Index*. Mark Carpenter. Cherry Hill, N.J.: Computer Horizons, Inc., Mar. 1979. PB 293033/AS

"National Economic Resources and the Production of Research in Lesser Developed Countries," J. Davidson Frame. *Social Studies of Science*, 9, 233-247, 1979.

"The Payoffs of Science for Development," J. Davidson Frame. *Intersciencia*, Vol. 4, Sept./Oct. 1979, pp. 263-266.

**Report on the Conference of the U.S.-U.S.S.R. Joint Subgroup on Financing Research and Development*. Prepared by SRI International. Arlington, Va., 1979. PB 81-249849

1978

*"International Scientific Activities at Selected Institutions, 1975-76 and 1976-77," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 37. Washington, D.C.: American Council on Education, Mar. 1978. PB 293851/AS

**Reference Source of Soviet R&D Statistics, 1950-1978*. Robert W. Campbell. Washington, D.C.: National Science Foundation, 1978. PB 80-139371

*"Scientific and Technical Cooperation with Developing Countries, 1977-78," Frank J. Atelsek and Irene L. Gomberg. *Higher Education Panel Report*, No. 40. Washington, D.C.: American Council on Education, Aug. 1978. PB 293846/AS

1977

"The Distribution of World Science," J. Davidson Frame, Francis Narin, and Mark P. Carpenter. *Social Studies of Science*, 7, 501-516, Nov. 1977.

"Mainstream Research in Latin America in the Caribbean," J. Davidson Frame. *Interciencia*, 2, 143-147, Jun. 1977.

**Osobennosti Finansirovaniya Nauki v SSR*, Ye. I. Valuyev, L. S. Glyozer, et. al. Moscow, USSR, 1976. PB 81-249799

1976

**Indicators of International Trends in Technological Innovation*. Stephen Feinman and William Fuentevilla. Jenkintown, Pa.: Gellman Associates, Apr. 1976. PB 263738/AS

Overseas Research and Development by United States Multinationals, 1966-1975: Estimates of Expenditures and A Statistical Profile. Daniel Creamer. New York: The Conference Board, 1976.

**Reference Source on U.S.S.R. R&D Statistics*. Robert W. Campbell. Bloomington, Ind.: Indiana Univ., 1976. PB 276290/AS

**Unique Characteristics of Financing of Science in the USSR*. Ye I. Valuyev, L. S. Glyozer, et. al. Translation of Soviet Report, *Osobennosti Finansirovaniya Nauki v SSR*, by U.S. Joint Publications Research Service. Moscow, USSR, 1976. PB 81-212243.

1975

'National Publication and Citation Comparisons," Francis Narin and Mark P. Carpenter. *Journal of the American Society for Information Science*, 26, 80-93, Mar.-Apr. 1975.