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ABSTRACT

Although academic employment of full-time scientists and engineers increased by three percent in 1977, more than one-fourth of public and private institutions reported a reduction in employment levels. There appeared to be a shift in emphasis toward applied rather than basic research. The employment of women as full-time scientists and engineers in the academic sector has grown at a rate approximately double that of men in 1977. Among the other information contained in this report is a chart of the number of scientists and engineers employed by the fifty leading situations broken down by field and sex. (BB)

SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION • WASHINGTON, D. C. 20550 • FEBRUARY 15, 1978 • NSF 77-327

Academic Employment of Full-Time Scientists and Engineers Increased Another 3 Percent in 1977

Of the 2,190 institutions included in NSF's 1977 Survey of Scientific and Engineering Personnel Employed at Universities and Colleges, 1,835, or 84 percent, responded; NSF provided estimates for the remaining 355 nonrespondents. Among the 302 doctorate-granting institutions surveyed—which accounted for more than two-thirds of total employment of academic scientists and engineers—the response rate was 96 percent. Because of the excellent rate of response from these larger institutions, the rate of estimation made by NSF for the total number of scientists and engineers amounted to only 11 percent in 1977. However, since totals also include additional estimates by some of the institutions, small yearly changes should be viewed with caution.

- Despite continuing financial pressures at many institutions of higher education, the budgetary constraints of recent years have not been so severe as to prevent the addition of professional staff in science and engineering(S/E) fields. Employment of full-time scientists and engineers at universities and colleges, which account for approximately one of every eight scientists and engineers in the United States,[1] rose by 3 percent from January 1976 to January 1977, to 236,200, continuing the average growth of 3 percent reported annually since 1969. The slow steady growth in employment of scientists and engineers at academic institutions may be attributed to a combination of factors, such as: (1) The recent upward trend in graduate enrollment in S/E fields; (2) real, though small, growth in academic R&D expenditures, due largely to increased Federal support; (3) an increase in institutional control of personnel costs (through more restrictive tenure-granting policies and by hiring of a larger percentage of slower-ranked instructional staff); (4) a possibility that employment in S/E fields is increasing at the expense of non-S/E fields; and (5) deferral of some non-personnel-related expenditures in periods of budget cutbacks.

- The 1976-77 employment gain was not shared by all institutions. More than one-fourth of both public and private institutions reported reduction in their employment levels.

- As a result of the present pattern of academic research support, R&D scientists and engineers are shifting their research emphasis toward "applied" areas of current interest and away from long-term or traditionally "basic" lines of research. Applied research and development has increased from a 23-percent share of total academic R&D expenditures in fiscal year 1970 to a 32-percent share in 1976.[2] A shift in the focus of Federal academic R&D support has been the principal reason for the increase in the proportion of applied R&D activities at universities and colleges.

- The number of full-time scientists and engineers within public institutions has risen by 4 percent on an average annual basis between 1969 and 1976; the growth rate dropped to 3 percent between 1976 and 1977. Employment within the private universities and colleges, however, has increased by only 1 percent annually over the same period, despite a 2-percent increase in each of the last 2 years.

- The employment of women as full-time scientists and engineers in the academic sector has grown at a rate approximately double that of men between 1976 and 1977.

[1] National Science Foundation, *U.S. Scientists and Engineers, 1974* (NSF 76-306) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1976).

[2] National Science Foundation, *Detailed Statistical Tables, Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1976* (NSF 77-316) (Washington, D.C. 20550, 1977).

(Prepared in the Universities and Nonprofit Institutions Studies Group, Division of Science Resources Studies.)

Trends in Full-Time Employment

The total number of full-time scientists and engineers at all universities and colleges rose by nearly 3 percent from January 1976 to January 1977 to 236,200. This was the eighth consecutive increase since 1965 when this survey series began, despite claims of financial problems by officials of many institutions of higher education and by various higher education analysts (table 1). The 3-percent average annual growth in employment of full-time scientists and engineers at academic institutions from 1969 to 1977 agreed closely with the 4-percent annual growth in total higher education enrollment and the 3-percent annual growth in total graduate enrollment in the sciences and engineering from 1971 to 1976.[3]

While budget constraints, fluctuations in student enrollment, significant inflation, and reduced value of endowments all have had an adverse impact on academic science programs at many institutions of higher education,[4] the majority of institutions have thus far managed to continue to operate without reducing employment of scientists and engineers. If these economic pressures continue, academic institutions may soon need to address questions involving possible reductions in their overall employment levels, and thus, also of scientists and engineers, and reallocation of financial and personnel resources between teaching and research functions. Other issues that are being addressed are associated with the aging of faculty and severe limitations in the number of positions available to young investigators.

[3] See Department of Health, Education, and Welfare, National Center for Education Statistics, *Survey of Opening Fall Enrollment in Higher Education*, annual series, and National Science Foundation, *Graduate Science Education: Student Support and Postdoctorals*, annual series.

[4] Smith and Karlesky, *The State of Academic Science* (New Rochelle, N.Y.: Change Magazine Press, 1977).

Table 1.—Characteristics of scientists and engineers employed in universities and colleges: January 1976 and January 1977

Item	1976	1977	Percent change
Total	289,301	298,055	3
Full-time employment	230,213	236,225	3
By type of activity:			
Teaching	171,298	175,678	2
Research and development	44,686	46,237	3
Other activities	14,229	14,310	[illegible]
By major field of employment:			
Engineers	22,928	23,808	4
Physical scientists	27,172	27,590	1
Environmental scientists	7,259	7,874	9
Mathematical and computer scientists	23,124	23,624	1
Life scientists	92,085	94,779	3
Psychologists	36,417	37,125	2
Social scientists	40,898	40,968	[illegible]
By [illegible]:			
Male	163,752	166,304	[illegible]
Female	66,461	69,921	[illegible]
By highest degree earned in science and engineering:			
Doctorate or equivalent	134,121	137,947	3
Master's or equivalent	26,411	27,202	3
Bachelor's or equivalent	22,867	23,591	3
No S.E. degree	26,814	26,440	[illegible]
By sex:			
Male	164,334	169,131	[illegible]
Female	65,879	66,934	1
Part time employment	58,888	61,830	5

[illegible]

[illegible]

NOTE: [illegible]

SOURCE: National Science Foundation

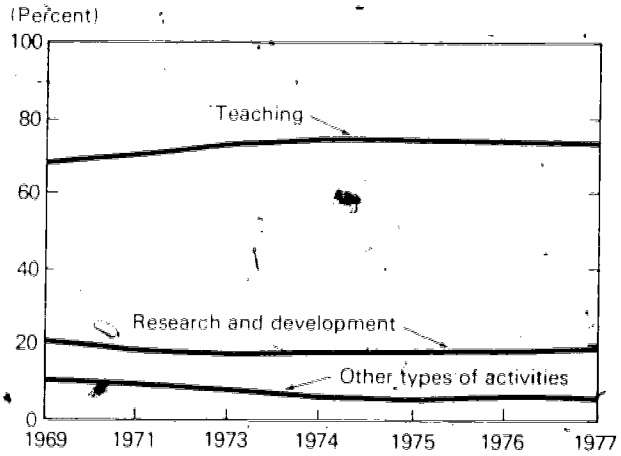
Type of Activity

Approximately three-fourths of full-time scientists and engineers employed at universities and colleges in January 1977 were reported as primarily engaged in teaching, a ratio that has remained nearly constant over the past 3 years (chart 1). The shifting emphasis from research into teaching over the previous decade, thus, has apparently halted. In addition, the composition of research activity between basic and applied lines of inquiry, as well as the level of research funding at academic institutions, may be largely dependent upon the perceived needs and interests of Federal agencies.

During the seventies employment of full-time R&D scientists and engineers has grown at a rate comparable to that of R&D expenditures (in constant dollars) at academic institutions.[5] Employment of full-time R&D scientists and engineers grew at an average annual rate of 2.1 percent from 1969 to 1977, compared to an average annual increase of 1.4 percent in academic R&D expenditures for approximately the same fiscal years, 1970-76. The difference in growth patterns may be explained, in part, by the labor-intensive nature of

[5] National Science Foundation, *Detailed Statistical Tables: Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1976*, NSF 77-316, [illegible]

Chart 1. Full-time scientists and engineers employed at universities and colleges by type of activity: January 1969-77



SOURCE: National Science Foundation

academic R&D costs. Nonpersonnel-related spending, since it can be postponed in a period of economic constraints, is more dependent upon short-run financial trends than is employment. There is less flexibility for deferral of labor-intensive costs because of the fixed nature of salaries for both tenured faculty and for full-time support staff.

Field of Employment

Each of the major areas of employment showed increases in S/E employment from 1976 to 1977, ranging from less than one-half of 1 percent for social scientists to nearly 9 percent for environmental scientists (table 2).

Institutional Control

Between 1969 and 1977, publically controlled institutions have increased their employment of full-time scientists and engineers by 4 percent on an average annual basis. They employed 70 percent of all full-time personnel in 1977, up from 64 percent in 1969. Private institutions retained virtually the same employment level between 1969 and 1975; however, it is encouraging that in the 1975-77 period, employment rose by 2 percent per year, an indication that the financial plight of private institutions may not be as severe in recent years as originally thought (chart 2).

Level of Institution

Doctorate- and master's-granting institutions together increased their number of full-time scientists and engineers by nearly 4 percent to a total of 186,800, while all undergraduate institutions showed a decline of less than 1 percent to 49,400. Graduate institutions accounted for 79 percent of all full-timers in 1977, a proportion that has remained relatively steady over the past 12 years of the survey's history. However, over one-fourth of all

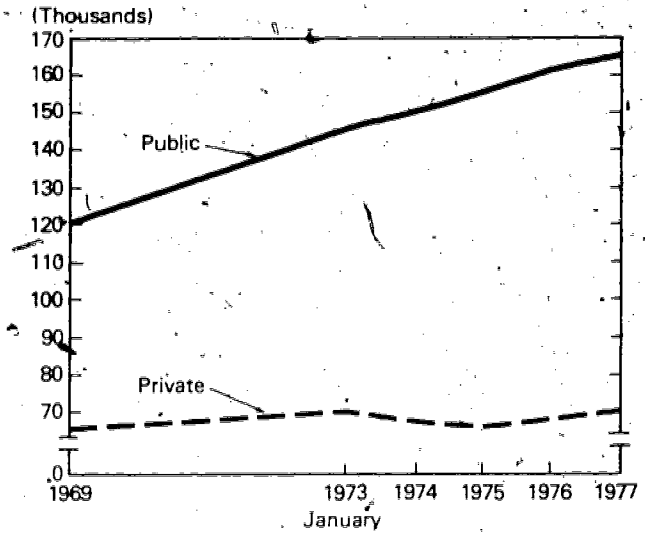
Table 2. Full-time scientists and engineers employed at universities and colleges by field: January 1969 and January 1977

Field	1969	1977	Percent change 1976-77	Average annual percent change 1969-77*
Total, all areas	167,082	236,225	2.6	3.0
Engineers	21,433	23,898	4.2	1.4
Physical scientists	25,040	27,500	1.2	1.2
Environmental scientists	4,045	7,879	8.5	6.0
Mathematical and computer scientists	18,490	23,874	4.2	3.3
Life scientists	54,802	64,759	3.1	3.0
Psychologists	11,536	17,324	3.0	5.2
Social scientists	30,868	40,960	[illegible]	3.6

*Less than 0.5 percent change.

SOURCE: National Science Foundation.

Chart 2. Full-time scientists and engineers employed at universities and colleges by institutional control: January 1969-77



SOURCE: National Science Foundation

institutions showed declines in their employment levels from 1976 to 1977. The largest proportion of institutions with employment declines (37 percent) occurred at the master's-granting level, while 2-year institutions showed the smallest relative number of reductions (23 percent). Although a substantially higher share of the master's-granting institutions reported reductions than 2-year institutions, the total number of full-time scientists and engineers employed at master's-granting institutions increased by 3 percent from 1976 to 1977, while employment at 2-year institutions remained at virtually the same level.

Sex

Women employed as full-time scientists and engineers continued to show larger relative increases (nearly 4 percent) than men (2 percent) between 1976 and 1977. Despite a growth rate approximately double that for men over the last 3 years, the overall proportion of women scientists and engineers has changed little since 1974—up from 15 percent to 16 percent of all full-time scientists and engineers employed at academic institutions. This minor growth is not surprising since, in view of the small starting base, rather large annual changes would be required to change the ratio significantly over a short period of time. Even if these same differential growth rates were to continue for the next 10 years, the proportion of academic women scientists and engineers would rise to only about 19 percent of the total. This has definite implications for the implementation of Federal policies seeking to correct the present imbalance in

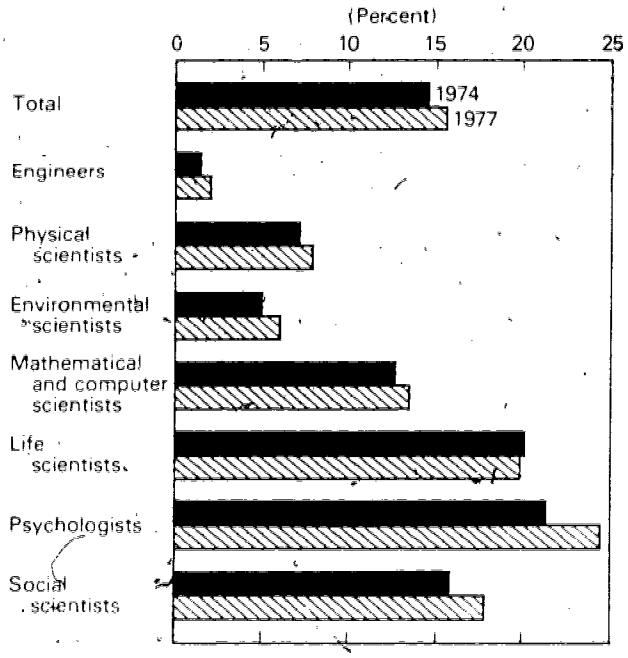
employment opportunities for women scientists and engineers.

Women represent a considerably higher proportion of S/E employment in the academic sector than in the national employment scene; in 1974 they represented only 6 percent of all scientists and engineers in the United States.[6]

Between 1974 and 1977 women showed relative gains in academic employment in all but one of the major science areas—the life sciences—where little change occurred. Psychology, which employed the highest proportion of women, showed an increase from 21 percent to 25 percent during this period, the largest relative gain of women in any field (chart 3).

[6] National Science Foundation, *U.S. Scientists and Engineers, 1974* (NSF 76-329), op. cit.

Chart 3. Women as a percent of all full-time scientists and engineers employed at universities and colleges by field: January 1974 and January 1977



SOURCE: National Science Foundation

The 50 Leading Institutions

The 50 leading institutions shown in table 3 employed 76,100 full-time scientists and engineers, or 32 percent of all full-timers at academic institutions. Across the major fields the concentration at these 50 institutions ranged from 18 percent for mathematical and computer scientists and psychologists to 44 percent for life scientists. The high proportion of life scientists is attributable to the fact that many of the 50 leading universities have affiliated medical schools or agricultural experiment stations.

There is considerable variation in the numbers and proportion of women employed among the 50 leading universities; a principal reason for this divergence is women employment levels is a difference in emphasis on career development outside the normal faculty ranks. Such a program may include sizable numbers of professional staff that have not attained graduate degrees. The University of Michigan for example, with 735 women representing 31 percent of the institutional total for full-time scientists and engineers, reported a relatively low proportion of doctorate-holders (59 percent, compared to 79 percent for all doctorate-granting institutions) and a high number holding a bachelor's degree as their highest earned degree (25 percent, compared to 8 percent for all doctorate-level institutions). Many of these individuals at the University of Michigan are professional staff on "research career ladders" and generally are assigned to assist primary researchers.

* * * * *

Comprehensive statistical tabulations representing these survey results have recently been published in the report, *Detailed Statistical Tables, Manpower Resources for Scientific Activities at Universities and Colleges, January 1977* (NSF 77-321), copies of which may be obtained free from the Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550.

A final report analyzing the data from the 1977 survey will *not* **follow this** *Highlights*. **Full analytical reports and detailed statistical tables will be issued biennially in the future. For example, the next final report will contain January 1978 survey data and trends.** Data tapes for January 1977 and prior surveys may be purchased from:

Moshman Associates, Inc.
6400 Goldsboro Road
Washington, D.C. 20034
202-229-3000

TABLE 1. FULL-TIME SCIENTISTS AND ENGINEERS AT 50 LEADING DOCTORATE-GRANTING INSTITUTIONS IN EMPLOYMENT OF SCIENTISTS AND ENGINEERS, BY FIELD AND SEX: JANUARY 1977

INSTITUTIONAL RANKING	TOTAL, ALL FIELDS		ENGINEERS		PHYSICAL SCIENTISTS		ENVIRON-MENTAL SCIENTISTS		MATH. AND COMPUTER SCIENTISTS		LIFE SCIENTISTS		PSYCHOLOGISTS		SOCIAL SCIENTISTS	
	GRAND TOTAL	WOMEN	TOTAL	WOMEN	TOTAL	WOMEN	TOTAL	WOMEN	TOTAL	WOMEN	TOTAL	WOMEN	TOTAL	WOMEN	TOTAL	WOMEN
TOTAL, ALL DOCTORATE-GRANTING INSTITUTIONS	159592	23609	17747	414	15867	983	5384	338	10847	1072	80175	15318	7878	1738	21694	3746
1 HARVARD UNIVERSITY	3285	510	53	1	231	17	32	2	43	6	2735	457	39	5	152	22
2 UNIV OF WISCONSIN-MADISON	3185	639	354	20	231	15	197	33	147	9	1536	323	299	117	421	122
3 UNIVERSITY OF MINNESOTA	2890	445	187	0	153	6	63	3	139	11	1706	309	128	25	514	91
4 UNIVERSITY OF MICHIGAN	2677	735	348	28	254	36	91	3	113	11	1393	539	151	51	327	71
5 OHIO STATE UNIVERSITY	2375	477	275	5	167	6	53	1	106	5	1069	424	47	4	258	32
6 CORNELL UNIVERSITY	2207	362	279	5	154	5	58	6	44	2	1246	205	26	7	400	132
7 UNIVERSITY OF WASHINGTON	2187	587	197	5	113	5	169	11	68	4	1446	520	44	13	150	29
8 UNIV ILLINOIS URBANA	2074	441	351	76	297	50	63	13	242	56	613	138	165	32	338	76
9 TEXAS A & M UNIVERSITY	2012	98	322	2	95	3	69	3	120	10	994	21	38	8	374	51
10 MASS INST OF TECHNOLOGY	1996	253	778	50	427	31	105	14	136	12	336	114	31	10	183	22
TOTAL 1ST 10 INSTS.	24888	4547	3144	188	2122	174	905	89	1158	126	13474	3050	968	272	3117	648
11 JOHNS HOPKINS UNIVERSITY	1990	392	54	1	112	8	31	1	58	11	1564	290	28	4	143	37
12 LOUISIANA ST UNIV SYSTEM	1885	229	107	1	95	0	53	4	105	18	1369	179	32	5	124	22
13 PENNSYLVANIA STATE UNIV	1873	161	441	5	183	9	79	3	186	28	703	77	77	19	204	20
14 STANFORD UNIVERSITY	1872	368	263	9	159	7	43	1	74	5	1215	317	31	13	87	16
15 UNIV OF TEXAS AT AUSTIN	1670	337	253	26	387	29	129	21	144	17	210	67	155	58	392	119
16 PURDUE UNIV ALL CAMPUSES	1601	163	323	3	206	12	26	3	159	15	576	96	93	19	198	15
17 MICHIGAN STATE UNIVERSITY	1575	197	117	0	174	5	35	0	127	11	735	125	114	22	273	34
18 YALE UNIVERSITY	1561	306	46	1	124	5	32	2	51	1	1115	271	34	8	149	18
19 UNIVERSITY OF PITTSBURGH	1552	431	126	3	126	8	17	0	108	14	856	317	112	49	207	40
20 U OF CAL LOS ANGELES	1550	206	154	3	156	7	69	6	83	5	827	151	65	11	197	23
TOTAL 1ST 20 INSTS.	41997	7297	5038	240	3844	264	1318	130	2253	251	22644	4940	1709	480	5091	992
21 COLUMBIA UNIV MAIN DIV	1468	316	113	4	161	13	176	29	30	2	839	243	43	13	106	12
22 U OF CAL BERKELEY	1364	179	288	9	186	8	32	1	87	8	476	97	45	14	250	42
23 UNIVERSITY OF CHICAGO	1313	235	34	0	213	21	43	2	69	4	763	181	40	11	151	16
24 UNIVERSITY OF IOWA	1300	170	65	0	72	0	14	0	61	4	892	145	34	6	162	15
25 RUTGERS THE STATE UNIV	1288	234	92	1	133	15	45	1	169	30	382	59	139	46	328	82
26 DUKE UNIVERSITY	1281	263	45	0	63	4	15	1	35	2	979	243	26	2	118	11
27 UNIVERSITY OF ARIZONA	1259	118	150	0	241	11	92	4	65	5	466	64	72	11	173	23
28 N C STATE UNIV AT RALEIGH	1254	70	208	1	63	4	20	0	118	8	636	15	21	7	188	35
29 NEW YORK UNIVERSITY	1230	218	6	0	87	4	2	0	86	7	824	164	89	23	136	20
30 UNIV OF MD COLLEGE PARK	1229	169	155	7	271	19	15	4	136	16	360	61	78	22	214	40
TOTAL 1ST 30 INSTS.	54983	9269	6194	262	5334	363	1872	172	3109	337	29261	6212	2296	635	6917	1288
31 CASE WESTERN RESERVE UNIV	1222	181	117	4	93	6	13	0	38	1	879	154	21	4	64	12
32 UNIV OF STHRN CALIFORNIA	1217	207	114	1	97	11	16	0	67	5	700	117	43	5	180	48
33 UNIV OF MISSOURI COLUMBIA	1165	104	123	0	71	5	19	0	49	0	727	82	35	6	141	11
34 UNIVERSITY OF KANSAS	1156	227	73	1	96	7	51	7	67	5	520	112	100	22	249	73
35 IOWA ST U OF SCI & TECH	1124	109	316	4	84	1	49	2	92	2	394	46	30	6	159	48
36 UNIV OF KENTUCKY ALL CAM	1119	48	120	0	59	3	11	1	78	2	667	34	35	4	149	4
37 WASHINGTON UNIVERSITY	1118	213	67	0	60	6	7	2	29	0	867	195	26	2	63	8
38 U OF CAL DAVIS	1107	93	113	1	58	0	27	0	37	2	719	65	21	2	132	23
39 UNIV OF NC AT CHAPEL HILL	1051	125	0	0	113	6	51	2	76	0	661	100	46	11	104	6
40 UNIVERSITY OF ROCHESTER	1045	128	42	0	155	5	11	0	60	2	612	105	67	11	98	5
TOTAL 1ST 40 INSTS.	66307	10704	7279	273	6220	413	2124	186	3702	356	36007	7242	2719	708	8256	1526
41 UNIVERSITY OF GEORGIA	1035	63	24	0	96	5	40	3	56	4	568	30	92	12	159	9
42 OREGON STATE UNIVERSITY	1026	114	135	1	96	3	115	5	70	8	480	69	20	4	110	19
43 TEMPLE UNIVERSITY	1021	183	20	1	67	8	0	0	76	8	606	105	112	31	140	30
44 WEST VIRGINIA UNIVERSITY	992	139	112	3	35	1	15	0	45	12	675	113	17	0	92	10
45 VA POLYTECH INST & ST U	973	53	257	5	82	3	37	2	105	12	361	16	23	3	108	12
46 U OF CAL SAN FRANCISCO	965	231	0	0	28	2	0	0	0	0	924	222	0	0	13	7
47 UNIV OF HAWAII-MANOA	954	141	71	0	73	4	84	2	45	2	412	96	45	6	224	31
48 VIRGINIA COMMONWLTH UNIV	946	230	2	0	16	0	0	0	47	2	699	151	33	5	149	42
49 WASHINGTON STATE UNIV	928	41	178	2	77	2	25	0	55	0	429	26	17	3	147	8
50 U OF CAL SAN DIEGO	919	86	45	0	149	5	198	14	41	1	383	50	20	3	73	13
TOTAL 1ST 50 INSTS.	76056	11955	8133	285	6939	446	2639	212	4242	405	41544	8120	3038	789	9471	1707
TOTAL ALL OTHER INSTS.	83526	11654	9614	129	8928	537	2745	126	6605	667	38631	7198	4840	949	12223	2039

NOTE: TABLE DOES NOT INCLUDE ANY LEADING INSTITUTION THAT (1) REQUIRED NATIONAL SCIENCE FOUNDATION ESTIMATES IN 1977, OR (2) REQUESTED THAT ITS DATA BE HELD CONFIDENTIAL.

SOURCE: NATIONAL SCIENCE FOUNDATION.