enson, Eds. (Pergamon, Oxford, 1973), vol. 4, pp. 355–452.
19. A. Camus, C. Cocevar, G. Mestroni, *J. Organometal. Chem.* **39**, 355 (1972).
20. M. L. H. Green, L. C. Mitchard, W. E. Silverthorn, *J. Chem. Soc. Dalton Trans.* **1974**, 1361 (1974).
21. T. Kruck, G. Sylvester, I. P. Kunau, *Angew. Chem. Int. Ed. Engl.* **10**, 725 (1971).
22. M. Wrighton, plenary lecture at the 5th Symposium on Photochemistry of the International Union of Pure and Applied Chemistry, Enschede, Netherlands, 21 to 27 July 1974.
23. V. Balzani and V. Carassiti, *Photochemistry of Coordination Compounds* (Academic Press, London, 1970).
24. G. Sartori, P. D. Fleischauer, A. W. Adamson, *Prog. Inorg. Chem.* **17**, 1 (1972).
25. C. F. Campen, Jr., A. E. Cole, T. P. Condron, W. S. Ripley, N. Sissenwine, I. Solomon, Eds., *Handbook of Geophysics* (Macmillan, New York, rev. ed., 1960), p. 16-14.
26. We thank the National Research Council of Italy for financial support.

Doctorates Granted to Women and Minority Group Members

What changes have there been in recent years in numbers and in distribution among fields of study?

Joseph L. McCarthy and Dael Wolfle

Current emphasis on affirmative action in recruiting new faculty members focuses attention on those universities from which appropriately qualified young holders of doctorates are most likely to be obtained. Most of these universities are members of the Association of American Universities (AAU). The 46 AAU universities (*1*) within the United States have awarded 75 percent of all doctorates awarded to date in this country, and are currently awarding about 60 percent of the yearly total. In quality, too, the AAU universities are a select group. They include 89 percent of all graduate departments rated as "distinguished" or "strong" in the 1969 Roose-Andersen survey (*2*).

Clearly the AAU institutions offer a rich hunting ground for beginning faculty members. It is therefore of interest to know their current record and trends in providing doctoral education to women and to members of the principal minority groups. To obtain that information, we asked the graduate dean of each member university to supply information on the number of doctorates (Ph.D., Ed.D., D.B.A., D.M.A., and so on, but not M.D., D.D.S., D.V.M., D.Th., or J.D.) conferred in each field from 1 July 1969 to 1 July 1972 and the number expected to be conferred in each field from 1 July 1972 to 1 July 1975, and also to show the numbers in each field and time period awarded to women, to minority women, and to minority men. The four minority groups—American Indian, Asian American, Black, and Spanish origin—were defined in accordance with the instructions of the Department of Health, Education, and Welfare concerning affirmative action programs (*3*).

All AAU members except McGill University and the University of Missouri supplied data. Not every university could supply all the information asked for, but the gaps were relatively few and were filled by adding proportionate estimates. Figures and percentages reported below are therefore either actual or estimated totals for the 46 AAU universities in the United States (including the Berkeley and Los Angeles campuses of the University of California). Data concerning each university were sent to its graduate dean for verification.

The data are summarized by fields in Table 1. Several conclusions can be drawn from that table:

1) The total number of doctorates from AAU institutions is expected to be essentially the same in 1972–75 as in 1969–72; the figures show an increase of less than 0.1 percent. This slight increase is much smaller than the 20 percent increase projected by the U.S. Office of Education (*4*) for all doctoral degrees from all U.S. universities. However, it is consistent with a recent report of the American Council on Education (*5*) which included figures or estimates for the "top 20" universities in the country. In these 20 universities, the average number of doctorates in 1972–73 and 1974–75 (the first and third years of our second 3-year period) is projected to be 0.7 percent greater than the number in 1971–72 (the final year of our first 3-year period). It seems clear that for the immediate future the AAU universities are not increasing their total number of doctorates significantly above the 1969–72 level.

2) The small total increase is the net result of four substantially larger changes in the representation of women and minority group members (recapitulated in Table 2).

3) A number of individual fields show substantial increases or decreases. Some that increased more than 10 percent are applied mathematics, business administration, fine arts, psychology, and foreign languages. Those that decreased more than 10 percent are mathematics, chemistry, engineering, biochemistry, and physics.

4) The individual fields differ very substantially in the percentages of doctorates awarded to women and to minority members. For women, the percentage of doctorates for the entire 6-year span is less than 10 percent in each of the following fields. Note that the fields included in this list (and also the three following lists) are more finely divided than those of Table 1. The figure in parentheses is the 6-year total of doctorates from the AAU institutions; a field is not listed if its total is less than 100.

Geography (1042)	9%
Astronomy (500)	8
Economics (3372)	8
Mathematics (3356)	8
Religion (608)	8
Computer science (958)	6
Applied mathematics (1562)	5
Geology (1530)	4
Agriculture (1856)	3
Atmospheric science (201)	3
Business administration (2373)	3
Physics (5621)	3
Engineering (all branches) (11,912)	1
Operations research (100)	1

In contrast, women received more than 25 percent of the doctorates in the 6-year span in each of the following fields:

Home economics (121)	79%
Art history (302)	53
Romance languages (2026)	46
Germanic languages (893)	40
Comparative literature (332)	40
Social work (978)	38
Health sciences (1651)	34
English (5470)	34
Speech (1409)	33

Dr. McCarthy is Professor of Chemical Engineering and Dean Emeritus of the Graduate School and Dr. Wolfle is Professor of Public Affairs at the University of Washington, Seattle 98195.

Psychology (5705)	33%
Anthropology (1550)	32
Library science (133)	31
Linguistics (839)	29
Education (16,476)	28
Classics (531)	28
Microbiology (1011)	28
Sociology (2546)	27

There are few surprises in either list. In general, women constitute prominent percentages in those fields in which traditionally they have held significant numbers of doctorates, and they remain few in those fields in which traditionally that has been the case. In percentage terms, the trend is upward in nearly all fields, but in some it will be difficult to increase the number of women faculty members rapidly because the absolute numbers of degrees awarded are so small. In 1969–72, 47 percent of all of the women's doctorates were concentrated in only six fields: anthropology, biology, education, health sciences, psychology, and Romance languages. For 1972–75, 45 percent are still in these six fields.

5) For minorities—both men and women—there are also significant field differences. Minorities received 3 percent or less of the doctorates awarded in the 6-year span in these fields:

History of art (302)	3.0%
Mechanical engineering (1891)	2.9
Mathematics (3356)	2.8
English (5470)	2.5
International relations (238)	2.5
Business administration (2373)	2.4
Computer science (958)	2.4
Aeronautic and astronautic engineering (885)	2.4
Chemical engineering (1333)	2.3
Physics (5621)	2.2
Statistics (239)	2.1
Linguistics (839)	2.0
Operations research (100)	2.0
Agriculture (1856)	1.9
Civil engineering (1616)	1.9
Astronomy (500)	1.6
Religion (608)	1.6
Classics (531)	1.3
Geology (1530)	1.2
Germanic languages (893)	1.1%
Nuclear engineering (388)	1.0
Home economics (121)	0.0

In the following fields, minorities received 5 percent or more of the 1969–75 doctorates:

Social work (978)	15%
Romance languages (2026)	11
Comparative literature (322)	9
Education (16,476)	8
Microbiology (1011)	8
Library science (133)	8
Pharmaceutical sciences (847)	7
Biostatistics (155)	7
Atmospheric sciences (201)	6
Sociology (2546)	6
Fine arts (2093)	5
Biochemistry (1464)	5
Philosophy (1516)	5

As with women, the distribution across fields is quite uneven, and some fields will have great difficulty recruiting minority faculty members. Of all doctorates awarded to members of the four minority groups, 52 percent are concentrated in just

Table 1. Doctoral degrees conferred by AAU universities, by field, 1969–72 and 1972–75: totals, to women, to minority men, and to minority women.

Field*	Total awarded			Awarded to women		Awarded to minority members			
	Number		Percent change			Men		Women	
	1969–72	1972–75		1969–72	1972–75	1969–72	1972–75	1969–72	1972–75
Arts and humanities	9,999	10,669	+6.7	2,290	3,425	177	351	84	207
English	2,750	2,720	−1.1	820	1,031	22	44	22	52
Fine arts†	956	1,137	+18.9	167	343	19	44	14	38
History	2,713	2,779	+2.4	393	614	41	86	7	38
Foreign languages	1,991	2,260	+13.5	693	1,008	55	108	34	63
Philosophy	768	748	−2.6	93	134	31	40	2	3
Other‡	821	1,025	+24.8	128	295	9	29	5	13
Business	1,079	1,294	+19.9	14	56	18	34	0	4
Education	8,132	8,344	+2.6	1,952	2,595	276	592	171	334
Engineering§	6,428	5,484	−14.7	32	93	176	203	4	4
Health professions‖	1,242	1,256	+1.1	283	372	37	69	3	21
Life sciences	6,089	6,012	−1.3	895	1,166	209	205	36	74
Biology#	1,127	1,187	+5.3	242	307	37	31	10	15
Biochemistry	784	680	−13.3	133	148	27	24	13	13
Microbiology	490	521	+6.3	122	158	37	34	1	10
Physiology	652	614	−5.8	92	119	17	24	3	2
Agriculture	963	893	−7.3	29	35	15	18	0	2
Botany	593	557	−6.1	68	80	19	16	4	5
Zoology	641	653	+1.9	100	185	17	30	2	5
Other**	839	907	+8.1	110	133	40	28	3	22
Mathematical sciences	2,565	2,353	−8.3	187	214	49	72	10	9
Mathematics	1,870	1,486	−20.5	140	132	36	45	7	7
Applied mathematics††	695	867	+24.7	48	80	13	27	3	2
Physical sciences	7,628	6,673	−12.5	404	520	194	217	21	41
Chemistry	3,460	2,930	−15.3	301	372	121	138	17	35
Physics	2,974	2,647	−11.0	71	101	57	58	3	5
Other‡‡	1,194	1,096	−8.2	48	65	16	21	1	1
Basic social sciences	8,334	9,197	+10.4	1,650	2,318	161	315	41	173
Economics	1,700	1,672	−1.6	109	174	32	59	3	12
Political science	1,526	1,594	+6.2	211	292	36	65	9	22
Psychology	2,651	3,054	+15.2	817	1,060	37	76	19	73
Sociology	1,236	1,310	+6.0	278	411	23	71	7	39
Other§§	1,221	1,567	+28.3	234	387	33	44	3	27
Other fields‖ ‖	1,799	2,045	+13.7	488	656	35	81	44	97
Grand total	53,295	53,327	+.1	8,195	11,415	1,332	2,139	414	964

*The AAU institutions reported 225 different disciplinary names for their doctoral programs. Closely similar fields and disciplines were combined under a common title, and later into the broad areas and fields listed in Table 1. The following footnotes will illustrate, but not show exhaustively, which disciplines are included within certain fields named in Table 1. †Fine arts, drama, music. ‡Architecture, comparative literature, linguistics, religion. §Aeronautics and astronautics, chemical, civil, electrical, mechanical, nuclear, and other engineering. ‖ Biomedical sciences, dentistry, epidemiology, hospital administration, medical sciences, nursing, optometry, pharmaceutical sciences, physical medicine, public health, surgery. #Ecology, embryology, endocrinology, environmental health, immunology, toxicology. **Anatomy, entomology, fisheries, forestry, genetics, pathology. ††Statistics, computer science, operations research, biostatistics. ‡‡Astronomy, atmospheric sciences, geological sciences, oceanography. §§Anthropology, geography, social sciences. ‖ ‖Communications, criminology, foreign affairs, home economics, international relations, library science, public administration, social work, speech, urban planning.

five fields: education (28 percent), engineering (8 percent), chemistry (6 percent), foreign languages (5 percent), and psychology (4 percent).

Distinguished and Strong Departments

Included within the data reported above was information concerning women's doctorates from 433 of the 712 distinguished and strong graduate departments in the AAU universities, and information concerning doctorates to minority members from 380 of those departments. We made a separate analysis of these superior graduate departments, but there is no need to give all the details here; they were nearly identical with the results for all graduate programs in AAU institutions.

The distinguished and strong departments show a decline of about 3 percent in total number of doctorates from 1969–72 to 1972–75, as compared with an essentially unchanged total for all departments. Majority men show a decrease of 7 percent in these departments (compared with a decrease of 9 percent for all departments); majority women increase 39 percent (34 percent); minority men increase 47 percent (61 percent); and minority women increase 221 percent (133 percent). In specific fields also the distinguished and strong departments are acting pretty much like all AAU departments in the same fields; only occasionally is there a difference of more than 2 or 3 percentage points between the percentage of women or minorities in the distinguished and strong departments in a field and all departments in that field.

Table 2. Number of doctorates conferred on majority men, majority women, minority men, and minority women, 1969–72 and 1972–75.

Recipient group	1969–72	1972–75	Percent change
Majority men	43,768	39,773	−9
Majority women	7,781	10,451	+34
Minority men	1,332	2,139	+61
Minority women	414	964	+133

Comparison with All 1973 Doctorates

In 1973, for the first time, the National Research Council (NRC) requested racial/ethnic information in its annual survey of doctorates awarded by U.S. universities. Of all recipients of doctorates in the academic year 1972–73, 11.8 percent were reported as being members of the four primary minority groups and 0.2 percent as members of other minority groups. The figure of 11.8 percent is so different from the 5.8 percent the AAU universities expected to award to minorities in 1972–75 as to require explanation, and a special analysis of 1973 doctorates by the NRC (*6*) helps explain it. The NRC data came from self-reports at the time of receipt of the doctorate. Information on citizenship status was also obtained, and cross tabulation shows that only 37 percent of the minority recipients of 1973 doctorates were U.S. citizens. An additional 29 percent were in the United States on immigrant visas and 34 percent on other types of visas.

The AAU data came from institutional records, and reports of the graduate deans made it clear that they had used different systems: some universities included noncitizens in their minority counts, but most did not; two universities excluded Asians from their counts; and four included only Blacks. Thus our figures for AAU universities probably underestimate the degrees awarded to members of minority groups who are citizens or prospective citizens of the United States.

On the other hand, the NRC figure of 11.8 percent clearly overstates the minority position. It includes an unknown number of persons from South Asia who identified themselves as Orientals and, more important, 34 percent of the total consists of foreign students in the United States on nonimmigrant visas, a group specifically excluded from some surveys of minority students and generally not included in reports by the AAU deans.

The importance of the citizenship variable is evident from the NRC data on percentage of 1973 doctorates awarded to minority students: U.S. citizens only, 5.2 percent; U.S. citizens plus students on immigrant visas, 8.7 percent; U.S. citizens plus students on all types of visas, 11.8 percent.

The AAU projection for 1972–75 of 5.8 percent is consistent with the 1973 citizens-only figure, for most of the AAU deans excluded foreign students from their reports of minority doctorates. In estimating how many of the minority recipients of doctorates of 1973 might be available for employment in this country, the NRC chose to include U.S. citizens and noncitizens holding immigrant visas. If one accepts this assumption as reasonable, the number of minority members with doctorates from AAU universities who are available for employment in the United States may be approximately one and a half times the number reported in Table 1.

The Individual Minority Groups

Preliminary inquiry showed that only a few universities could provide field-by-field data for each minority group separately, so only total minority figures were collected. However, the NRC survey of 1973 doctorates and two other recent reports provide a basis for estimating the division by minority groups. The Department of Health, Education, and Welfare collected fall 1972 data on graduate enrollment by minority groups from 650 institutions of higher education (*7*). From this report we have computed percentages of total graduate enrollment in the AAU universities for each of the four minority groups. The other source of comparison is a survey by the American Council on Education (*8*) of total graduate school enrollment in 154 universities in 1973.

Table 3 summarizes data from these three studies and also shows 1969–72 and 1972–75 percentages of doctorates from AAU universities awarded to minorities. In general, minority students constitute a higher percentage of graduate enrollment than of degree recipients, a relationship to

Table 3. Minority group members as percentages of graduate students and of recipients of doctorates.

Population	American Indian	Asian	Black	Spanish origin	Total
1972 graduate students in AAU universities	0.2	1.7	3.9	1.1	6.9
1973 graduate students in 154 universities	0.3	1.4	4.4	1.1	7.2
1973 recipients of doctorates from all U.S. universities; minority percentage includes:					
U.S. citizens only	0.5	1.1	2.7	0.8	5.2
Citizens and holders of immigrant visas	0.5	4.6	2.7	0.8	8.7
Citizens and holders of immigrant and other visas	0.5	7.4	2.9	1.1	11.8
Recipients of doctorates from AAU universities:					
1969–72					3.3
1972–75					5.8

be expected in a time of rising minority enrollment. As can also be seen in Table 3, students from Asian countries account for almost all of the differences in minority distribution of the citizen and the two noncitizen groups. And finally, one can estimate that the recipients of doctoral degrees from AAU institutions are probably divided among the four minority groups within the range of proportions shown in the top four lines of the table.

Table 4 shows the distribution of 1973 doctorates by racial/ethnic group and area of doctoral specialization (*6*). Data are for U.S. citizens and persons here on immigrant visas but not those holding other types of visas. For comparison, expected doctorates from AAU universities for the 1972–75 period are classified by the same areas of specialization. These data reinforce the point, already made for the AAU institutions, that minority students are very unevenly distributed among the fields of specialization, and show further that the several minority groups differ substantially in their interests.

Students of Asian ancestry concentrate in the sciences and engineering; over 80 percent of the 1973 doctoral recipients took their degrees in one of these fields. The concentration is about equally marked among U.S.-born students of Asian ancestry and those of foreign birth. The concentration is also consistent with past trends; 75 percent of all minority members of the national stock of doctoral level scientists and engineers are of Asian background (*6*).

Black recipients of 1973 doctorates showed two contrasting distributions of interest. Those born in the United States concentrated heavily (60 percent) in education, with relatively small numbers scattered through the science and engineering fields. Black students from other countries, and especially those on nonimmigrant visas, were much more often found in the scientific fields and much less frequently in education (*6*).

American Indian and Spanish-origin recipients of 1973 doctorates were more evenly distributed across fields of specialization. American Indians divided about 50 percent in scientific and engineering fields, 30 percent in education, and 20 percent in other fields. Native-born students of Spanish background distributed themselves about as did the general majority of students, but with a greater preference for the arts and humanities. In the near term the impact of both groups on total employment trends will be small, for American Indian and Spanish-origin holders of doctorates will account for only about one-fifth of the minority total.

Table 4. Minority group members as percentages of recipients of doctorates, by specialty fields.

Field	All U.S. universities, 1973					AAU universities, 1972–75, minority total
	American Indian	Asian	Black	Spanish origin	Total	
Engineering, mathematics and physical science	0.3	11.0	1.0	0.6	12.8	3.8
Life sciences	0.5	7.0	1.9	0.9	10.3	4.6
Psychology	0.6	1.3	1.3	0.9	4.1	4.9
Social sciences	0.5	3.8	1.9	0.6	6.9	5.5
Arts and humanities	0.5	1.2	1.7	1.4	4.8	5.2
Education	0.7	0.8	6.9	0.9	9.3	11.1
Other professions	0.1	2.6	2.2	0.2	5.1	6.7
All fields combined	0.5	4.6	2.7	0.8	8.7	5.8

Summary

The AAU universities, a prime recruiting ground for new faculty members in selective colleges and research-oriented universities, are significantly increasing the number of doctorates awarded to women and minority members and are decreasing the numbers awarded to majority males. Between 1969–72 and 1972–75, doctorates awarded by AAU universities to majority men declined by 9 percent; to majority women increased by 34 percent; to minority men increased by 61 percent; and to minority women increased by 133 percent.

The field distribution is very uneven. In some fields women with doctorates are fairly numerous, but most of these fields are ones in which women have for long constituted a significant portion of the total. In other fields, notably engineering and some of the physical sciences, it is still difficult to find women with doctorates from the universities in which large numbers of new faculty members receive their graduate education.

Increasing numbers of minority students are earning doctorates in some fields, but in many fields the number is still very low. The several minority groups show quite different patterns of distribution among fields of specialization. The two smaller groups—American Indian and Spanish-origin—are most like the white majority in distribution by fields. Black doctorates are concentrated in education, with relatively few in the sciences. Students of Asian ancestry are heavily concentrated in engineering and the natural sciences.

References and Notes

1. The Association of American Universities at the time of this survey in the spring of 1974 included the following universities: Brown, California, California Institute of Technology, Case Western Reserve, Catholic, Chicago, Clark, Colorado, Columbia, Cornell, Duke, Harvard, Illinois, Indiana, Iowa, Iowa State, Johns Hopkins, Kansas, Maryland, Massachusetts Institute of Technology, McGill, Michigan, Michigan State, Minnesota, Missouri, Nebraska, New York, North Carolina, Northwestern, Ohio State, Oregon, Pennsylvania, Pennsylvania State, Princeton, Purdue, Rochester, Southern California, Stanford, Syracuse, Texas-Austin, Toronto, Tulane, Vanderbilt, Virginia, Washington (St. Louis), Washington (Seattle), Wisconsin-Madison, and Yale. We are most appreciative of the generous help given by the graduate deans and their colleagues in providing the data that made this summary possible.
2. K. Roose and C. Andersen, *A Rating of Graduate Programs* (American Council on Education, Washington, D.C., 1970).
3. Equal Employment Opportunity Commission, *Higher Education Staff Information Report EEO-6*, vol. 29, CFR part 1602 (1974), pp. 3450–3451.
4. M. Frankel and J. Beamer, *Projections of Educational Statistics to 1982–83*, 1973 edition (Department of Health, Education, and Welfare, Washington, D.C., 1974).
5. J. Dutton and E. El-Khawas, *Production of Doctorates in Selected Fields, 1972–75*, Higher Education Panel Report No. 16 (American Council on Education, Washington, D.C., 1974).
6. *Minority Groups Among United States Doctorate Level Scientists, Engineers, and Scholars, 1973* (National Research Council, Washington, D.C., 1974).
7. *Chron. Higher Educ.* **9**, 8 (2 Dec. 1974).
8. E. El-Khawas and J. Kinzer, *Enrollment of Minority Graduate Students at Ph.D. Granting Institutions*, Higher Education Panel Report No. 19 (American Council on Education, Washington, D.C., 1974).