37. Anomalous flood deposits have ^{14}C dates of 11,720, 12,000, and 12,020 years ago on the Kom Omo plain [(*51*), pp. 115, 129, 278]; of 11,200 and 11,410 years ago at Dibeira East; and of 10,920 and 11,000 years ago at Khor Musa [J. de Heinzelin, in *The Prehistory of Nubia*, F. Wendorf, Ed. (Southern Methodist Univ. Press, Dallas, 1968), pp. 21, 38]; also, H. T. Irwin, J. B. Wheat, L. F. Irwin, *Univ. Utah Anthropol. Pap. 90* (1968), p. 109, for similar evidence from opposite Wadi Halfa.
38. The geological record from the latter period is fragmentary and the ^{14}C dates few, both essentially limited to the northernmost Sudan [see references in (*51*); also P. Vermeersch, *Chron. Egypt.* **45**, 45 (1970)].
39. Barbara Bell, *Geogr. J.* **136**, 569 (1970); *Amer. J. Archaeol.* **75**, 1 (1971); in preparation.
40. E. M. van Zinderen Bakker, personal communication.
41. For references and discussion see (*51*), p. 449.
42. This basin in southwestern Tanzania shows a high lake level fixed by dates of 9740 ± 130 years ago (A-945) and 8060 ± 120 years ago (A-944) [J. D. Clark, C. V. Haynes, J. E. Mawby, P. Gautier, *Quaternaria* **13**, 305 (1970)].
43. M. Servant, S. Servant, G. Délibrias, *C. R. Acad. Sci. Paris. D* **269**, 1603 (1969); M. Servant, S. Servant, *Rev. Géol. Dyn.* **12**, 63 (1970). The Chad basin derives its water from central African savannas. Two poorly resolved positive lake movements appear to have occurred prior to 21,000 years ago; they were followed by a long interval of desiccation and eolian activity until shortly before 12,000 years ago, when the lake began to expand again. Expansion was interrupted a little before 10,200 years ago but then continued, the lake reaching a maximum level with at least intermittent overflows at around 10,000 years ago. This high stand lasted until about 4000 years ago, although it was interrupted by a minor recession about 7000 years ago. After another recession between 4000 and 3500 years ago, the lake rose to a last, but minor high level in the time range 3500 to 2500 years ago.
44. R. L. Hay, *Curr. Anthropol.* **6**, 387 (1965); in *Background to Evolution in Africa*, W. W. Bishop and J. D. Clark, Eds. (Univ. of Chicago Press, Chicago, 1967), pp. 221–228.
45. G. L. Isaac, in *Background to Evolution in Africa*, W. W. Bishop and J. D. Clark, Eds. (Univ. of Chicago Press, Chicago, 1967, pp. 229–258.
46. K. W. Butzer, *Environment and Archeology: An Ecological Approach to Prehistory* (Aldine-Atherton, Chicago, 1971), pp. 312–351.
47. For example, R. F. Flint, *Glacial and Quaternary Geology* (Wiley, New York, ed. 3, 1971), p. 443; R. B. Morrison and J. C. Frye, *Nev. Bur. Mines Rep.* **9**, 1 (1965).
48. Several of the high mountains of equatorial East Africa carry small glaciers, and there is clear evidence that these were formerly much more extensive. Regrettably, few ^{14}C dates exist for phases of glacial expansion and retreat; however, a date of 14,750 ± 290 (I-556) for the initial retreat of the Lake Mahoma valley glacier on the Ruwenzori [see Whittow and Osmaston (*30*)] suggests that the expansion and contraction of ice bodies on these mountains may have been more nearly synchronous with high-latitude glaciers than were the fluctuations of lake level. A number of pollen cores provide evidence for marked changes in mountain vegetation during the late Quaternary. J. A. Coetzee [*Palaeoecol. Afr.* **3**, 1 (1967)] has interpreted these as reflecting shifts of the altitudinal vegetation zones controlled largely by temperature, which suggests a close fit with paleotemperature curves constructed for Europe and South America. D. A. Livingstone [*Ecol. Monogr.* **37**, 25 (1967)] argues that in addition to temperature, humidity factors and biogeographic colonization were also involved in the observed vegetation shifts. If these controls apply in significant measure, temperature fluctuations may be less apparent in the pollen records.
49. This recommendation was made in *Background to Evolution in Africa*, W. W. Bishop and J. D. Clark, Eds. (Univ. of Chicago Press, Chicago, 1967), p. 891.
50. R. W. Galloway, *Ann. Ass. Amer. Geogr.* **60**, 245 (1970); W. Haude, *Meteorol. Rundsch.* **22**, 29 (1969).
51. K. W. Butzer and C. L. Hansen, *Desert and River in Nubia: Geomorphology and Prehistoric Environments at the Aswan Reservoir* (Univ. of Wisconsin Press, Madison, 1968), chaps. 3, 6, and 9 and appendices B and D.

52. The Omo-Rudolf studies referred to were supported in part by NSF grants GS-1471 and GS-2506 to the University of Chicago, while the Lamont radiocarbon dating project (D. L. Thurber) was supported by NSF grants GA-1346 and GA-1648. L. H. Robbins (Michigan State University) kindly placed a number of unpublished ^{14}C dates from the Lake Rudolf shorelines in Turkana at our disposal. Stratigraphic and hydrobiological studies in the Nakuru and Naivasha basins were supported by NSF grants GS-2344 (G.L.I.) and GS-2447 (J.L.R.). D. A. Livingstone (Duke University) generously loaned the coring apparatus. The Archaeological Research Facility of the University of California assisted with funds for ^{14}C dating. The geomorphologic studies in the Nakuru-Elmenteita basin (C.W.-K.) were supported by a Royal Society Leverhulme Scholarship and by a NATO Research Studentship. Finally, the various projects were carried out with the permission and cooperation of the Imperial Ethiopian Government, the Institut Éthiopien d'Archéologie, the Ministry of Natural Resources, Kenya, and the Kenya National Parks. W. W. Bishop (Bedford College) and D. L. Thurber (Queen's University) provided useful comments on a preliminary draft.

University Affiliation and Recognition: National Academy of Sciences

An analysis of the dominance of disciplinary subsystems in recognition of scientific achievement.

Don E. Kash, Irvin L. White, John W. Reuss, and Joseph Leo

During the past two decades, sociologists of science have established the importance of recognition accorded scientific achievement as a means of institutionalizing and maintaining norms and values within the social system of science (*1–5*). Such a finding is hardly unexpected, since there appears to be a perceived need within every social institution to evaluate role performance (*6*). Indeed, the ultimate viability of every social institution is apparently related directly to the effectiveness of its evaluation system and, thereby, its reward system. Such systems act as mechanisms of social control, providing sanctions to curb excessively deviant behavior (*7*) and rewards to promote behavior that is in accordance with the norms and values of the particular social institution.

The social system of science incorporates highly visible, institutionalized evaluation and reward systems. Scientists are inducted into a system that allegedly places primary emphasis on the advancement of knowledge. But while ". . . the pursuit of science is culturally defined as being primarily a disinterested search for truth and only secondarily a means of earning a livelihood" (*1*, p. 659), scientists are also taught to expect to be rewarded when they make a contribution to science (*1*, *8*, *9*). In fact, "... the institution of science has developed an elaborate system for allocating rewards to those who variously live up to its norms" (*1*, p. 642). For the most part, these rewards are bestowed in some form of visible honorific recognition. That is, the professional recognition of scientists is stratified, with varying degrees of nonpecuniary recognition presumably corresponding to varying degrees of scientific achievement (*1*).

The range of rewards for scientific achievement is great. B. G. Glaser, for example, lists "eponymy, prizes, awards, fellowships, honorary memberships and

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committee work in scientific organizations, editorships, honorary degrees, professorships, chairs, lectureships, consultantships, mention by historians of science, publication, acknowledgement in others' work, and evaluation by colleagues" (*3*, p. 2). In his systematic analysis of social control in science, W. O. Hagstrom characterizes recognition as either institutional (recognition given through formal communications channels within the social system of science) or elementary (interpersonal approval and esteem communicated directly) (*4*). S. Cole and J. R. Cole go a step further, identifying three graded forms of institutional recognition: (i) honorific awards and memberships in honoric societies, (ii) appointments in top-ranked departments (*10*), and (iii) attention given one's research by the scientific community (*5*). Clearly, there is a consensus among those who study recognition that honorific awards and membership in honorific societies are an important form of reward in science.

Membership in the National Academy of Sciences apparently ranks second only to the Nobel Prize as a recognition of achievement in American science. Unexplainably, however, the Academy is a little-studied institution, and little information is available on scientists' perceptions of it (*11, 12*). Cole and Cole have determined the visibility and prestige of the Academy vis-à-vis other honorific awards and honorific societies, but their effort was limited to a study of university physicists in the United States. For this group, they found the Nobel Prize to be both most visible and most prestigious—a visibility score of 85 out of a possible 100 and a prestige score of 4.98 out of a possible 5.0. Membership in the Academy ranked a close second, with scores of 72 and 4.22. In contrast, all other awards and societies were found to be considerably less visible and less prestigious (*5, 13*).

Empirically for physicists, then, and implicitly for the scientific community as a whole, election to the Academy is a widely recognized, highly visible, institutionalized, graded award in the social system of science. By definition, membership is an indication of high visibility and significant scientific achievement. Individually, members are identified as distinguished men of science; collectively, the membership is recognized as the elite among American scientists. In this article, we take a close look at this elite: we determine the membership's social profile and offer several possible, plausible alternative explanations as to why the membership profile is what it is.

From an initial membership of 50 in 1863, the Academy has now grown to about 900 members, and the plan is to have approximately 1200 members by 1976 (*14*). However, the population upon which this study is based is limited to the 845 individuals who were members of the Academy as of August 1969 (*15*). On the basis of our data, we find the "typical" member in this population to be a white, male, physical or mathematical scientist, who in 1969 was 62 years old (*16*). His highest earned degree, the Ph.D., was awarded by a highly ranked department of a highly ranked U.S. university. His entire professional life, in fact, has been spent in similar institutions: he was located at such an institution when he was selected for membership at the age of 49, and he is now similarly located.

Table 1. Foreign universities at which Academy members earned their highest degree.

University	Members earning degree (No.)	Total members with foreign degrees (%)	Total Academy membership* (%)
Cambridge	14	10.4	1.7
Gottingen†]	10	7.4	1.2
Vienna]	10	7.4	1.2
Berlin	9	6.7	1.1
Swiss Federal Institute of Technology	7	5.2	0.8
Leiden]	5	3.7	0.6
Munich]	5	3.7	0.6
Freiburg]	4	3.0	0.5
London]	4	3.0	0.5
Utrecht]	4	3.0	0.5
Warsaw]	4	3.0	0.5
Total top 11	76	56.5	9.2
Total all other foreign‡	59	43.7	7.0
Total foreign	135	100.2§	16.2

* As of August 1969, 845 living members. † Brackets indicate a tie. ‡ This category includes 35 universities. Eight of them awarded three degrees each (24 members trained), eight awarded two degrees each (16), and 19 awarded one each (19). A total of 59 members were awarded their highest degree from these 35 universities. § Exceeds 100.0 percent because of rounding.

University Affiliation

One of the most striking aspects of the composite portrait of the Academy's membership is the extent to which members are educated in, elected from, and employed by a relatively small number of universities. The majority of the 845 living members of the Academy (810, or 95.9 percent) had earned some degree at the doctorate level (*17*); Ph.D., 689; M.D., 67; Sc.D., 37; and Ph.D.-M.D., 17. Of the other 35 members, 12 have masters, 12 bachelors, and 11 some other degree.

Of the members, 135 (16 percent) earned their highest degree at a foreign university. Although 46 universities awarded these 135 degrees, as indicated in Table 1, 76 of the degrees, or more than one-half of them, were awarded by just 11 universities. The largest number of members educated in foreign universities are physicists—21 (15.6 percent). They were trained in only 15 universities, and 11 of them (over 50 percent) were trained in 5 universities (*18*).

The role of a small number of the 46 foreign universities is even more pronounced in the mathematics, biochemistry, and zoology sections. Three universities—Gottingen, Utrecht, and Warsaw—awarded the highest degree

Table 2. U.S. universities at which Academy members earned their highest degree.

University	Members earning degree (No.)	Total members with foreign degrees (%)	Total Academy membership* (%)
Harvard	127	17.9	15.0
California†	58	8.2	6.9
Chicago‡]	56	7.9	6.6
Columbia]	56	7.9	6.6
M.I.T.	41	5.8	4.9
Caltech	39	5.5	4.6
Johns Hopkins	37	5.2	4.4
Wisconsin]	35	4.9	4.1
Yale]	35	4.9	4.1
Princeton	33	4.6	3.9
Total top 10	517	72.8	61.1
Cornell	25	3.5	3.0
Minnesota	18	2.5	2.1
Illinois	16	2.3	1.9
Pennsylvania]	15	2.1	1.8
Stanford]	15	2.1	1.8
Michigan	14	2.0	1.7
New York University	9	1.3	1.1
Rochester	7	1.0	0.8
Brown]	6	0.8	0.7
Ohio State]	6	0.8	0.7
Total second 10	131	18.4	15.6
Total top 20	648	91.2	76.7
Total all other U.S.§	62	8.7	7.3
Total U.S.	710	99.9‖	84.0

* As of August 1969, 845 living members. † Includes all campuses of the University of California. ‡ Brackets indicate a tie. § This category includes 28 universities. Four of them awarded five degrees each (20 members trained); three awarded four degrees each (12); three awarded three degrees each (9); three awarded two degrees each (6); and 15 awarded one de-degree each (15). A total of 62 members were awarded their highest degree from these 28 universities. ‖ Less than 100.0 percent because of rounding.

Table 3. Representation of departments in Academy sections.

Section	Members trained in U.S. universities (No.)	Most-represented departments: University*	Members (No.)†	Members (%)‡
Mathematics	37	Harvard (10) Princeton (8) Chicago (6)	24	64.9
Astronomy	30	California (6) § Harvard (5) Caltech (5) Chicago (4)	20	66.7
Physics	87	Columbia (11) Harvard (10) Chicago (10) Caltech (9) Princeton (8)	48	55.2
Engineering	49	M.I.T. (19) Chicago (4) Columbia (4)	27	55.1
Chemistry	112	Harvard (26) California (21) Caltech (11)	58	51.8
Geology	40	Yale (12) Harvard (5) California (4) M.I.T. (4)	25	62.5
Botany	39	Harvard (10) Wisconsin (6) California (4) M.I.T. (4)	24	61.5
Zoology	40	Harvard (9) Johns Hopkins (6) California (5) Columbia (5)	25	62.5
Physiology	28	Pennsylvania (6) Harvard (5) Johns Hopkins (5)	16	57.1
Microbiology	34	Johns Hopkins (10) Harvard (5) Chicago (4)	19	55.9
Anthropology	22	Harvard (8) Chicago (3) Yale (3)	14	63.6
Psychology	28	Harvard (8) Chicago (3) Brown (3)	14	50.0
Geophysics	32	California (5) Harvard (4) M.I.T. (3) Johns Hopkins (3) Stanford (3)	18	56.3
Biochemistry	67	Columbia (14) Wisconsin (7) Chicago (6) Harvard (5) Cornell (5)	37	55.2
Applied biology	11	Harvard (3) Cornell (3)	6	54.5
Applied physical and mathematical sciences	14	Harvard (2) Chicago (2) M.I.T. (2) Cornell (2)	8	57.1
Medical sciences	18	Harvard (3) Chicago (3) Columbia (3)	9	50.0
Genetics	22	Harvard (6) Columbia (3) Cornell (3)	12	54.5

* The number in parentheses is the number of section members whose highest earned degree was earned at the listed university. † The number of members whose highest degree was earned at one of the listed universities. ‡ Section members whose highest earned degree is from one of the listed universities, expressed as a percentage of all section members who earned their highest degree in a U.S. university. § Includes all campuses of the University of California.

Table 4. Disproportionate representation of departments in Academy sections. (Data are not available for all sections, since several of them do not have a counterpart in an academic discipline; degree production data are reported for academic disciplines. Degree production for physics and astronomy are reported in a single category.)

Section	Over-represented departments: Department	Section members* (%)	Degrees awarded: U.S.†	Degrees awarded: Department‡	Degrees awarded: Percentage§
Microbiology	Harvard Chicago Johns Hopkins	63.6	1,346	74	5.5
Psychology	Harvard Chicago	53.8	7,202	412	5.7
Chemistry	Harvard California‖ Chicago	51.7	17,109	1,593	9.3
Zoology	Harvard California	54.5	3,008	384	12.8
Biochemistry	Columbia Chicago Cornell Harvard	54.8	2,511	329	13.1
Engineering	M.I.T. Caltech	53.8	7,408	1,259	17.0
Geology	Harvard M.I.T. Yale	52.9	2,172	380	17.5
Mathematics	Princeton Chicago Harvard	50.0	3,279	587	17.9
Physiology	Pennsylvania	37.5¶	1,816	37	2.0
Botany	Harvard California Wisconsin	58.3	2,613	549	21.0
Genetics	Caltech Harvard Rochester Wisconsin Yale	75.0	451	114	25.3
Anthropology	Harvard Chicago Yale	72.7	748	246	32.9

* Those section members whose highest degree is from one of the listed universities, expressed as a percentage of all section members who earned their highest degree in a U.S. university between 1936 and 1959. † The total number of degrees granted in this discipline by U.S. universities between 1936 and 1959. ‡ The number of degrees awarded in this discipline by the listed universities between 1936 and 1959. § The percentage of all those degrees in this field awarded by U.S. universities between 1936 and 1959 that were awarded by the listed universities. ‖ Includes all campuses of the University of California. ¶ No other university granted the highest degree to more than one person between 1936 and 1959. The U.S. universities granting one degree were Columbia, Harvard, Johns Hopkins, Minnesota, and Rochester.

Table 5. University location of Academy members at time of election.

University	Members (No.)	Members in U.S. universities* (%)	Total Academy membership† (%)
Harvard	89	13.0	10.5
California‡	82	12.0	9.7
M.I.T.	47	6.9	5.6
Chicago	43	6.3	5.1
Columbia	38	5.5	4.5
Caltech	37	5.4	4.4
Wisconsin	31	4.5	3.7
Rockefeller§]	28	4.1	3.3
Stanford]	28	4.1	3.3
Princeton	25	3.6	3.0
Total top 10	448	65.4	53.1
Yale]	23	3.4	2.7
Illinois]	23	3.4	2.7
Cornell]	21	3.1	2.5
Johns Hopkins]	21	3.1	2.5
Pennsylvania	18	2.6	2.1
New York University]	12	1.7	1.4
Michigan]	12	1.7	1.4
Washington (St. Louis)	10	1.5	1.2
Minnesota]	9	1.3	1.1
Rochester]	9	1.3	1.1
Total second 10	158	23.1	18.7
Total top 20	606	88.5	71.8
Total all other U.S.	80	11.7	9.5
Total U.S.	686‖	100.0	81.3

* A total of 686 members were located in U.S. universities at the time of their election. † The total 845 living members as of August 1969. ‡ Includes all campuses of the University of California. § Brackets indicate a tie. ‖ One member was elected from a foreign university and 158 were elected from nonuniversity sources—government, industry, nonprofit institutions, and private employment.

Table 6. Departments in which members of the Academy were located at the time of their election.

Section	Members in U.S. universities (No.)	Most-represented departments: University*	Section members† (No.)	Section members‡ (%)
Mathematics	53	Harvard (11) California§ (7) Princeton (7) Chicago (5)	30	56.6
Astronomy	28	Caltech (8) Chicago (4) California (3)	15	53.6
Physics	90	California (12) Columbia (10) Harvard (9) Chicago (8) M.I.T. (8) Stanford (8)	55	61.1
Engineering	30	M.I.T. (20)	20	66.7
Chemistry	107	California (14) Harvard (11) Illinois (8) Wisconsin (8) Columbia (7) Caltech (6) Chicago (6) Cornell (6) M.I.T. (6)	72	67.3
Geology	25	California (7) Harvard (5) Yale (3)	15	60.0
Botany	35	Wisconsin (6) California (5) Harvard (5) Stanford (3)	19	54.3
Zoology	47	Harvard (9) California (5) Chicago (5) Johns Hopkins (4)	23	48.9
Physiology	30	Harvard (4) Johns Hopkins (4) California (3) Rockefeller (3) Pennsylvania (3)	17	56.7
Microbiology	34	Johns Hopkins (8) Chicago (4) Harvard (4)	16	47.1
Anthropology	20	Harvard (3) California (2) Chicago (2) Columbia (2) Johns Hopkins (2) Yale (2)	13	65.0
Psychology	29	Harvard (4) Johns Hopkins (2) M.I.T. (2) Michigan (2) Pennsylvania (2) Yale (2)	14	48.3
Geophysics	28	California (11) Caltech (4)	15	53.6
Biochemistry	75	Harvard (12) Rockefeller (8) Columbia (7) California (6) Wisconsin (5)	38	50.7
Applied biology	6	California (3)	3	50.0
Applied physical and mathematical sciences	13	Harvard (4) New York University (2)	6	46.2
Medical sciences	18	Chicago (3) Columbia (3) Harvard (2) Michigan (2) Pennsylvania (2)	12	66.7
Genetics	19	Caltech (5) Columbia (2) Wisconsin (2)	9	47.4

* The number in parentheses is the number of section members who were located at the listed university at the time of their election. † The number of section members who were located at the listed universities at the time of their election. ‡ Section members who were located in one of the listed universities, expressed as a percentage of all section members who, at the time of their election, were located in a U.S. university. § Includes all campuses of the University of California.

earned by 12 (4 from each university) of the 20 mathematician members trained abroad; three universities—Berlin, Cambridge, and Vienna—trained 9 (3 each) of the 17 foreign-trained biochemist members; and 8 out of 15 of the zoologist members who earned their highest degree from a foreign university were trained in just three universities—three in Cambridge, three in Freiburg, and two in Munich (*19*).

A majority of the members of the Academy earned their highest degree in a U.S. university. Of the 845 living members of the Academy, 710 (84 percent) were trained in U.S. universities. As indicated in Table 2, 517 were trained in just ten universities, all of which are generally considered to be among the elite, if not the elite, universities in the United States. Twenty universities granted the highest degree earned by 648 (91.2 percent) of the 710 members educated in the United States. These universities, especially the top ten, have consistently been ranked high in the major assessments of quality in graduate education in U.S. universities (*20*). For example, Harvard, which clearly stands apart from other U.S. universities in the number of graduates elected to the Academy, has consistently had an overall ranking that, most observers concede, identifies it as one of the top two universities in the country. And the same has been true of the University of California at Berkeley. According to the 1969 American Council on Education study (*21*), the universities most often ranked in the top five positions of all fields surveyed include, in addition to Berkeley and Harvard, Stanford, Chicago, Yale, Princeton, Massachusetts Institute of Technology, Michigan, Caltech, Wisconsin, Illinois, Columbia, and Rockefeller (*22*).

Despite a substantial increase during the past two decades in both Academy membership and in the number of universities granting doctoral degrees in science, the proportion of new members whose highest earned degree is from one of the universities listed in Table 2 has remained virtually constant. Over these 20 years, the top ten universities have, on the average, granted the highest earned degree of 56.6 percent of all new members, and the top 20 universities to 75.4 percent of all new members (*23*).

As was the case with those whose highest degree was earned at a foreign university, a majority of members who earned their highest degree in a U.S. university were trained within a small number of departments (see Table 3). Most often, of course, these are departments in one of the top ten universities listed in Table 2. However, there are several exceptions, all of which are included in the top 20 universities: Stanford in geophysics, Brown in psychology, and Cornell in biochemistry, applied biology, mathematical sciences, and genetics.

Even in chemistry and biochemistry, the two sections whose members are drawn from the largest number of U.S. universities, a small number of departments train a majority of the members. Harvard (26), California (all campuses) (21), and Caltech (11) account for over one-half the members in chemistry, as do Columbia (14), Wisconsin (7), Chicago (6), Harvard (5), and Cornell (5) in biochemistry. Clearly M.I.T. has had a special role in engineering, as has Yale in geology and Johns Hopkins in microbiology (see Table 3). But the university possessing truly remarkable strength across all the disciplines represented in the National Academy of Sciences is Harvard. Harvard is the only university in the country from which some members in every section of the Academy have earned their highest degree (*24*).

In terms of graduates elected to the Academy, the departments identified in Table 3 are numerically overrepresented in the Academy's membership. For example, while the mathematics departments of Harvard, Princeton, and Chicago trained 7 of the 14 members of the mathematics section who earned their highest degree in a U.S. university between 1936 and 1959, these same three universities awarded only 587 (17.9 percent) of the 3279 Ph.D. degrees in mathematics earned in the United States between 1936 and 1959 (*25*). A similarly disproportionate representation is found in each of the other nine sections for which data are available (see Table 4).

A majority, 53.1 percent, of the 845 living members of the Academy were located in just ten universities at the time of their election (see Table 5). With two exceptions (Rockefeller and Stanford rather than Johns Hopkins and Yale), these are the same ten universities from which a majority of Academy members earned their highest degree. Almost 72 percent of the 845 were elected from just 20 universities; and, again, with but two exceptions [Rockefeller and Washington (St. Louis) rather than Ohio State and Brown], the list parallels the listing of universities granting the highest earned degree.

The proportion of members elected to the Academy each year who are located at one of the universities listed in Table 5 has been consistent for the past two decades. During this time, 50.7 percent of all members elected were at the top ten universities, and 69.5 percent at the top 20 universities (*26*).

As with institutions awarding the highest degree, a relatively small number of departments in these top-ranked universities account for a disproportionate number of members in each section. For example, it was determined earlier that, taken together, the mathematics departments of Harvard, Princeton, and Chicago granted the highest earned degree of 64.9 percent of all members of the mathematics section who had earned their highest degree in a U.S. university (Table 3); now we find that these three universities, together with the combined campuses of the University of California, were the location at the time of election of 56.6 percent of all members of the mathematics section who were located in a university at the time of their election (*27*) (see Table 6). As may be seen by

Table 7. Universities at which Academy members were located in 1969.

University	Members (No.)	Members in U.S. universities* (%)	Total Academy membership† (%)
California‡	105	15.0	12.4
Harvard	87	12.4	10.3
M.I.T.	50	7.1	5.9
Rockefeller	38	5.4	4.5
Caltech	35	5.0	4.1
Columbia	34	4.9	4.0
Chicago	33	4.7	3.9
Stanford	29	4.1	3.4
Wisconsin	28	4.0	3.3
Princeton	25	3.6	3.0
Total top 10	464	66.2	54.8
Yale	24	3.4	2.8
Cornell	20	2.9	2.4
Illinois	19	2.7	2.2
Pennsylvania	15	2.1	1.8
Johns Hopkins	14	2.0	1.7
Michigan	12	1.7	1.4
New York University	11	1.6	1.3
Minnesota§]	10	1.4	1.2
Washington (St. Louis)]	10	1.4	1.2
Arizona	8	1.1	0.9
Total second 10	143	20.3	16.9
Total top 20	607	86.5	71.7
Total all other U.S.	94	13.4	11.1
Total U.S.	701	99.9‖	82.8

* A total of 701 Academy members were located in U.S. universities in 1969. † The total 845 living membership as of August 1969. ‡ Includes all campuses of the University of California. § Brackets indicate a tie. ‖ Less than 100 percent because of rounding.

comparing Tables 3 and 6, similar patterns exist in other sections; the differences that are evident tend to be an increase in the number of departments represented.

Of the 845 Academy members included in our study, 701 were located at a U.S. university at the time our data were gathered (*28*). A majority of them, 464 (66.2 percent), were located in ten universities, and 607 of them (86.5 percent) were located in just 20 (see Table 7). These ten and 20 universities account for 54.8 and 71.7 percent, respectively, of the total Academy membership (*29*).

As we have now come to expect, a relatively small number of departments accounts for a disproportionate number of the members in each section in terms of current location. Recall that the mathematics departments of just three universities—Harvard, Princeton, and Chicago—granted the highest earned degree to 64.9 percent of all members of the mathematics section who were trained in U.S. universities; and recall that 56.6 percent of all mathematics members located in a university at the time of their election were at Harvard, Princeton, Chicago, and California (all campuses). Now we find that 49.1 percent of the members of the mathematics section who were located at a U.S. university in 1969 were at Harvard, Princeton, Chicago, and California (all campuses) (see Table 8). Comparing Tables 3, 6, and 8, it becomes evident that this pattern, with few exceptions, is repeated for virtually every section in the Academy. As was the case with location at the time of election, the most evident differences tend to be an increase in the number of departments represented, particularly for Stanford and Rockefeller.

Age and Academy Membership

Some distinctive variations in age patterns appear in the membership of the Academy. The average age in our population at the time of election is 49, with 31 being the youngest age at election and 80 the oldest (*30*). Only 11 members were elected before age 35, and only seven after age 70.

Academicians whose highest earned degree is from one of the top ten universities listed in Table 2 are, on the average, 48 years old at the time of their election (*31*). They are nearly 3 years younger when elected than are those with degrees from other universities. A similar pattern exists for those affiliated with the ten universities that have the largest number of members at the time of election. The average age at election for this second group is 47 years (*32*); this is nearly 4

Table 8. Departmental location of Academy members in 1969.

Section	Members in U.S. universities (No.)	Most-represented departments: University*	Section members† (No.)	Section members‡ (%)
Mathematics	53	California§ (8) Harvard (7) Princeton (6) Chicago (5)	26	49.1
Astronomy	29	Caltech (8) California (5) Harvard (4)	17	58.6
Physics	90	California (14) Harvard (9) M.I.T. (9) Caltech (8) Columbia (8) Chicago (7) Stanford (7)	62	68.9
Engineering	32	M.I.T. (20)	20	62.5
Chemistry	110	California (17) Harvard (13) Caltech (7) Illinois (6) M.I.T. (6) Stanford (6) Wisconsin (6)	61	55.5
Geology	29	California (7) Harvard (5) Yale (3)	15	51.7
Botany	38	California (8) Wisconsin (7) Harvard (4)	19	50.0
Zoology	53	Harvard (8) California (6) Rockefeller (5) Chicago (4) Johns Hopkins (3) Princeton (3)	29	54.7
Physiology	30	Harvard (6) Rockefeller (5) California (4)	15	50.0
Microbiology	33	Rockefeller (7) Harvard (5) Chicago (3) Cornell (2) M.I.T. (2) New York University (2)	21	63.6
Anthropology	20	Harvard (3) Pennsylvania (3) California (2) Chicago (2) Columbia (2) Yale (2)	14	70.0
Psychology	30	Rockefeller (5) California (3) Harvard (2) Michigan (2) Pennsylvania (2) Yale (2)	16	53.3
Geophysics	30	California (15)	15	50.0
Biochemistry	75	Harvard (11) California (10) Rockefeller (8) Columbia (5) Cornell (5) Illinois (4) Wisconsin (4)	46	61.3
Applied biology	7	California (2) Harvard (1) Illinois (1)	4	57.1
Applied physical and mathematical sciences	16	Harvard (4) M.I.T. (2) New York University (2)	8	50.0
Medical sciences	15	Columbia (3) Chicago (2) Michigan (2) Pennsylvania (2)	9	60.0
Genetics	18	Caltech (5) Wisconsin (3)	8	44.4

* The number in parentheses is the number of section members who in 1969 were located at the listed university. † The number of section members who in 1969 were located at the listed universities. ‡ The percentage of all section members who in 1969 were located in a U.S. university accounted for by those who were located at one of the listed universities. § Includes all campuses of the University of California.

years younger than those affiliated with all other institutions (see Table 9).

This same pattern of earlier election is maintained in 14 of the Academy's 18 sections. Degree holders from other than the top ten universities have an age advantage only in the life sciences sections of botany, physiology, microbiology, and genetics. Members located at one of the top ten universities are younger at the time of their election in 16 of the 18 sections. In only two sections, engineering and geology, are members from other than the top ten universities elected at a younger age (see Table 9).

Observations and Conclusions

Even when they have studied a particular discipline or institution, sociologists of science have generally tended to focus primarily upon, and to generalize about, the social *system* of science. In the case of the Academy, our findings suggest that the disciplinary *subsystems* of science are a more appropriate and revealing focus.

As we have reported, a majority of the living membership of the Academy as of August 1969 was and had been located in universities. This, of course, is to be expected, since in the United States the locus of basic science and scientific activity continues to be either within, or in close association with, the university.

In the West, knowledge has historically been divided analytically, and the university, being for the most part organized around analytical disciplines, has been and is still the social institution most responsible for perpetuating and promoting this structuring of knowledge. The Academy not only reflects, but seems to rigidify this analytical, disciplinary structure of knowledge as it is institutionalized in the university (*33*).

In our examination of the Academy's membership, we have determined that a few elite departments within a few elite universities are dominant in the disciplinary subsystems of science, in terms of their representation in those sections of the Academy that have disciplinary counterparts. How is it that so few departments within so few universities dominate the disciplinary subsystems of science in this way? Several explanations are plausible: (i) the brightest and most promising graduate students are attracted to and trained by the few top departments in each discipline; (ii) the most promising and productive scientists are attracted to and employed by the few top departments in each discipline; (iii) by virtue of being located in one of the few top departments within a discipline, the visibility of a scientist and his work is enhanced; (iv) being located in one of the few top departments and associated with scientists already recognized as eminent stimulates a scientist to do significant work; and (v) the few top departments are better able to recruit and retain scientists who either are eminent or are likely to become eminent than are most other departments. Doubtless there are other possible explanations, as well as other ways of stating the ones listed here. Indeed, some of them have been considered by scientists and sociologists of science (*34*). However, our data limit us to a consideration of inferences to be drawn from an examination of the procedures for nominating and electing members of the Academy and the results that these procedures produce.

According to Joseph Henry, the second president of the Academy, ". . . the basis of selection [for membership] is actual scientific labor in the way of original research; that is, in making positive additions to the sum of human knowledge, connected with unimpeachable moral character." Henry stressed that "it is not social position, popularity, extended authorship or success as an instructor in science which entitles to membership, but actual new discoveries" (*35*).

The Academy's procedures for electing its new members are careful, extended, and complex (*36*); science writer Daniel Greenberg, with more than ample justification, has characterized the process as "wondrously arcane . . . and inclusive of . . . all the attributes of a papal election except smoke" (*12*, p. 223).

The Academy's election procedures extend from a 1 October deadline for nominations to a final vote by the members attending the annual meeting in the last week in April. Nominations are made in one of five ways: ". . . in writing and approved by two-thirds of the members voting in a section on the branch of research in which the person is eminent, or by a majority (however distributed) of the members voting in any two sections, by a temporary nominating group, or by a voluntary nominating group, or by a majority of the Council" (*37*). The names of nominees go to section chair-

Table 9. Mean age of Academy members at the time of election, by section (845 living members of the Academy as of August 1969).

Section	Institution granting degree: Top ten universities (members) No.	Age (years)	All other universities (members) No.	Age (years)	Location at time of election: Top ten universities (members) No.	Age (years)	All other institutions* (members) No.	Age (years)
Mathematics	29	44.9	28	52.5	39	47.6	18	50.4
Astronomy	26	43.5	10	48.9	22	46.8	14	49.1
Physics	72	43.5	36	46.5	70	43.2	38	48.2
Engineering	38	52.9	19	55.5	26	54.0	31	53.5
Chemistry	85	44.4	33	48.9	66	43.5	52	48.5
Geology	33	51.4	10	53.2	16	53.0	27	51.1
Botany	26	51.8	20	51.1	23	51.2	23	51.8
Zoology	31	51.3	24	54.1	28	50.1	27	54.3
Physiology	14	53.4	21	53.1	12	52.1	23	53.5
Microbiology	25	52.4	13	50.9	21	51.3	17	52.7
Anthropology	19	55.1	3	60.7	10	53.5	12	57.8
Psychology	15	46.1	16	50.3	14	46.2	17	49.9
Geophysics	23	45.7	15	46.5	23	44.7	15	48.1
Biochemistry	42	47.5	42	48.7	44	47.2	40	53.2
Applied biology	4	55.8	8	57.5	4	50.8	8	60.0
Applied physics	9	51.7	10	53.3	8	49.0	11	55.1
Medical sciences	12	52.0	10	61.2	9	52.7	13	58.6
Genetics	14	50.1	10	43.1	13	45.2	11	50.4
Total	517		328		448		397	
Average		48.2		51.1		47.5		51.4

* Includes those members not affiliated with universities, as well as those affiliated with universities other than the top ten.

men no later than 1 October (*38*). No later than 1 November, section chairmen submit the names of eligible nominees, together with documentation of their scientific eminence, to the members of their section for an informal ballot (*39*). Section members are requested to indicate on this ballot those individuals whom they are willing to endorse for nomination. On the basis of the returns from this ballot, the section chairman prepares a formal ballot, which indicates the results of the informal ballot, and again each member is asked to indicate those individuals whom he considers worthy of support for membership in the Academy. The section chairman records the results of this formal ballot and certifies to the home secretary (*40*) the names of all the persons who received votes, indicating the number of votes each received and reporting the number of members voting.

Sometime before 1 March, class membership committees are convened to consider in detail the qualifications of the nominees assigned to the respective committees. Each committee prepares a rank ordering of nominees, up to 150 percent of the quota assigned the class by the Council (*41*). The chairman of the class membership committee certifies the preference list to the home secretary, who then distributes to the entire membership of the Academy a ballot comprised of the preference lists of the three class membership committees (*42*). This ballot is accompanied by a statement documenting the scientific achievements of each nominee, together with a record of the voting in the sections and temporary nominating groups (*43*). Members are requested to indicate which of the nominees they prefer for membership, but each member is instructed to select no fewer than one-third and no more than one-half the number of nominees on each of the three lists (*44*).

The home secretary then draws up a rank order of the nominees on the basis of the number of votes received; he divides them into two lists, the number of names on the first list being equal to the quotas set for the classes, and the second list naming all of the remaining nominees. These final lists are presented to the members of the Academy at their annual meeting, where election is by a two-thirds vote of those present and voting (*45*).

Visibility necessarily precedes recognition. Publishing, presenting papers, and related activities for reporting one's research are the principal means available to most scientists for calling their work to the attention of a broad audience of their peers (*4*). On the basis of our findings, it is a tenable hypothesis that receiving one's degree from or being located in an elite department in an elite university is also an important means whereby scientists achieve visibility (*10*). It is plausible that being associated with an elite department in an elite university heightens the visibility of scientists to members of the Academy—we have determined that more new members receive their highest earned degree from and are located in these few universities than in all others combined, and that, on the average, members from these few are elected (recognized) at a younger age than are those from other institutions.

The nomination procedures seem designed primarily for nominations to be made by sections—with several alternatives being provided for special cases (*46*). Since a majority of Academy members received their highest degree from and are located in just a few universities and even fewer departments, scientists who contribute significantly to science and who are university or departmental colleagues, or both, of Academy members are, all else being equal, more likely to be visible to more Academy members than are similar scientists in other institutions. The same argument can be applied to the entire nomination and election process.

In short, while virtually everyone seems to agree that membership in the Academy is the highest honorific recognition that can be bestowed within the U.S. social system of science, the nomination and election procedures are completely in-house. The scientific community at large can neither nominate nor elect; identification, nomination, election, and thereby Academy membership in recognition of eminence in American science, is the prerogative of an elite who, by virtue of membership in the Academy, have already been recognized as eminent. Our data and analysis strongly suggest to us that the Academy and its sections effectively constitute an in-group. Whether by conscious design or not, the nomination and election procedures have permitted, or perhaps simply resulted in, the self-perpetuation of this group as a numerical majority of the Academy's membership.

References and Notes

1. R. K. Merton, *Amer. Sociol. Rev.* **22**, 635 (1957). Merton's program in the sociology of science at Columbia University has been the principal institutional source of most of the work in this area.
2. ———, *Science* **159**, 56 (1968).
3. B. G. Glaser, *Organizational Scientists: Their Professional Careers* (Bobbs-Merrill, Indianapolis, 1964). Glaser adapted his list from Merton's (*1*).
4. W. O. Hagstrom, *The Scientific Community* (Basic Books, New York, 1965).
5. S. Cole and J. R. Cole, *Amer. Sociol. Rev.* **32**, 377 (1967).
6. H. A. Zuckerman, *Amer. J. Sociol.* **74**, 276 (1968).
7. J. Walsh [*Science* **172**, 539 (1971)] reports on the election of new members to the Academy and the apparent sanction imposed to bar Lamont C. Cole from membership.
8. J. D. Watson, *The Double Helix* (Atheneum, New York, 1968).
9. M. Blissett and M. Weinstein, "Cultural influences upon norms of scientific inquiry," mimeographed (Department of Political Science, Purdue University, Lafayette, Ind., 1971).
10. It is striking that "top-ranked" departments are mentioned so infrequently. Caplow and McGee do discuss the relation between departmental prestige and personal prestige; and they observe that "a man may . . . publish what would be, in other circumstances, a brilliant contribution to his field, but if he is too old, or too young, or located in the minor league, it will not be recognized as brilliant and will not bring him the professional advancement which he could claim if he were of the proper age and located at the proper university" [T. Caplow and R. J. McGee, *The Academic Marketplace* (Basic Books, New York, 1958), pp. 108, 128–129]. Crane also has considered departmental location, concluding that "scientists located at major universities are more likely to be highly productive and more likely to receive recognition than those located at minor universities" (D. Crane, *Amer. Sociol. Rev.* **30**, 699 (1965); H. Orlans [*Effects of Federal Programs on Higher Education* (Brookings Institution, Washington, D.C., 1962)] and L. Wilson [*The Academic Man* (Oxford Univ. Press, London, 1958)] likewise note the relation between recognition and academic affiliation.
11. Little has been written beyond D. S. Greenberg's three-part series (*12*) and C. E. Barfield's two-part series [*Nat. J.* **3**, 101; 220 (1971)]. P. M. Boffey is now engaged in a study of the Academy; the study is being sponsored by the Center for the Study of Responsive Law.
12. D. S. Greenberg, *Science* **156**, 222; 360; 488 (1967).
13. S. Cole and J. R. Cole had their respondents rank in prestige (from a low of 1 to a high of 5) a list of 98 awards. The visibility score is the percentage of respondents who were able to rank an award; the prestige score was computed by taking the mean of the ranks assigned by the respondents. Unfortunately, the Coles do not report the prestige scores of the lesser awards. The visibility scores are reported by Merton (*2*, p. 59), who cites the Coles' paper "Visibility and the structural basis of observability in science," paper presented before the American Sociological Association, August 1967.
14. Members of the Academy are distributed, on the basis of their own choice, among 18 sections. The following are the sections and the number of members in each: 1, mathematics (57); 2, astronomy (36); 3, physics (108); 4, engineering (57); 5, chemistry (118); 6, geology (43); 7, botany (46); 8, zoology (55); 9, physiology (35); 10, microbiology (38); 11, anthropology (22); 12, psychology (31); 13, geophysics (38); 14, biochemistry (84); 15, applied biology (12); 16, applied physical and mathematical sciences (19); 17, medical sciences (22); and 18, genetics (24). Sections have been grouped into three classes: I, physical and mathematical sciences—sections 1, 2, 3, 5, 6, and 13; II, biological and behavioral sciences—sections 7 through 12, 14, 17, and 18; and III, engineering and applied sciences—sections 4, 15, and 16. At the 1971 annual meeting two new classes were added: IV, medical sciences; and V, behavioral and social sciences. Section 17 was transferred to class IV, and sections 11 and 12 to class V. Class II was renamed biological sciences.
15. The data upon which this study is based were collected in 1969. Principal sources of data were a mail questionnaire, membership lists of the Academy, and *American Men of Science*, supplemented by other sources of biographical data.
16. The Academy is "color-blind," at least it is in its record-keeping, but there appears to be only one Black member. The Academy also apparently is blind to sex differences, but on the basis

of name and appearance, there are 11 female members. Two women have been elected in each of the last two annual elections (1970 and 1971). Both Blacks and women are numerical minorities in the larger scientific community as well.

17. These 810 members earned their degrees in 94 universities, 48 in the United States and 46 abroad.
18. Leiden, 3; Leipzig, 2; Cambridge, 2; Munich, 2; and the Swiss Federal Institute of Technology, 2.
19. The same analysis can be extended to classes: class I has 62 members, 34 (54.8 percent) of whom were trained in seven foreign universities —Cambridge, 5; Gottingen, 7; Vienna, 4; Berlin, 4; Leiden, 4; Utrecht, 6; and Warsaw, 4. Class II has 59 members, 27 (45.8 percent) of whom were trained in five foreign universities —Cambridge, 8; Vienna, 5; Berlin, 5; Freiburg, 5; and London, 4. Fourteen members of class III received their highest earned degree from a foreign university. Only one foreign university trained more than one of them—the Swiss Federal Institute of Technology, 3 (21.4 percent).
20. Four major assessments of graduate education in U.S. universities have been made: R. Hughes' 1925 study reprinted in *American Universities and Colleges* (American Council on Education, Washington, D.C., 1928); H. Keniston's 1957 study, *Graduate Study in the Arts and Sciences at the University of Pennsylvania* (Univ. of Pennsylvania Press, Philadelphia, 1959); and the 1964 and 1969 American Council on Education studies [K. D. Roose and C. J. Anderson, *A Rating of Graduate Programs* (American Council on Education, Washington, D.C., 1970); (*21*)].
21. A. M. Cartter, *An Assessment of Quality in Graduate Education* (American Council on Education, Washington, D.C., 1966).
22. Only four of these universities, Illinois, Michigan, Stanford, and Rockefeller, are not among the top ten listed in Table 2. Illinois, Michigan, and Stanford have consistently been ranked in the top ten in the disciplines corresponding to Academy sections, and Stanford has been steadily improving its ranking in most disciplines corresponding to the Academy's sections since the 1925 Hughes study (*20, 21*). Rockefeller is a newcomer to graduate education, granting its first doctorate in 1959; however, it has been ranked in the top ten in several fields in both American Council on Education studies.
23. During this 20-year period, 696 new members were elected to the Academy. In only 4 years during this period—1950, 1953, 1959, and 1965 —have the top ten universities failed to account for a majority of all new members elected. At least two new members with their highest degree earned at Harvard have been elected each year. No other university has had even one of its graduates elected each year; however, not one of the top ten has failed to have at least one of its graduates elected in fewer than 14 of the 20 years.
24. Representation in sections from the top 20 universities listed in Table 2 is as follows: Harvard, 18; Chicago, 15; Columbia and Yale, 14; Johns Hopkins and Wisconsin, 13; Cornell, 12; California (all campuses) and Princeton, 11; Minnesota and Michigan, 10; M.I.T. and Caltech, 9; Pennsylvania, 8; Illinois and Stanford, 7; New York University and Rochester, 6; Ohio State, 5; and Brown, 3.
25. Data on Ph.D. production are taken from Office of Education, Department of Health, Education, and Welfare, *Earned Degrees Conferred* (Government Printing Office, Washington, D.C., yearly 1950–1968) and National Academy of Sciences–National Research Council, *Doctorate Production in United States Universities 1936–1956* (National Academy of Sciences–National Research Council, Washington, D.C., 1958), as supplemented in some instances by information furnished by the universities themselves. Of the 845 members, 370 earned their highest degree in a U.S. university between 1956 and 1959. Only one of the 845 members earned his highest degree after 1959; he is a member of section 14, and his degree was earned at Rockefeller in 1960.
26. In only 8 of the 20 years—1951, 1953, 1955, 1958, 1959, 1962, 1965, and 1969—were fewer than a majority of the members elected while at the top ten universities; in only 1 year, 1951, were fewer than a majority located at one of the top 20. An average of 19.5 percent were elected from outside universities, and in 1968 one member was elected while located at a foreign university. At least one new member has been elected from the combined campuses of the University of California each year. Each of the top ten universities has been the current location of at least one new Academy member in no fewer than 13 of the 20 years.
27. Four members of this section were not at a university at the time of their election.
28. Of the remainder, 143 were in government, industry, nonprofit institutions, or private employment. One member was at Oxford.
29. Of the 696 new members elected during the past 20 years, in 1969 54.0 percent were located in the top ten universities, and 71.3 percent in the top 20 universities listed in Table 7; 16.5 percent were located outside universities.
30. The mean age at time of election is 49.3.
31. The mean age of these members is 48.2.
32. The mean age of these members is 47.5.
33. We should note also that the Academy has tended to lag behind the university in recognizing new scientific specialties, whether it be an offshoot of traditional disciplines or an applied specialty such as engineering and medicine. For example, the National Academy of Engineering is said to be a response to the engineers' threat to break away and establish their own academy; of course, the engineers are not as tied to the university as are people in the more traditional disciplines. Pressures for greater representation of applied mathematicians are said to be at least partially responsible for the addition of section 16; pressures from medical scientists are said to have resulted in the establishment of an Institute of Medicine in 1970; and pressures for greater representation of clinical, social, and behavioral scientists are credited for two new classes being added in 1971.
34. For example, H. Zuckerman, *Sci. Amer.* **217**, 25 (November 1967).
35. National Academy of Sciences, *News Rep.* **20**, 11 (1970).
36. The number of members to be elected each year has changed from time to time. At its 1971 annual meeting, the membership voted to increase the annual intake to 75 in 1972 and to 100 in 1973. Reportedly the change is intended to enlarge the total membership; lower the average age of the membership and permit increased representation of the clinical, social, and behavioral sciences. The expectation is that these goals will be achieved by 1975; the annual intake will then begin to decrease, so that by 1977 only 60 new members will be taken in each year. The annual intake is to stabilize at 60. See also (*7*).
37. National Academy of Sciences, *Constitution and Bylaws* (National Academy of Sciences, Washington, D.C., 1968), Bylaw IV.10. The council is comprised of the officers of the Academy, together with 12 members elected by the membership. The constitution also provides for the inclusion of the chief executive officer of the National Research Council, if he is a member of the Academy. (At this time, the provision is redundant, because the chief executive officer of the National Research Council is the president of the Academy.)
38. The procedures for temporary nominating groups, which may be established by the council, parallel those described here for sections; in effect, insofar as nomination is concerned, the temporary nominating groups function as temporary sections. In the case of the voluntary nominating groups, 20 or more members may submit a nomination to a class membership committee, where it is considered along with the nominations that come from the sections and temporary nominating groups.
39. Names are struck from the list if the nominee: (i) was on the previous year's list and received "the votes of less than ten percent of the members voting on the informal ballot"; (ii) was "on the list for three consecutive years without receiving in any one of these years the votes of so many as one-fourth of the members voting on the informal ballot"; or (iii) was "on the list for five consecutive years without receiving in any one of these years the votes of so many as one-half of the members voting on the formal ballot" (Bylaw IV.11).
40. There are two secretaries, home and foreign, both of whom are elected officers of the Academy (Article II, section 1).
41. There have been three classes—each of which has a class membership committee. As for quotas, the council recommends the quota before the annual meeting. This recommendation can be discussed at the annual meeting before the quotas are finally established by the council (Bylaw IV.9).
42. Presumably there will now be five class membership committees and five preference lists.
43. Voluntary nominating groups apparently are not required to vote. They do submit their nominees' names, together with supporting documents, to the home secretary; they also submit a recommendation as to which class membership committee should consider the nomination.
44. Bylaw IV.14.
45. The lists, not individuals, are voted on; however, the lists are subject to adjustment. That is, names can be switched from the second to the first list or vice versa, names can be added to or deleted from the first list, and, on the objection of a single member, a name may be set aside to be considered separately after the vote on the list. The procedures for these changes are detailed in Bylaw IV.16. Apparently the council has been assigning—and the membership approving—quotas that left four members to be named by the council. Informed speculation is that the council has customarily either used these four positions to reward those who have served science but whose research contribution would not ordinarily make them eligible for membership, or simply extended the general list. The council is reported to have departed from this practice at its 1971 meeting, skipping the name of a nominee apparently as an indication of displeasure with his public statements on the environment, statements which were considered to violate the norms of science.
46. Several kinds of special cases can be identified, including the recognition of scientists in specialties not reflected in the organization of the Academy and the occasional recognition of science administrators who are to be rewarded for their service to science (*45*).