79. O. F. Hutter and W. Trautwein, *J. Physiol. (London)* **133**, 610 (1956).
80. D. L. Ypey, *Pflügers Arch.* **355**, 291 (1975).
81. D. L. IJpeij, P. L. M. Kerkhof, A. C. Bobbert, *ibid.* **347**, 309 (1974).
82. B. F. Hoffman and P. F. Cranefield, in *Electrophysiology of the Heart* (McGraw-Hill, New York, 1960).
83. M. M. Dewey and L. Barr, *Science* **137**, 670 (1962); N. S. McNutt and R. S. Weinstein, *J. Cell Biol.* **47**, 666 (1970); G. H. Pollack and L. L. Huntsman, *Experientia* **29**, 1501 (1973).
84. J. Ushiyama and C. M. Brooks, *J. Electrocardiol.* **7** (No. 2), 119 (1974).
85. A. Noma and H. Irisawa, *Pflügers Arch.* **364**, 45 (1976).
86. H. Irisawa and S. Noma, *Jpn. J. Physiol.* **26**, 133 (1976).
87. L. N. Bouman, E. D. Gerlings, P. A. Biersteker, F. I. M. Bonke, *Pflügers Arch. Eur. J. Physiol.* **302**, 255 (1968).
88. T. Sano and S. Yamagishi, *Circ. Res.* **16**, 423 (1965).
89. H-H. Lu, G. Lange, C. M. Brooks, *ibid.* **17**, 460 (1965); S. Yamagishi and T. Sano, *Am. J. Physiol.* **212**, 829 (1967).
90. G. H. Pollack, *J. Electrocardiol.* **7** (No. 3), 245 (1974); *J. Physiol. (London)* **255**, 275 (1976).
91. T. Tomita, in *Smooth Muscle*, E. Bülbring, A. F. Brading, A. W. Jones, T. Tomita, Eds. (Williams & Wilkins, Baltimore, 1970), p. 197.
92. E. Bozler, *Am. J. Physiol.* **149**, 299 (1947); G. Burnstock and C. L. Prosser, *ibid.* **198**, 921 (1960); G. Burnstock, M. E. Holman, C. L. Prosser, *Physiol. Rev.* **43**, 482 (1963).
93. G. Gabella, in *Physiology of Smooth Muscle*, E. Bülbring and M. F. Shuba, Eds. (Raven, New York, 1976), p. 265; E. E. Daniel, V. P. Daniel, G. Duchon, R. E. Garfield, M. Nichols, S. K. Malhotra, M. Oki, *J. Membr. Biol.* **28** (No. 2/3), 207 (1976).
94. T. C. West and J. Landa, *Am. J. Physiol* **187**, 333 (1956).
95. Many colleagues have given constructive criticism; I hesitate to list them for fear of inadvertently omitting one or two. However, special thanks are due to H. ter Keurs and B. R. Fink for their very helpful suggestions.

NEWS AND COMMENT

National Academy of Sciences: How the Elite Choose Their Peers

Philip Handler, president of the National Academy of Sciences, was drawing to the close of his annual report to the members on 26 April when he touched on the subject of election to the prestigious academy. Just that morning the members had completed their secret, mysterious, year-long election rites by voting in 60 new members "in recognition of their distinguished and continuing achievements in original research." Now Handler took note that there are pressures on the academy to broaden the pool of scientists from which it selects members. "The external world views us with a cocked eyebrow," he warned. "Egalitarianism and populism are in flood. There are those who would urge upon us public nomination of candidates for membership in the Academy. . . . There are . . . those who would have the membership of the Academy reflect the proportions of various groups within the population; by states, by sex, by ethnic groups. And there are those who consider the Academy to be an elitist relic of the past.

"Perhaps so," Handler continued. "But the hallmark of the Academy must continue to be excellence in all things and we must, above all else, retain our single criterion for election. We do believe that in science the best is vastly more important than the next best." A few sentences later Handler concluded. The members rose to give him a sustained standing ovation—the most heartfelt applause, some say, that Handler had ever received for an annual report. His defense of excellence and of the academy's ability to recognize it had touched a responsive chord.

But how well does the academy's labyrinthine elections process actually perform when it comes to selecting the most accomplished scientists in the land for membership? "That's a valid question," says David R. Goddard, the academy's home secretary and chief elections official. "I wish to hell I could give you an objective answer to it. We don't have an objective measure that I really know of." Goddard said it is his subjective opinion that "you can always find people outside the Academy who are just as good as the Academy members." But he described the number of "mediocre people" who gain admission to the academy as "minimal—there are relatively few Academy members that one would say shouldn't have been elected." However, with the academy membership now exceeding 1200, he added, even a 10 percent error rate "would leave you with a large number of ordinary people."

One imperfect measure of the academy's perspicacity is the extent to which it recognizes and honors talent of Nobel prize quality. (The measure is imperfect, among other reasons, because the Nobel judges are by no means infallible.) According to Goddard, "the Academy often has a red face" when the Nobel awards are announced and it turns out that some American scientist has been honored who is not yet a member of the academy. The 1976 Nobel prize in physics went to Burton Richter, of the Stanford Linear Accelerator Center, and Samuel C. C. Ting, of the Massachusetts Institute of Technology, neither of whom were members of the academy at the time. Both were elected to the academy at the recent meeting. The Richter-Ting case is understandable in that their Nobel prize came unusually soon after the work for which they were honored. But since 1950 there have been 12 other American scientists who received the Nobel prize but were not members of the academy at the time.

Many of these individuals appear to have been missed because they came from disciplines or institutions that were not strongly represented in the academy. Thus, in the past few years, the Nobel prize has been awarded to such non-academicians as Simon Kuznets and Wassily Leontief, both economists, a field in which the academy has only recently been building up its strength; Leon N Cooper, a physicist from Brown University, outside the mainstream of elite institutions which dominate the academy; and Ivar Giaever, an applied physicist from industry (General Electric), who was thus outside the community of pure academic scientists who predominate in the academy. In all of these cases, the academy subsequently elected the Nobelist to membership. Another industrial scientist who may have been overlooked unjustly for many years is Lewis H. Sarett, a chemist and president of Merck Sharp & Dohme Research Laboratories, who synthesized cortisone by various routes in 1944 and 1952 and won the National Medal of Science last year; he was finally elected to the academy this year. On an overall basis, however, Goddard believes that the academy does a respectable job in selecting the nation's most outstanding scientists. He notes that some 68 living academicians have won Nobel prizes and that "relatively few" of these got their Nobel award before their academy membership.

The chief criterion for election to the academy has traditionally been outstanding original research work. But there are no written guidelines defining just what a scientist must do to qualify, and other factors sometimes influence the academy electorate.

Some individuals appear to be elected because of their eminence as administra-

tors of major institutions on the scientific scene. This year, for example, the academy elected Harold Brown, the Carter Administration's Secretary of Defense. Goddard says that the process that led to Brown's election was well under way before it was realized that Brown would become Secretary of Defense. Even so, Brown had been out of active research for many years and had largely made his reputation in a series of important administrative posts, including that of director of defense research and engineering for the Pentagon, Secretary of the Air Force, and president of Caltech. He joins a number of other academicians who are probably better known for their administrative accomplishments than for their research contributions, including H. Guyford Stever, former director of the National Science Foundation; James A. Shannon, former director of the National Institutes of Health; and S. Dillon Ripley II, secretary of the Smithsonian Institution.

The membership of the academy consists primarily of post–middle aged white males from a relatively small number of elite institutions. As of last year, some 60 percent of the members were 60 years or older and another 25.6 percent were 51 to 59. The number of blacks elected has been miniscule (no records are kept of a member's race). And there are currently only some 28 women in a membership of 1219.

Academy officials say the lack of women reflects the lesser role of women in the scientific community at large, but feminists see evidence of male chauvinism at the academy. Years ago the academy was embarrassed by an obvious injustice to the female half of a distinguished research team. In 1940, Carl F. Cori was elected to the academy. In 1947, he and his wife, the late Gerty T. Cori, shared a Nobel prize in physiology or medicine with an Argentine scientist. In 1948, the academy belatedly woke up and elected Gerty to membership. Similarly, partisans of anthropologist Margaret Mead were annoyed for years that she had not made the academy, but were mollified when she finally won election in 1975. In the most recent election, 4 of the 60 new members were women.

Geographically, according to Goddard, the academy members are concentrated in three areas—the eastern seaboard between Washington, D.C., and Cambridge, Massachusetts; the state of California; and a midwestern region that includes Illinois, Wisconsin, Michigan, and areas immediately adjacent. As of 1976, 12 states had no members at all—Alaska, Arkansas, Hawaii, Idaho, Kentucky, Louisiana, Mississippi, Montana, North Dakota, Oklahoma, South Dakota, and Wyoming. The academy says its membership reflects the distribution of scientific talent in the country, but scientists from some of the have-not states find it hard to believe there is not a single scientist in their areas who is as good as some of the academy members.

There appear to be no up-to-date analyses of the institutional affiliations of academy members. A computer printout that tabulates the number of academicians who were employed full time at various universities in October 1976 reveals that Harvard had the greatest number, 98, followed by Berkeley, 67; MIT, 64; Stanford, 51; the University of Chicago, 45; Caltech, 44; Rockefeller University, 39; University of California at San Diego, 34; University of Wisconsin, 31; and Yale, 27. Just missing the top ten were Cornell and Illinois, with 24 apiece. This year the rich got richer. Harvard claimed the most new members (6), followed by Stanford (5) and MIT (4). Also this year Bell Laboratories, the National Institutes of Health, and the University of California at Los Angeles had three apiece.

By most accounts, election to the academy is second only to the Nobel in the esteem accorded to it by most of the American scientific community. Universities boast of the number of academicians on their faculties, and the individual who wins membership in the academy is said to have an enhanced bargaining position when it comes time to bargain for a new job or a higher salary. Thus the elaborate, closely guarded elections process excites considerable interest and speculation among the upwardly mobile segment of the scientific community that aspires to academy membership. "I'll probably be criticized by some members for even talking to you," Goddard told *Science* as he launched into a description of how the process works.

As Goddard sees it, there are two main elements—the process by which an individual is nominated, and the process of election. The chief role in nominations is played by the academy's 23 disciplinary sections—covering such areas as mathematics, physics, genetics, and economic sciences—to which academy members are assigned at their own choice. The existing members of a section generate the names of new candidates for membership, review a list of each candidate's most important scientific articles and a 250-word summary of his major accom-

Califano Takes Richmond

Health, Education, and Welfare (HEW) Secretary Joseph A. Califano Jr., who has been trying to get an assistant secretary for health ever since January, has persuaded Harvard psychiatrist Julius B. Richmond, 60, to take the job. Word that Richmond is to be nominated came only days after Christopher C. Fordham III, who was slated for the position, abruptly withdrew following a dispute with Califano (*Science*, 6 May). All in all, Califano's search for an assistant secretary has not gone terribly well. The first persons to whom he offered the job turned him down, in part because he has greatly diminished its influence. So now, 4 months into the new Administration, there is a lot riding on Richmond's taking the job and staying.

Richmond already had ties to the Carter Administration as a member of the President's Commission on Mental Health, so he comes to HEW as a known quantity. In addition, he has Washington ties from the Kennedy and Johnson years, when he was associated with the Office of Economic Opportunity and served as the first director of Project Head Start, the program to help disadvantaged children by starting their education early—in prekindergarten years.

Richmond, who holds professorships in child psychiatry and human development and in preventive and social medicine at Harvard, is also director of the Judge Baker Guidance Center for disturbed children and adolescents. In addition to his interests in mental health, he has developed an interest in policy issues involving medical care and medical education. He was, for example, chairman of a study on the cost of medical education that the Institute of Medicine–National Academy of Sciences did for Congress about a year ago. Richmond, who is well regarded in medical circles, surprised his colleagues by accepting the assistant secretaryship. "I don't know how he did it, but Califano pulled off a brilliant maneuver," said one of Richmond's admirers. "I guess Julie just wanted a change of scene," said another. The question now is whether he'll like it.—B.J.C.

plishments, and conduct a series of informal and formal ballots. At the end of the process, all persons who have received the votes of two-thirds of the members voting in any one section are considered nominated. The vast majority of nominations—probably more than 80 percent in a typical year, according to Goddard—emerge in this way.

The process has been criticized for being incestuous because many of the sections tend to be dominated by faculty members from a handful of university departments—a circumstance that causes scientists at other institutions to grumble occasionally about institutional favoritism in the nominations process. But the academy has also established other avenues for nomination. Any five members of the academy can propose that a prospect be treated as an intersectional candidate, in which case the prospect needs only 50 percent of the combined vote in two sections to be nominated instead of two-thirds of the vote in one section. A group of 20 or more members of the academy can set themselves up as a "voluntary nominating group" and propose their own candidate, who is thereupon deemed an official nominee. (No more than five members of the group can be affiliated with the same institution, a provision designed to prevent the institutions that dominate the academy from steamrollering their colleagues in.) And the academy's governing council occasionally forms "temporary nominating groups" to develop lists of candidates in areas where the academy is known to be weak. This year, for example, a temporary group for the area of history and philosophy of science sparked the election of Martin J. Klein, historian of physics at Yale; Otto E. Neugebauer, historian of mathematics at Brown; and Willard Van Orman Quine, philosopher at Harvard. Another such temporary group has been operating in geography for 4 years. The academy council itself has the power to make nominations, but has not exercised that privilege for more than a decade.

The academy makes no effort to publicize it, but there is even a mechanism whereby the general public can feed names into the hopper. Goddard says there is nothing in the bylaws to prevent the submission of names by outsiders; in fact, the home secretary occasionally gets a letter from some outsider nominating himself or someone else. If it is "not obviously a screwball nomination" and involves someone working in areas relevant to the academy, Goddard says he will forward the name to one or more sections for consideration as a possible nominee. Goddard, who has been in the academy for 26 years and has served as home secretary for the past two elections, says he "can't recall a case where a person has been elected from an outside nomination but I believe there have been such cases—we'd have to search the records."

Once all the nominations are in, the most crucial elements in the elections process—the five class membership committees—swing into operation. These committees, composed of a dozen or more academicians, are responsible for broad areas of science, each of which encompasses several of the disciplinary sections. (The biological sciences class committee, for example, presides over biochemistry, botany, and five other disciplinary sections.) Each class committee prepares a rank list of the nominees that

NAS Elects 60 New Members

The National Academy of Sciences has elected 60 new members, bringing the total to 1219. The election of 15 foreign associates brings that total to 166.

The new Academy members, with the 15 foreign associates at the end, are as follows:

Gabriel A. Almond, Stanford University; **Michael Artin**, Massachusetts Institute of Technology; **Floyd E. Bloom**, The Salk Institute for Biological Studies; **Wallace S. Broecker**, Columbia University; **Harold Brown**, U.S. Department of Defense; **Purnell W. Choppin**, Rockefeller University; **Roderick K. Clayton**, Cornell University; **Elizabeth F. Colson**, University of California, Berkeley; **John M. Dawson**, University of California, Los Angeles; **Gerard Debreu**, University of California, Berkeley; **Theodor O. Diener**, U.S. Department of Agriculture; **Samuel Epstein**, California Institute of Technology; **Howard E. Evans**, Colorado State University; **Walter Feit**, Yale University; **Sheldon L. Glashow**, Harvard University; **Gerson Goldhaber**, University of California, Berkeley.

James E. Gunn, California Institute of Technology; **N. Bruce Hannay**, Bell Laboratories, Inc.; **David Harker**, State University of New York, Buffalo; **William R. Hewlett**, Hewlett-Packard Co.; **George H. Hitchings**, Burroughs Wellcome Fund Research Laboratories; **Louis N. Howard**, Massachusetts Institute of Technology; **Jesse D. Jennings**, University of Utah; **Nathan Keyfitz**, Harvard University; **Edwin D. Kilbourne**, Mount Sinai School of Medicine; **Martin J. Klein**, Yale University; **Richard M. Krause**, National Institute of Allergy and Infectious Diseases; **Israel R. Lehman**, Stanford University; **Seymour Lieberman**, Columbia University; **Richard S. Lindzen**, Harvard University; **John W. Littlefield**, The Johns Hopkins University; **Hugh O'N. McDevitt**, Stanford University Hospital; **Aron A. Moscona**, University of Chicago; **Elizabeth F. Neufeld**, National Institutes of Health; **Otto E. Neugebauer**, Brown University; **Richard M. Noyes**, University of Oregon; **Sanford L. Palay**, Harvard Medical School; **Robert P. Perry**, University of Pennsylvania.

James C. Phillips, Bell Laboratories, Inc.; **George W. Preston III**, Hale Observatories; **Willard V. O. Quine**, Harvard University; **Peter H. Raven**, Missouri Botanical Garden; **Charles N. Reilley**, University of North Carolina, Chapel Hill; **Howard Reiss**, University of California, Los Angeles; **Burton Richter**, Stanford University; **Ruth Sager**, Harvard Medical School; **Lewis H. Sarett**, Merck Sharp & Dohme Research Laboratories; **Roger N. Shepard**, Stanford University; **Philip S. Skell**, Pennsylvania State University; **David Slepian**, Bell Laboratories, Inc.; **Herbert Tabor**, National Institutes of Health; **James H. Taylor**, Florida State University; **Richard F. Thompson**, University of California, Irvine; **George R. Tilton**, University of California, Santa Barbara; **Samuel C. C. Ting**, Massachusetts Institute of Technology; **William N. Valentine**, University of California, Los Angeles; **Evelyn M. Witkin**, Rutgers University; **Gerald N. Wogan**, Massachusetts Institute of Technology; **Julian Wolpert**, Princeton University; **Herbert E. Wright, Jr.**, University of Minnesota, Minneapolis.

The foreign associates are:

Anatole Abragam, College of France; **Sydney Brenner**, Molecular Research Council Laboratory of Molecular Biology, England; **Douglas Coombs**, University of Otago, New Zealand; **Ralf Dahrendorf** (Federal Republic of Germany), London School of Economics and Political Science; **Louis M. N. Duysens**, Leiden University, Netherlands; **Frank Fenner**, Australian National University; **Hendrik Van De Hulst**, Leiden University, Netherlands; **Hiroshi Inose**, University of Tokyo, Japan; **Rolf Luft**, Karolinska Institute, Sweden; **Edmond Malinvaud**, Institut National de la Statistique et des Etudes Economiques, France; **Peter Mitchell**, Glynn Research Laboratories, England; **John Pople** (England), Carnegie-Mellon University; **Bernhard Rensch**, Zoological Institute, Federal Republic of Germany; **M. S. Swaminathan**, Indian Council of Agricultural Research; **Andre Weil** (France), Institute for Advanced Study.

have been emerged from the sections under its jurisdiction. For the most part they just interdigitate the nominees from various sections, deciding whether the nominee with the most votes from the chemistry section should rank ahead of the leading physics nominee, and so forth. But they also impose their own judgment on the process and occasionally differ markedly from the sections in evaluating a particular individual. A vigorous partisan or opponent on the class membership committee can mean the difference between an individual's eventual election or defeat. The committees are assigned quotas that they may not exceed, and thus in effect eliminate many of the names from further consideration and forward the rest, in serial order of the committee's preference, to be voted on by the membership. In the most recent election, some 150 persons were nominated, of whom 90 (the quota limit) survived scrutiny by the class committees. Under bylaws previously adopted, only 60 of those 90 could be elected to membership.

The major ballot is then conducted by mail. Each member of the academy gets a packet of material that includes the rank list of each class membership committee, a summary of each candidate's accomplishments, and a record of the voting by the nominating groups that initiated the whole process. Each member is supposed to vote for from one-third to one-half of the names on each of the five class rank lists. Since many academicians know few of the candidates outside of their own discipline, they tend to follow the suggested rank lists or else, some say, they vote on the basis of institutional loyalty, assuming, for example, that the chemist from their own university must be better than the chemist from another school. One academician told *Science* he finds the process so complicated and the idea of just blindly following the committee rank lists so distasteful that he doesn't bother to vote.

The end product of the mail ballot is yet another ranking—the nominees are listed in order of votes received, with suitable adjustments made to ensure that each class receives its proper quota. The final ballot then takes place at the annual meeting, at which time there are various mechanisms whereby those members present can make a last-ditch try to boost or block a particular candidate. Six years ago, the council of the academy successfully blocked the election of Lamont C. Cole, a Cornell ecologist, causing a furor that reached public attention. Since then, the elections have been relatively quiet. This year the only questions raised from the floor concerned the qualifications of William R. Hewlett, president and chief executive officer of the Hewlett-Packard Company. But after it was explained that Hewlett was being nominated for his contributions to scientific instruments that have revolutionized some fields of science rather than for basic research contributions, the questioner seemed satisfied, and Hewlett won final election—along with the other top 59 on the list—with no difficulty.

There have occasionally been suggestions that the academy should cast its electoral net wider, either by encouraging nominations from outside the academy or even—to the horror of most academicians—allowing nonmembers to vote in some fashion. But the academy, jealous of its prerogatives and its reputation for excellence, remains unapologetically elitist.—PHILLIP M. BOFFEY

Academy to Campaign Publicly for Oppressed Scientists

"My experience is that publicity helps, or at least does not harm. Silence kills."

So said Columbia mathematics professor Lipman Bers, a member of the newly appointed Committee on Human Rights of the National Academy of Sciences, at an announcement last week of the committee's existence.

Formation of the committee marks a new departure in academy policy toward persecuted scientists. Having relied in the past on silent diplomacy, in the form of discreet representations by its president and foreign secretary, the academy has now decided to open up a public channel of protest as well.

The committee has already written in the academy's name to Soviet Ambassador Dobrynin, expressing concern over the arrest of high energy physicist Yuriy F. Orlov, a founding member of the Soviet Amnesty International Group. Sent on 19 April, the letter asks for information as to where Orlov is being held and the charges against him.

With judicious regard for diplomatic balance, the academy has also written to the U.S. Departments of State and Justice seeking elimination of a law that impedes visits by people having past or present association with Communist organizations.

The NAS committee on human rights plans to aid individuals "from the natural constituency of the NAS" who are being oppressed or harassed for political reasons.

As a start it has adopted the cases of eight scientists suffering political oppression for their beliefs, two in the Soviet Union, one in Uruguay, and five in Argentina. They are:

▶ Sergei A. Kovalev, a research biologist who played a leading role in the struggle for human rights in the Soviet Union until his arrest in 1974. Sentenced to 7 years hard labor and 3 years exile, Kovalev was until recently denied a needed operation (*Science*, 5 November 1976).

▶ Yuriy Orlov, arrested on 10 February this year. Orlov headed an unofficial group for monitoring Soviet compliance with the provisions of the Helsinki agreement.

▶ José Luís Massera, a well-known mathematician. Massera was a member of the Uruguayan Communist Party, which was outlawed by the government in 1973. He was also for a long time a member of the House of Representatives, which the government scrapped at the same time. He was arrested on 21 October 1975 and has been held incommunicado ever since. He is reported to have undergone severe and prolonged torture, and also to have suffered a fracture of the pelvis. Massera, aged 62, is now being tried secretly by correspondence, trials by jury having been abolished in Uruguay. The NAS committee will petition the Uruguayan government to allow Massera's family and others to visit him and for observers to be present at legal proceedings.

▶ Federico Alvarez Rojas, Gabriela Carabelli, Juan Carlos Gallardo, Antonio Misetich, and Eduardo Pasquini, five Argentinian physicists who disappeared at various times in 1976. Alvarez was abducted with his wife, Hilda; neither has