The National Academy of Sciences: Profile of an Institution (I)

A distinguished researcher, long influential in the high councils of science and government, relates the following experience: Several years ago, in his capacity as an officer of the National Academy of Sciences, he visited the chairman of a Senate committee that was directly concerned with a rapidly expanding area of federal support for science and technology. The scientist told the Senator that, under its 100-year-old charter as scientific adviser to the federal government, the Academy would be pleased to undertake studies that might assist the committee in its legislative duties. At once he realized that the Senator took him to be a representative of a commercial consulting firm. "He essentially ran me out of the office with a collection of insults. . . . He said, 'What is the National Academy? I've never heard of it. . . . Before I'd even consider it, you'd have to write me a formal application giving the source of all the funds you received, and specify how much you wish to be paid for your services.'" Thus ended the interview.

The experience was especially distasteful to the scientist because the Senator once had attended a dinner given by the Academy to make its presence better known to members of Congress. Since all congressmen are deluged by dinner invitations from organizations trying to promote one objective or another, and acceptances often are joylessly given at the behest of influential acquaintances, perhaps the Senator can be excused for failing to recollect one evening of hospitality from among scores or hundreds. But even if he had remembered it very well, he might still have wondered, "What is the National Academy?"

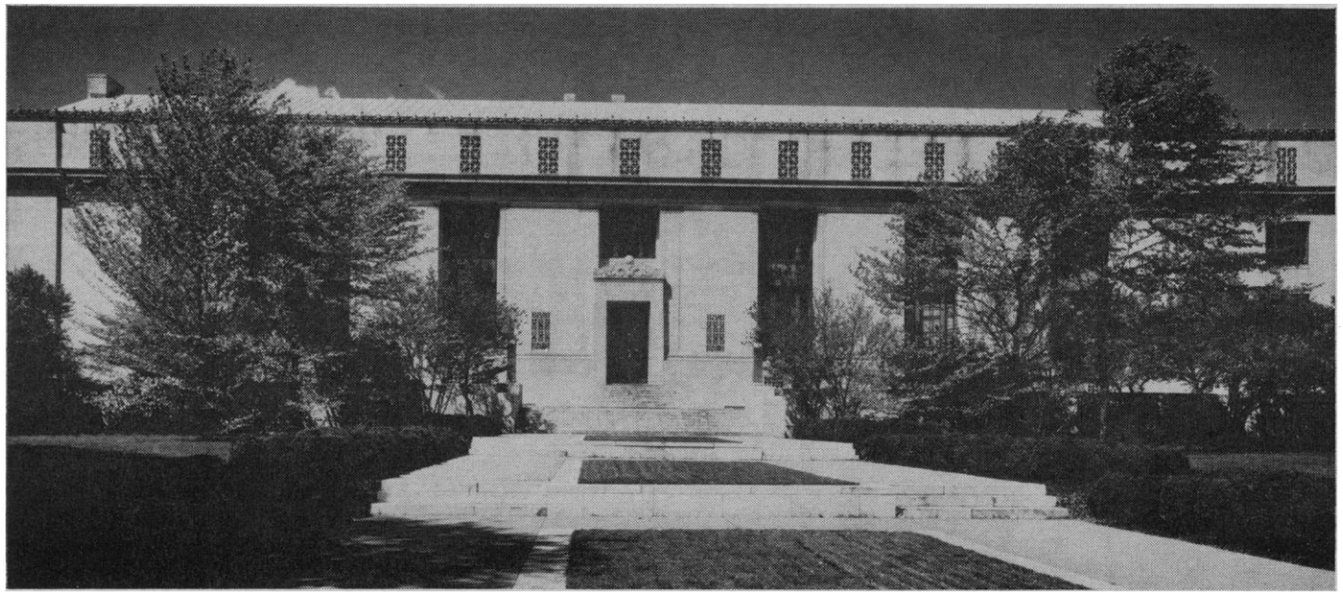
The fact of the matter is that the answer is not easy to assemble or comprehend. Though the Academy is a private organization, it regularly turns up in the Washington telephone book and the official *Congressional Directory* as an agency of the U.S. Government. By act of Congress it is scientific adviser to the entire federal government, but the major scientific issues on which its advice has not been sought are multitudinous. It has relatively little money of its own; nevertheless, it provides its president with a $225,000 residence. It pays no consulting fees; nevertheless, it freely obtains the consulting services of thousands of the nation's most distinguished, and expensive, scientists and engineers. There are informed people who take the Academy very seriously; and there are informed people who think it is a harmless anachronism. What is the National Academy of Sciences?

The question is worth examining in great detail, for whatever the Academy is—and it is an astonishing conglomeration of functions, traditions, triumphs, pretensions, strengths, and nonsense—the Academy, among other things, is a kind of political and administrative junction point of all American science and technology, as well as a remarkably effective staging area for scientific entrepreneurship. It is, of course, not the only device for accomplishing these purposes, nor is it indispensable or even influential in relation to all the matters that come within its range. But over the past 15 years, and especially during the past 3 or 4, the organization that is now properly known as the National Academy of Sciences–National Academy of Engineering–National Research Council (or NAS–NAE–NRC) has been cautiously, sometimes clumsily, but continuously developing new strength. It is searching for new areas of influence and becoming ever more involved with decisions affecting the development and employment of the nation's scientific and technical resources. And, as political, economic, and social decisions increasingly come to hinge upon the formulation or selection of technological alternatives, the Academy is displaying the intention, as well as the potential, to become, more involved in helping to shape these decisions.

At the outset of this examination of the Academy it is necessary to point out that one of the impediments to a clear perception of this organization is the surrounding atmosphere of congenial myth regularly put forth by its elders, partly, one might guess, out of affection for their venerable institution but possibly also out of concern for its vulnerabilities and deficiencies. Perhaps more than any other American institution, the Academy lays title to wisdom, selflessness, and ethical purity, and as is often the case with institutions that claim to have discovered the means for extracting rare, desirable qualities from an imperfect humanity, the Academy traces its origins to an immaculate conception. Thus, in 1944, Academy president Frank Jewett told a congressional committee that the Academy's Act of Incorporation "created in the whole domain of science a Supreme Court of final advice . . . and ensured that so far as was humanly possible its findings would be wholly in the public interest uninfluenced by any elements of personal, economic, or political force." What was the genesis of this creation? Here we find mythology blooming out of wishful thinking. In a volume titled *The Scientific Endeavour* (Rockefeller Institute Press), containing a collection of papers delivered upon the occasion of the Academy's centennial celebration in 1963, there appears a foreword over the names of Academy President Frederick Seitz and his immediate predecessor, Detlev W. Bronk, president of what is now Rockefeller University.

"The Civil War revealed the need of our federal government for scientific and technical advice," states the foreword. "Accordingly, 1863 was a propitious time for the Congress to call upon fifty scientists to found the National Academy of Sciences for the encouragement of research and the diffusion of scientific knowledge, and to advise the federal government on matters of science and technology."

Now, as stated, that is a noble, inspiring genesis, deserving of emphasis in connection with the 100-year mark in the life of a distinguished institution. (On that occasion, President Kennedy addressed the Academy in the course of a 4-day celebration attended by distinguished scholars from throughout the world.) However, the only difficulty with the Seitz-Bronk tale of genesis is that, historically, it is only slightly less askew than asserting that Martin Luther set up a branch church at the invitation of the Pope. The fact is that during the Civil War, after many years



Headquarters of the National Academy of Sciences, on Washington's Constitution Avenue. The building was dedicated in 1924.

of experiencing a frustrating governmental indifference to science, a small group of scientists, mainly in federal employ, sought a chance to obtain a greater voice for science in government councils. As A. Hunter Dupree records in his pioneering work *Science in the Federal Government* (Belknap Press, 1957), they persuaded an otherwise now-forgotten Senator, Henry Wilson of Massachusetts, to introduce a bill providing a federal charter for the Academy. The bill went through both Houses without debate, on the crowded last day of a lame-duck session, and apparently was signed into law that evening by President Lincoln.

An interpretation by a person who was contemporary to these events is to be found in a letter written 6 days after the Academy's birth by Smithsonian Secretary Joseph Henry, who was included as one of the 50 charter members and who served as Academy president from 1866 until his death in 1878. "I do not think," Henry wrote, "that one or two individuals have a moral right to choose for the body of scientific men in this country who shall be members of a National Academy and then by a political ruse obtain the sanction of a law of Congress for the act" [Henry to Stephen Alexander, in *Science in the 19th Century, a Documentary History*, Nathan Reingold, Ed. (Hill and Wang, New York, 1964), p. 204].

Enough of mythology. Let us now proceed to look at the Academy.

At the most elemental level, the Academy is far and away the most prestigious society among the thousand or so scientific and technical societies that are spread across the American landscape. In the hierarchy of professional honor and recognition among American scientists, election to the Academy is surpassed only by the Nobel prize, and, actually, only an infinitesimal sliver of the scientific community ever gains the distinction of Academy membership. At present, approximately 100,000 persons in this country hold the Ph.D. in the physical, natural, or social sciences, and there are at least 2 million others with some professional level of scientific or technical training. From this huge mass the Academy currently selects 45 a year, the stated criterion for election being eminence in scientific research. Its total membership stands at approximately 740, plus 78 foreign associates and ten members emeritus.

The 2½-year-old National Academy of Engineering, which is administratively an equal of the Academy of Sciences but legally just another of the many functions that stem from the NAS's congressional charter, is supposed to confer similar prestige upon the engineering professionals. But NAE's youth and its still-small membership (growing, but only 100 at present), coupled with the engineering profession's identity crisis and the ever-present shadow of the century-old, self-assured Academy of Sciences, leaves NAE at present in the status of no more than an interesting, though potentially powerful, fledgling.

Now, with a membership of 740 drawn from a scientific and technical community that exceeds 2 million, and with election bringing no duties beyond payment of an annual $10 fee, the Academy, as is often the case with the academies of other nations, might easily be no more than the mutual-admiration society of post-middle-aged scientists that the astronomer George E. Hale considered it to be upon his election in 1902. As noted in the autobiography of his colleague Robert A. Millikan, Hale found the Academy "a small, exclusive, relatively uninfluential body which was apparently more interested in keeping young men out of its membership than in acting as a vital force in the scientific development of the United States." Today it is still small and exclusive, and it is scarcely overrun by youth. In 1963 the average age at election was 49.5, and the average age of the total membership was 61.6. Furthermore, the seniority bias, coupled with longevity and the fact that the Academy is a self-perpetuating body—it employs a wondrously arcane electoral process that has all the attributes of a papal election except smoke—tends to build a membership that is increasingly distant from the frontiers of research. The specifications for election, said to be "streamlined" from earlier versions, are set forth in eight dense pages of the Academy's bylaws. What they boil down to, however, is the fact that each year the Academy admits 18 in the life sciences, 18 in the physical sciences, six in engineering and applied science, and three of any disciplinary stripe whose mem-

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Membership of the National Academy of Sciences as of 1 July 1966

Mathematics—52 members
Brauer, Richard, *chairman* (1967)
Ahlfors, L. V.
Albert, A. A.
Alexander, J. W.
Bers, Lipman
Bing, R. H.
Blackwell, David
Bochner, S.
Bott, Raoul
Chern, S. S.
Courant, R.
Doob, J. L.
Eilenberg, S.
Evans, G. C.
Feller, William
Friedrichs, K. O.
Gleason, A. M.
Gödel, Kurt
Hille, Einar
Jacobson, Nathan
John, Fritz
Kac, Mark
Kaplansky, Irving
Lefschetz, Solomon
Lewy, Hans
Lin, C. C.
Mackey, George W.
Mac Lane, Saunders
McShane, E. J.
Milnor, J. W.
Montgomery, Deane
Moore, R. L.
Morrey, C. B., Jr.
Morse, Marston
Murnaghan, F. D.
Neyman, Jerzy
Shannon, C. E.
Smith, Paul A.
Spencer, D. C.
Steenrod, N. E.
Stoker, J. J.
Stone, M. H.
Tarski, Alfred
Thomas, T. Y.
Tukey, John W.
Ulam, S. M.
Walsh, J. L.
Whitney, Hassler
Whyburn, G. T.
Wilder, R. L.
Zariski, O.
Zygmund, Antoni

Foreign Associates
Alexandroff, P. A.
Dirac, P. A. M.
Hodge, Sir William
Hopf, Heinz
Leray, Jean
Taylor, Sir Geoffrey

Astronomy—30 members
Clemence, G. M., *chairman* (1968)
Abbot, C. G.
Aller, L. H.
Babcock, H. W.
Baker, J. G.
Bowen, I. S.
Chandrasekhar, S.
Friedman, Herbert
Goldberg, Leo
Greenstein, J. L.
Herbig, George H.
Herget, Paul
Joy, A. H.
Kuiper, G. P.
Leighton, R. B.
Mayall, N. U.
Menzel, D. H.
Minkowski, R. L.
Morgan, W. W.
Osterbrock, D. E.
Sandage, A. R.
Schwarzschild, M.
Shane, C. D.
Shapley, Harlow
Slipher, V. M.
Spitzer, Lyman, Jr.
Tousey, Richard
Whipple, F. L.
Whitford, A. E.
Wilson, Olin C.

Foreign Associates
Ambartsumian, V.
Minnaert, M. G. J.
Oort, Jan Hendrik
Swings, P.

Physics—102 members
Dennison, D. M., *chairman* (1969)
Alvarez, L. W.
Anderson, C. D.
Anderson, H. L.
Bacher, R. F.
Bainbridge, K. T.
Bardeen, John
Beams, J. W.
Bethe, H. A.
Birge, R. T.
Bleakney, Walker
Bloch, Felix
Bloembergen, N.
Bradbury, N. E.
Brattain, W. H.
Breit, Gregory
Brillouin, Léon
Brode, R. B.
Chamberlain, Owen
Chew, Geoffrey F.
Christy, R. F.
Condon, E. U.
Crane, H. R.
Deutsch, M.
DuBridge, L. A.
DuMond, J. W. M.
Dunning, J. R.
Dyson, Freeman J.
Fairbank, W. M.
Feynman, R. P.
Fitch, V. L.
Fowler, W. A.
Gamow, George
Garwin, R. L.
Gell-Mann, Murray
Glaser, Donald A.
Goldberger, M. L.
Goldhaber, M.
Gordy, Walter
Goudsmit, S. A.
Haworth, L. J.
Herb, R. G.
Herzfeld, K. F.
Hofstadter, R.
Houston, W. V.
Inghram, Mark G.
Kemble, E. C.
Kerst, D. W.
Kittel, C.
Kusch, P.
Lamb, W. E., Jr.
Land, E. H.
Lauritsen, C. C.
Lederman, L. M.
Lee, Tsung-Dao
Loomis, F. W.
Marshak, R. E.
Matthias, Bernd
Mayer, M. G.
McMillan, E. M.
*Meggers, W. F.
Morse, P. M.
Mulliken, R. S.
Nier, A. O. C.
O'Brien, Brian
*Oppenheimer, J. R.
Pais, A.
Panofsky, W. K. H.
Pound, R. V.
Purcell, E. M.
Rabi, I. I.
Ramsey, N. F.
Rossi, Bruno
Schiff, L. I.
Schwinger, Julian
Segrè, E.
Seitz, Frederick
Serber, R.
Simpson, J. A.
Slater, J. C.
Steinberger, J.
Stern, Otto
Street, J. C.
Teller, Edward
Thomas, L. H.
Townes, C. H.
Tuve, M. A.
Uhlenbeck, G. E.
Van Vleck, J. H.
Webster, D. L.
Weinberg, Alvin M.
Weisskopf, V. F.
Wentzel, Gregor
Wheeler, J. A.
Wick, Gian-Carlo
Wigner, E. P.
Wilson, Robert R.
Wu, C. S.
Yang, Chen Ning
Zacharias, J. R.
Zachariasen, W. H.
Zener, Clarence

Foreign Associates
Amaldi, Edoardo
Blackett, P. M. S.
Born, Max
Bragg, Sir Lawrence
de Broglie, Prince Louis
Heisenberg, Werner
Kapitza, P. L.
Landau, L. D.
Mott, Sir Nevill
Tomonaga, Sin-itiro
Yukawa, Hideki

Engineering—52 members
Gilliland, E. R., *chairman* (1969)
Astin, A. V.
Bain, E. C.
Benedict, Manson
Bode, H. W.
Brooks, Harvey
Bush, Vannevar
Chipman, John
Curme, G. O., Jr.
Darken, L. S.
Den Hartog, J. P.
Draper, C. S.
Edgerton, H. E.
Emmons, H. W.
Fisk, J. B.
Fletcher, Harvey
Foote, P. D.
Gibbs, W. F.
Ginzton, E. L.
Greenewalt, C. H.
Hottel, H. C.
Hunsaker, J. C.
Johnson, C. L.
Kantrowitz, Arthur
Kelly, M. J.
Kinzel, A. B.
Lewis, W. K.
Loomis, A. L.
Mehl, R. F.
Newmark, N. M.
Olson, Harry F.
Pickering, W. H.
Pierce, J. R.
Piore, E. R.
Raymond, A. E.
Savage, J. L.
Sherwood, T. K.
Shockley, W.
Slepian, Joseph
Smith, C. S.
Soderberg, C. R.
Sporn, Philip
Stratton, J. A.
Suits, C. G.
Terman, F. E.
Thomas, C. A.
Timoshenko, Stephen
Weber, Ernst
Wiesner, J. B.
Wolman, Abel
Zinn, W. H.
Zworykin, V. K.

Foreign Associates
Brun, Edmond A.
Hawthorne, W. R.
Penney, Sir William
Roy, Maurice
Southwell, Sir Richard

Chemistry—108 members
Crawford, Bryce, Jr., *chairman* (1968)
Adams, Roger
Alberty, R. A.
Badger, R. M.
Baker, W. O.
Bartlett, P. D.
Bigeleisen, Jacob
Blomquist, A. T.
Boekelheide, V.
Bolton, E. K.
Breslow, Ronald
Brewer, Leo
Brode, W. R.
Brown, H. C.
Büchi, George
Cairns, T. L.
Calvin, Melvin
Conant, J. B.
Connick, R. E.
Corey, E. J.
Cram, Donald J.
Curtin, David Y.
Daniels, Farrington
Davidson, N.
Djerassi, Carl
Doering, William
Drickamer, H. G.
Elderfield, R. C.
Emmett, P. H.
Eyring, Henry
Ferry, John D.
Fieser, L. F.
Flory, P. J.
Folkers, Karl
Fuoss, R. M.
Fuson, R. C.
Gates, M.
Giauque, W. F.
Gilman, Henry
Gutowsky, H. S.
Hammett, L. P.
Hammond, G. S.
Harned, H. S.
Hauser, C. R.
Hildebrand, J. H.
Hill, T. L.
Hirschfelder, J. D.
Hornig, D. F.
Hutchison, C. A., Jr.
Jacobs, W. A.
Johnson, J. R.
Johnson, W. S.
Johnston, H. S.
Kauzmann, Walter
Keyes, F. G.
Kimball, G. E.
Kistiakowsky, G. B.
Kolthoff, I. M.
Kraus, C. A.
*La Mer, V. K.
Leonard, N. J.
Libby, W. F.
Lipscomb, W. N.
Long, Franklin A.
Longsworth, L. G.
Mark, H. F.
Marvel, C. S.
Mayer, J. E.
McConnell, H. M.
McElvain, S. M.
Newman, M. S.
Noyes, W. A., Jr.
Onsager, Lars
Pauling, Linus
Perlman, Isadore
Pimentel, G. C.
Pitzer, K. S.
Rice, Oscar K.
Roberts, John D.
Rossini, F. D.
Scatchard, George
Scheraga, H. A.
Seaborg, G. T.
Shedlovsky, Theodore
Sheehan, J. C.
Smith, L. I.
Smyth, C. P.
Spedding, F. H.
Stockmayer, W. H.
Stork, Gilbert
Tarbell, D. S.
Taube, Henry
Tishler, Max
Turner, Richard B.
Urey, H. C.
Wall, Frederick T.
Walling, Cheves
Warner, J. C.
Weissman, S. I.
Westheimer, F. H.
Williams, J. W.
Wilson, E. Bright, Jr.
Winstein, Saul
Woodward, R. B.
Wyckoff, R. W. G.
Yost, D. M.
Young, W. G.
Zimm, B. H.

Foreign Associates
Eigen, Manfred
Hinshelwood, Sir Cyril
Karrer, Paul
Prelog, Vladimir
Reichstein, Tadeus
Robinson, Sir Robert
Ruzicka, Leopold
Semenov, Nikolai N.
Svedberg, The
Lord Todd

Geology—38 members
Bradley, W. H., *chairman* (1969)
Abelson, P. H.
Anderson, C. A.
Birch, Francis
Blackwelder, Eliot
Bramlette, M. N.
Buddington, A. F.
Buerger, M. J.
Chaney, R. W.
Cloos, Ernst
Cloud, Preston E., Jr.
Dunbar, C. O.
Garrels, R. M.
Gilluly, James
Gregory, W. K.
Hedberg, H. D.
Hess, H. H.
Hewett, D. F.
Hubbert, M. King
James, Harold L.
Knopf, Adolph
Krauskopf, K. B.
Longwell, C. R.
Lovering, T. S.
Mackin, J. H.

*Deceased since the compilation of this list.

Nolan, T. B.
Patterson, Bryan
Pecora, W. T.
Pettijohn, F. J.
Rubey, W. W.
Russell, R. J.
Schairer, J. F.
Simpson, G. G.
Turner, F. J.
Waters, Aaron C.
Williams, Howel
Woodring, W. P.
Yoder, H. S., Jr.

Foreign Associates
Geijer, Per
Harrison, J. M.
Kuno, Hisashi
Sander, Bruno

Botany—50 members
Hendricks, S. B., *chairman* (1968)
Anderson, Edgar
Anderson, T. F.
Arnold, William A.
Arnon, Daniel I.
Barker, H. A.
Beadle, G. W.
Benzer, Seymour
Blinks, L. R.
Bonner, James
Borthwick, H. A.
Braun, A. C.
Brink, R. A.
Burkholder, P. R.
Burris, R. H.
Chandler, W. H.
Clausen, Jens
Cleland, R. E.
Couch, J. N.
Delbrück, Max
Esau, Katherine
Fred, E. B.
French, C. S.
Giles, N. H.
Goddard, D. R.
Granick, Sam
Hershey, A. D.
Hollaender, A.
Horsfall, J. G.
Kaufmann, B. P.
Kramer, Paul J.
McClintock, Barbara
Raper, John R.
Raper, K. B.
Rhoades, M. M.
Riker, A. J.
Robbins, W. J.
Roberts, R. B.
Sax, Karl
Sinnott, E. W.
Skoog, Folke
Smith, A. C.
Stakman, E. C.
Stebbins, G. L.
Thimann, K. V.
Van Niel, C. B.
Walker, J. C.
Went, F. W.
Wetmore, R. H.
Wilson, P. W.

Foreign Associates
Ephrussi, Boris
Kihara, H.
Lundegårdh, H. G.
Robertson, R. N.
Tamiya, H.

Zoology and Anatomy—68 members
Glass, H. Bentley, *chairman* (1967)
Bartelmez, G. W.
Bigelow, H. B.
Bloom, William
Bodenstein, D. H.
Bodian, David
Briggs, Robert
Bullock, T. H.
Burns, R. K.
Cleveland, L. R.
Colbert, E. H.
Corner, G. W.
Crow, James F.
Danforth, C. H.
Darlington, P. J., Jr.
Dethier, V. G.
Dobzhansky, Th.
Dunn, L. C.
Emerson, Alfred E.
Flexner, Louis B.
Friedmann, Herbert
Griffin, D. R.
Grobstein, Clifford
Hamburger, Viktor
Haskins, C. P.
Hisaw, F. L.
Holtfreter, J.
Hubbs, C. L.
Hutchinson, G. E.
Hyman, Libbie
Irwin, M. R.
Jacobs, M. H.
Kellogg, Remington
Lerner, I. M.
Levine, Philip
Little, C. C.
Mayr, Ernst
Mazia, Daniel
Metz, C. W.
Michener, C. D.
Mirsky, A. E.
Moore, J. A.
*Muller, H. J.
Neel, J. V.
Owen, R. D.
Painter, T. S.
Palade, G. E.
Pittendrigh, C. S.
Porter, Keith R.
Riddle, Oscar
Roeder, Kenneth D.
Romer, A. S.
Schmidt-Nielsen, K.
Schmitt, F. O.
Scholander, P. F.
Smith, Philip E.
Sonneborn, T. M.
Stern, Curt
Stone, W. S.
Straus, W. L., Jr.
Sturtevant, A. H.
*Twitty, V. C.
Weiss, Paul
Wetmore, Alexander
Williams, C. M.
Willier, B. H.
Wright, Sewall
Zirkle, R. E.

Foreign Associates
Brachet, Jean
von Frisch, Karl
Lorenz, Konrad
Watson, D. M. S.

Physiology—36 members
Visscher, M. B., *chairman* (1968)
Astwood, E. B.
Aub, Joseph C.
Bard, Philip
Brink, Frank, Jr.
Brodie, B. B.
Bronk, Detlev W.
Cole, K. S.
Comroe, Julius H., Jr.
Cournand, André
Davis, Hallowell
Evans, H. M.
Fenn, W. O.
Gerard, R. W.
Gilman, Alfred
Goodman, L. S.
Hartline, H. K.
Hastings, A. B.
Ingle, D. J.
Kety, Seymour S.
Krayer, Otto
Kuffler, S. W.
Landis, E. M.
Lim, Robert K. S.
Lloyd, D. P. C.
Loeb, R. F.
Long, C. N. H.
Lorente de Nó, R.
Magoun, H. W.
Mountcastle, V. B.
Pappenheimer, J. R.
Pincus, Gregory
Pitts, R. F.
Richards, D. W.
Schmidt, C. F.
Woolsey, C. N.

Foreign Associates
Lord Adrian
Best, C. H.
Dale, Sir Henry
Eccles, Sir John
Hill, A. V.
Houssay, B. A.
Lwoff, André

Pathology and Microbiology—47 members
McCarty, Maclyn, *chairman* (1969)
Armstrong, Charles
Bailey, P.
Cannon, P. R.
Castle, W. B.
Coggeshall, L. T.
Coons, Albert H.
Dalldorf, Gilbert
Dingle, J. H.
Dragstedt, L. R.
Dubos, R. J.
Dulbecco, Renato
Eagle, Harry
Enders, J. F.
Francis, Thomas, Jr.
Goebel, W. F.
Heidelberger, Michael
Hirst, George K.
Horsfall, F. L., Jr.
Hotchkiss, R. D.
Huebner, R. J.
Huggins, C. B.
Jacobson, L. O.
Long, E. R.
Luria, S. E.
MacLeod, C. M.
*Maxcy, K. F.
McMaster, P. D.
Meyer, K. F.
Miller, C. P.
Opie, E. L.
Paul, John R.
Puck, T. T.
Rich, A. R.
Rous, Peyton
Sabin, Albert B.
Shannon, J. A.
*Shope, R. E.
Taliaferro, W. H.
Tillett, W. S.
Waksman, S. A.
Wangensteen, O. H.
Warren, Shields
Watson, C. J.
Weller, Thomas H.
Whipple, G. H.
Wood, W. Barry, Jr.

Foreign Associates
Andrewes, Sir Christopher
Burnet, Sir Macfarlane
Lord Florey
Medawar, P. B.
Penfield, Wilder

Anthropology—18 members
Eggan, Fred, *chairman* (1969)
Albright, W. F.
Braidwood, Robert J.
Coon, C. S.
Davis, Kingsley
Greenberg, J. H.
Hallowell, A. Irving
Haury, E. W.
Krogman, W. M.
Movius, H. L., Jr.
Murdock, G. P.
Rouse, Irving
Shapiro, H. L.
Steward, J. H.
Stewart, T. D.
Washburn, S. L.
Wedel, W. R.
Willey, G. R.

Foreign Associates
Caso, Alfonso
Clark, Sir Wilfrid LeGros

Psychology—27 members
Miller, N. E., *chairman* (1968)
Beach, F. A.
Boring, E. G.
Carmichael, Leonard
Estes, W. K.
Galambos, R.
Garner, W. R.
Graham, C. H.
Guilford, J. P.
Harlow, H. F.
Hilgard, E. R.
Klüver, Heinrich
Köhler, Wolfgang
Lindsley, D. B.
Miles, W. R.
Miller, George A.
Neff, Willam D.
Pfaffmann, Carl
Ratliff, Floyd
Richter, C. P.
Riggs, Lorrin A.
Skinner, B. F.
Spence, K. W.
Sperry, R. W.
Stevens, S. S.
v. Békésy, Georg
Wever, E. G.

Foreign Associates
Bartlett, Sir Frederic
Konorski, Jerzy
Piaget, J.

Geophysics—37 members
Byers, H. R., *chairman* (1969)
Adams, Leason H.
Arnold, James R.
Benioff, Hugo
Berkner, L. V.
Bjerknes, J.
Booker, H. G.
Brown, Harrison
Byerly, Perry
Chamberlain, J. W.
Charney, Jule G.
Eckart, Carl
Elsasser, W. M.
Ewing, Maurice
Forbush, Scott E.
Griggs, D. T.
*Gunn, Ross
Haurwitz, B.
Iselin, C. O'D.
Kaplan, Joseph
Knopoff, Leon
MacDonald, G. J. F.
Munk, W. H.
Pekeris, C. L.
Piggot, C. S.
Press, Frank
Redfield, A. C.
Reichelderfer, F. W.
Revelle, Roger
Slichter, L. B.
Stommel, Henry
Suess, H. E.
Van Allen, J. A.
Verhoogen, John
Vestine, E. H.
Villard, O. G., Jr.
Wulf, O. R.

Foreign Associates
Alfvén, Hannes
Bullard, Sir Edward
Bullen, Keith Edward
Chapman, Sydney
Jeffreys, Sir Harold
Vening Meinesz, F. A.

Biochemistry—70 members
Bloch, K. E., *chairman* (1969)
Anfinsen, C. B.
Ball, E. G.
Berg, Paul
Buchanan, John M.
Carter, H. E.
Chance, Britton
Chargaff, Erwin
Clarke, H. T.
Cori, Carl F.
Craig, L. C.
Doisy, E. A.
Doty, Paul
Doudoroff, Michael
du Vigneaud, V.
Edsall, J. T.
Fruton, J. S.
Green, David E.
Gunsalus, I. C.
Handler, Philip
Hassid, W. Z.
Hofmann, Klaus
Horecker, B. L.
Kabat, E. A.
Kalckar, H. M.
Kamen, Martin D.
Kendall, E. C.
Kennedy, E. P.
Khorana, H. G.
King, C. G.
Kornberg, A.
Koshland, D. E., Jr.
Lardy, Henry
Lederberg, Joshua
Lehninger, A. L.
Link, K. P.
Lipmann, Fritz
Lowry, Oliver H.
Maynard, L. A.
McCollum, E. V.
McElroy, W. D.
Moore, Stanford
Nachmansohn, David
Neurath, Hans
Northrop, J. H.
Ochoa, Severo
Oncley, J. L.
Racker, Efraim
Rittenberg, David
Rose, W. C.
Shemin, David
Smith, Emil L.
Snell, E. E.
Spiegelman, Sol
Stanley, W. M.
Stein, W. H.
Sutherland, E. W., Jr.
Szent-Györgyi, A.
Tatum, E. L.
Van Slyke, D. D.
Vickery, H. B.
Wald, George
Watson, J. D.
Williams, R. C.
Williams, R. J.
Wintersteiner, O.
Wolfrom, M. L.
Wood, H. G.
Woolley, D. W.
Yanofsky, Charles

Foreign Associates
Katchalski, Ephraim
Krebs, Sir Hans A.
Leloir, Luis F.
Lynen, Feodor
Theorell, Hugo
Tiselius, Arne W. K.

Applied Biology—5 members
Knipling, E. F., *chairman* (1967)
*Debye, Peter
Harrar, J. G.
Mangelsdorf, P. C.
Sears, Ernest R.

John F. Kennedy at centennial celebration of the Academy's founding, on 22 October 1963. With him are (left to right) Kenneth Raper, University of Wisconsin; Harrison Brown, Academy foreign secretary; the Very Reverend T. M. Hesburgh, Notre Dame; Detlev Bronk, immediate past president of NAS; Frederick Seitz, NAS president; Victor Paz Estenssoro, president of Bolivia; Jerome Wiesner, Kennedy's science adviser; and J. A. Stratton, M.I.T.

bership is deemed desirable by the Academy's 15-member governing Council. Nominations originate with a variety of small groups and committees, then pass through various screening bodies until, finally, lists of the surviving candidates, accompanied by a detailed record of their research achievements, are submitted to the entire membership, about two-thirds of whom bother to vote. (An Academy member who now occupies a high government position says that when he headed a university department he would eagerly look forward to Academy elections. "The biographical information accompanying the nominations gives the best recruiting information you could ever hope for.")

The inevitable consequence of this electoral inbreeding is that the Academy tends to reproduce itself, with limited reference to relative intellectual value or numbers of practitioners among the various fields of scientific inquiry. Since the Academy was brought into existence by a clique dominated by physicists, it is not surprising to find that, throughout its history, physicists have always held membership in numbers highly disproportionate to their overall ranks—though, through at least most of this century, perhaps not disproportionate to the place of physics in terms of its contributions to scientific knowledge. For example, the National Register of Scientific and Technical Personnel reported 11,850 doctorate holders in physics and 23,915 in chemistry in 1966. The physics section of the Academy numbers 102 members; the chemistry section, 108. The register lists 12,545 Ph.D.'s in psychology, but psychology has been granted no more than a beachhead; the section numbers 27 members. On the other hand, anthropology, for which the register lists 830 Ph.D.'s in the entire country, has an Academy section of 18 members. Why so enormous a disparity between the representation for psychology and anthropology? Who knows?

However, the Academy, in its role of identifying and honoring scientific creativity, is neither required to be nor claims to be a representative assembly of science, even if this were possible. But once it is recognized that legally it is a private organization and can do as it pleases in terms of membership, it is also necessary to note that its traditions and internal structure impose certain biases on the objective of electing members "in recognition of distinguished contributions to scientific and technological research."

While disciplinary boundaries have been shifting or dissolving in many of the substantive proceedings of science, the Academy, with a few exceptions, sticks to the traditional designations in its 15 disciplinary sections. Some flexibility results from the fact that members choose a section upon coming into the Academy, rather than being elected into a section. But the maintenance of the traditional categories tends to impede recognition of the disciplinary amalgamation that has characterized so much recent progress in science.

Though a couple of hundred Academy members behave as though they are barely aware of their membership in the institution that sits at the honorary apex of American science, there are many who take it very seriously—perhaps never more seriously than at election time, which occasionally evokes a politicing that is intense and even a touch Machiavellian. A Harvard professor confides that his election, long ago at a relatively young age, was due to the fact that a Caltech man in the same field had made it very young. "The Harvard people said that if Caltech can get its youngster elected ahead of time, so can we." During a recent election time, an Academy staff man recalls, he overheard one academician

saying to another, "Damn it, he's a good man, and he deserves to be in, but he's just too abrasive."

One of the highest officers of the Academy confidentially states that "creativity in certain narrow fields is rewarded more than in others. High-energy physics," he contends, "is over-represented, while, for example, inorganic chemists don't get elected in proper numbers." He also contended that "creative scientists from smaller places don't have much of a chance." An analysis of Academy membership seems to bear out at least this last observation. Out of 740 members, 407 reside in California, New York, and Massachusetts, and most of these are employed at major universities. Eighty-five percent of the membership is from nine states: the three cited above, plus the Maryland-District of Columbia region, Illinois, New Jersey, Wisconsin, Connecticut, and Pennsylvania. At last count, 12 states had no Academy members at all: South Carolina, West Virginia, Kentucky, Mississippi, Arkansas, North Dakota, South Dakota, Nebraska, Oklahoma, Wyoming, Idaho, and Alaska.

Furthermore, while the volume and quality of basic research in industrial and government laboratories have markedly expanded since World War II, the Academy still stands as a bastion of academic basic research. And its election criterion of original contributions to scientific knowledge—which was established by Joseph Henry—has probably played no small part in the lesser prestige that this country accords technology and engineering. Of the current 740 members, 592 are affiliated with universities, 46 are with government laboratories, 32 are in industry, and 43 are with various other types of research institutions. The rest are otherwise occupied or retired.

Of the 740 members, 423 are employed by 14 universities: University of California, 86 (43 of them at Berkeley); Harvard, 62; Rockefeller University, 34; Massachusetts Institute of Technology, 32; Stanford, 29; Wisconsin, 28; Caltech, 27; Columbia, 27; Chicago, 23; Princeton, 22; Hopkins, 16; Yale, 15; Illinois (Champaign and Chicago), 13; and Cornell, 9.

There is no doubt, however, that, once allowance is made for the tendency to favor the old over the young, and the coastal academic enclaves over science in the interior, members of the Academy are drawn from the cream of

NEWS IN BRIEF

• **ENGINEERING GRADUATE GAP:** According to a recent survey by the Engineering Manpower Commission of the Engineers Joint Council, between 1965 and 1976 employers will demand 830,000 new college graduates in engineering, but only 500,000 will be available. The projected national growth in engineering employment is 33 percent from 1965 to 1976, with employment in education topping all other engineering fields with a predicted growth of 66 percent during that period. Other high-growth industries for engineers are aerospace, construction, metals, chemicals, and electronics. Employment of engineering technicians is expected to increase by 36 percent during the decade, the survey indicated. Factors contributing to the shortage, the report suggested, are: declining popularity of engineering among freshmen; lengthening of the average curriculum from 4 to 5 years; increasing number of graduates who continue on to advanced degrees, and loss of 10 to 15 percent of engineering graduates to other fields. The report, *Demand for Engineers and Technicians—1966,* is available for $4 from the Engineers Joint Council, Department P, 345 East 47 St., New York.

• **GAS CENTRIFUGE POLICY:** In line with the government's nonproliferation policy, the Atomic Energy Commission has announced that it is terminating all authorizations for privately sponsored work on the gas centrifuge process for separation of isotopes. National security interests would be best served, the Commission said, if the private work were discontinued. The process lends itself to small plants, a Commission spokesman said, and therefore may have a nuclear weapons proliferation potential. Further, more firms had expressed an interest in working in the field, which would have expanded the numbers having knowledge of the process. The decision affects two joint projects—General Electric–Allied Chemical and W. R. Grace & Co.–Electro-Nucleonics, Inc. The commission will review the programs of the firms to determine if they could make a substantial contribution to the Commission's own classified program under direct contractual arrangements. If, in the future, it is in the national interest to allow private participation in gas centrifuge development, the Commission said, it will then make available, subject to security regulations, economic and other required information for investment decisions by industry.

• **CONGRESSIONAL SCIENCE COMMITTEE:** Establishment of a Joint Congressional Committee on Science and Technology to promote efficient management and coordination has been proposed in a bill (S. 1305) introduced in the Senate recently by Senator Gordon Allott (R–Colo.). The goals of the committee, which would have no legislative power, would be to review all federal scientific and technical programs and to make recommendations to the appropriate legislative committees, to Congress, and to executive departments and agencies. It would also serve as a center for information on all governmental and nongovernmental programs and promote cooperation between the two. Further it would seek a means for the distribution of federal research grants and contracts in a geographically fair manner without endangering the quality of the research. In explaining the need for the committee, Allott said, despite the existence of the Office of Science and Techonolgy, the President's Science Advisory Committee, and the Federal Council for Science and Technology, there has been no guarantee of efficient management of federal programs or effective intergovernmental coordination. The bill was referred to the Commission on Labor and Public Welfare where hearings have not yet been scheduled.

• **GROUND TRANSPORTATION:** A report on research and development of high-speed ground transportation has been issued by a special panel appointed last year by the Commerce Technical Advisory Board to study the subject. The report contains recommendations to the Department of Transportation for both immediate and long-range research and development which may lead to practical high speed ground transportation systems. Copies may be obtained from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. Order No. PB173911.

A Baedeker for Scientists

The London branch of the Office of Naval Research recently issued a supplement to its regular publication, *European Science Notes*, offering a variety of travel tips to American scientists planning to visit Europe. In addition to providing details on such matters as car rentals, security clearances, bank holidays, and the use of credit cards, the supplement offers some pertinent (and, as it says, not altogether tongue-in-cheek) remarks on the habits of American scientific travelers and their reception by their European colleagues. An excerpt from the supplement reads:

> At the risk of over-generalizing, it might be safe to say that there is a correlation between the specific European laboratories visited by Americans and the tourist attractions of the area in which they are located. For example, laboratories in Stockholm, metropolitan and historic sections of England, Paris, and Rome appear to have far more appeal and "importance" than do equally sophisticated institutes in relatively isolated and uninteresting areas. Without question, the laboratories and work in many of the metropolitan centers is superb and well worth a visit. At the same time, there is a surprising frequency of visits to laboratories where the work holds little relevance to the visitor's own professional interest and expertise.

The ONR recognizes that face-to-face encounters among scientists are increasingly important. But at the same time it points out that the proliferation of American visitors has been by no means an unmixed blessing for their hosts. One laboratory, according to ONR, has developed an unusual way of dealing with the problem: it has devised a scale for rating the mutual benefit of the proposed visit. The ONR says:

> Members of the staff consider the visitor's background and his work and determine the nature of the reception he shall receive. The only thing not considered on this scale is the "importance" or professional position of the visitor. The department chairman from a U.S. university or director of a government laboratory or other dignitary whose work is obviously unrelated to the laboratory in question will be given a 15-minute tour by an assistant. In this way the staff of the laboratory have made it possible for the visitor to carry out his itinerary. At the same time, neither the visitor nor the laboratory staff have devoted time to a discussion which is not truly of interest. Scientists whose work is directly related to the laboratory, so that considerable interaction of mutual benefit is anticipated, are received with open arms.

Not all laboratories have equally fixed channels. According to ONR, other laboratories sometimes display excessive hospitality that is not particularly "considerate of the visitors and their own time." "One wonders," the report remarks, whether these gracious laboratory directors ". . . have the same table reserved each day for lunch at the most charming or 'typical' restaurant in town."

The ONR supplement advises the making—and keeping—of appointments. "Not only do Europeans . . . tend to be more formal with regard to laboratory visits than do their American colleagues," it points out, "but their staffs are usually much smaller than those in the U.S. Thus, foreign visitors actually can and often do constitute a significant source of disruption to ongoing research efforts."

The report notes that "European scientists have a surprisingly comprehensive knowledge of the U.S. literature in their discipline," and that "the individual whose work they know usually is well received." On the other hand, "A person unknown to the laboratory may have a rather strained and short visit with a senior scientist and spend most of his time with graduate students or assistants. Quite possibly he will not be received at all—particularly during the summer months. This is not a lack of courtesy or a reflection on the character of science in the country involved," ONR concludes; "It is a measure of self-protection."

—E.L.

their disciplines. The limitation on the annual intake of members—it has been raised in recent years to the present 45—means that not all the best are in, but, outside of a few appointments that invite curiosity—an Academy official explains that "occasionally, faithful service, rather than scientific creativity, is the basis for election"—there is no quibbling about the overall scientific quality of the Academy's membership. The academicians comprise an elite assemblage of scientific creativity. One means of assessing their value is to speculate on where contemporary science would be if it lacked the contributions that brought their election to the Academy. A reasonable guess is that the state of knowledge in many fields would be set back at least several decades.

In observing the contemporary Academy from certain perspectives, it could be concluded that there is durability to Hale's assessment and to other scoffing views of the institution. (In 1944, a high Navy officer told a congressional committee that the Academy "is a horse and buggy when there are already automobiles. . . . They [the Academy members] have been perfectly satisfied to sit there, all wrapped up in their diplomas and their togas and their great mass of knowledge and say, 'We know all the answers, but if you do not ask us we are not going to tell you; it is none of our business.' ") One government science adviser, himself an Academy member, fondly refers to it as "science's League of Women Voters." The Academy's annual April meeting and other periodic get-togethers are scholarly, tastefully ceremonial, and usually quite placid. When the members assemble, there is a chance to meet with old colleagues and read and discuss papers. On these occasions the Academy awards, to members and nonmembers, an assortment of medals and prizes that it administers. And the members observe one minute of silence for those who have died since the last assemblage.

Perish and Publish

In the gloomy Hall of the Academy's marbled Washington headquarters, such minutes seem to possess prodigious duration. This observance is followed by one of the few tangible perquisites of Academy membership—the composition by a fellow academician of an obituary that is usually so

sentimental and laudatory as to be of virtually no historical value. Collections of these are periodically published, producing the observation that the Academy exists for the members to write each other's obituaries.

Among the other perquisites of election is the unquestioned right to publish in the Academy's monthly journal, *Proceedings of the National Academy of Sciences* (PNAS), which is one of the very few unrefereed scientific publications of scholarly distinction. PNAS also automatically accepts papers of non-Academy authorship that are submitted by an Academy member. The only limitation is that no paper may exceed eight printed pages. This rule, rarely waived, has evolved from the general maximum of six pages which accompanied PNAS' birth in 1914. As for the absence of refereeing, a PNAS staff member reverently inquires, "Where would you find people superior to the members of the Academy?" Substantive editing, it is explained, is generally limited to "matters of taste," and no changes are made without the author's permission. For example, an author who wrote that a particular hypothesis "is not well founded" acceded to a request to have the sentence read, "does not appear to be well founded." Of PNAS, it may be said that when it is good, it is very good, and when it is bad it is often ridiculous. But, refereed or unrefereed, that description can probably be applied to all publications.

Such, then, is the ceremonial, scholarly, often-scoffed-at aspect of the Academy. Viewed as such, it would not even qualify for the commendation that Addison, 2½ centuries ago, bestowed upon the founders of the Royal Society. By establishing that learned institution, he wrote, they had "turned many of the greatest geniuses of that age to the disquisitions of natural knowledge, who, if they had engaged in politics with the same parts and applications might have set their country aflame."

But then, we have so far surveyed only the most readily visible portions of the Academy, the portions which, in fact, are significant mainly because of the prestige and power that they infuse into other activities. For, organically linked to the ceremonial, scholarly Academy is an incredibly vast network of activity that consumes the services, in Washington, of 700 full-time employees, 4000 unpaid consultants, and a budget of $19 million a year.

We began with the question, What is the National Academy? For the American scientific community, it is, in part, the Established Church, the House of Lords, the Supreme Court, and headquarters of the politics of science. It has made itself the community's duly delegated emissary to the U.S. Congress and the Executive Branch of Government at a time when both are increasingly involved with scientific and technical issues. There are other emissaries, of course, and the two governmental branches can pick and choose the advisers they invite and heed. But the Academy is ever-growing in importance among these advisers. The Academy is also vigorously engaged in the role of being the Foreign Ministry of American science. Its Office of the Foreign Secretary, with a powerful staff, including several members who came directly from the Central Intelligence Agency, is deeply involved in promoting international scientific activities and close relationships with the scientific communities of other nations.

It was the Academy that spawned Universities Research Associates, a nationwide consortium of universities that has designs of becoming the great holding company of American "big science."

It was the Academy that deftly defused the biggest scientific-pork-barrel issue in American history—selection of a site for the 200-Bev accelerator.

Through a series of interlocking appointments and longstanding relationships, the Academy serves as a little-known but powerful link between the nation's defense establishment and the civilian scientific community. Its president, Frederick Seitz, not only chairs the Defense Department's highest scientific advisory body, the Defense Science Board, but also sits as a member of the White House's highest science advisory board, the President's Science Advisory Committee.

The Academy, in short, is today a remarkable organization. But, though its roots go back to 1863, the contemporary Academy actually was born in 1950 with a tumultuous and never publicly revealed episode involving some of the most eminent figures of American science. Along with other matters, this will be discussed in another article.—D. S. GREENBERG

Courses

Information on courses and summer institutes will be listed in forthcoming issues of Science *as part of "Calendar of Events," a section that will follow Meetings.*

DNA-RNA Hybridization. International Laboratory of Genetics and Biophysics, Naples, Italy, 5–24 June. Limited to 16 postgraduate students in mathematics, physics, chemistry, and biology. Fellowships covering travel and living expenses available. Deadline, 30 April. (The Laboratory, Casella Postale 3061, Napoli, Italy)

Histochemistry. University of British Columbia, 12–21 June. Intended for physicians and graduate students. Tuition, $150. Deadline: *1 May.* (Department of Continuing Medical Education, University of British Columbia, Vancouver 8, B.C., Canada)

Histochemistry. Vanderbilt University, 30 July–19 August. For zoology teachers in accredited colleges and universities. Living and travel expenses for 20 participants provided by NSF. No tuition. Deadline: *1 May.* (Burton J. Bogitsh, Box 1733, Station B, Vanderbilt University, Nashville, Tenn. 37203)

Recent Deaths

Edward A. Avery, 62; museum specialist, department of botany, Smithsonian Institution; 24 February.

Jacob Fong, 53; professor of medical microbiology and immunology, School of Public Health, University of California at Berkeley; 28 February.

Max Frederick Meyer, 93; professor emeritus of experimental psychology at the University of Missouri; 14 March.

Albert J. Paquin, 46; professor and chairman of urology at the University of Virginia; 13 March.

Vladimir N. Sukachev, 87; director of the Laboratory of Biogeocenology, U.S.S.R. Academy of Sciences; 12 February.

Vittorio Tonolli, 53; director of the Istituto Italiano di Idrobiologia, Pallanza; 13 March.

Jane R. Wilhelmi, 56; professor of biochemistry, Emory University; 12 March.

Erratum: In the article of 31 March on antiballistic missile defense, the last sentence of paragraph 2, p. 1654, should read: "Manpower for producing . . . but the outer limit would be about 200,000, or half the number of contractor employees and civil servants working for NASA at the peak of the Apollo program."