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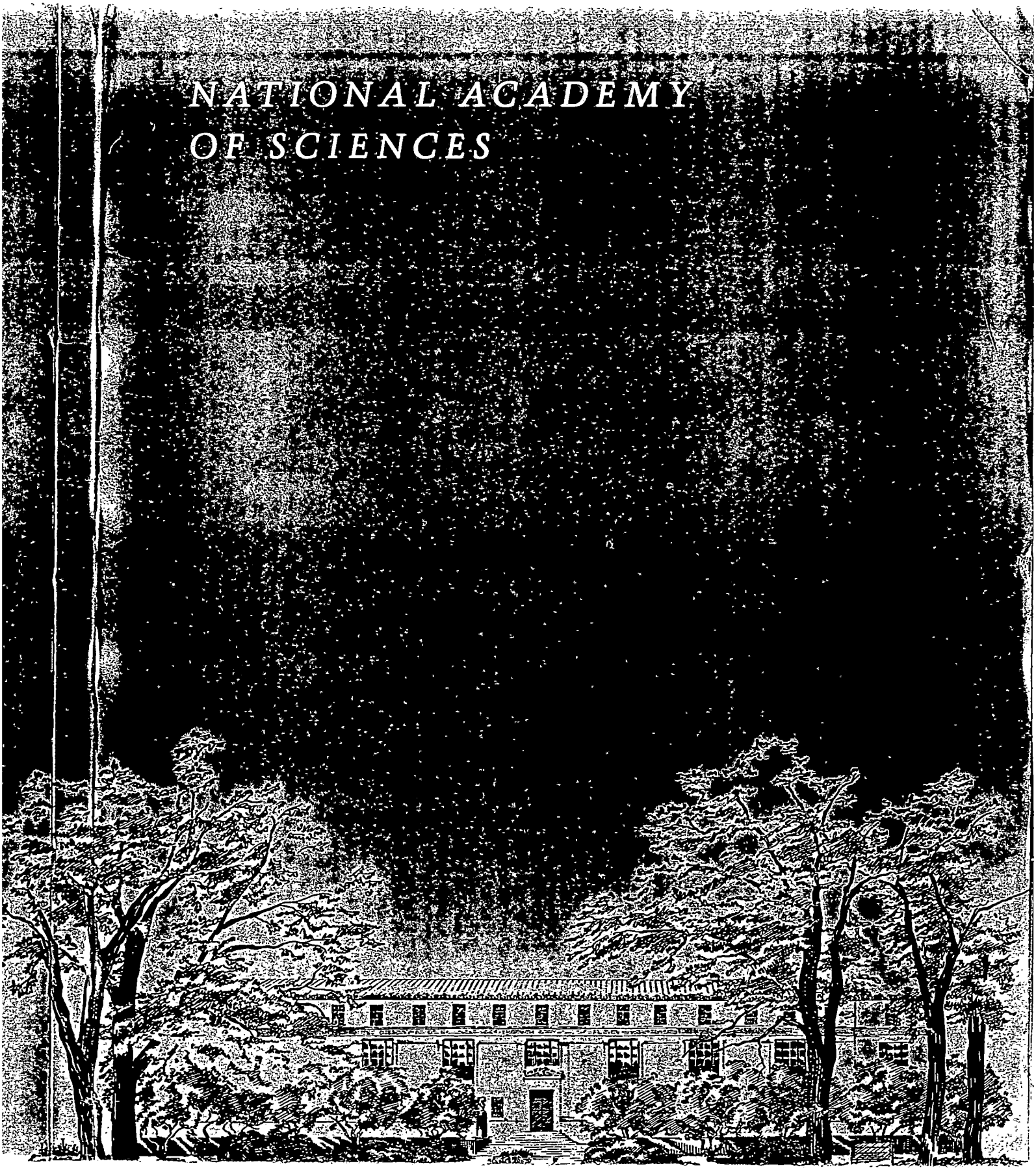
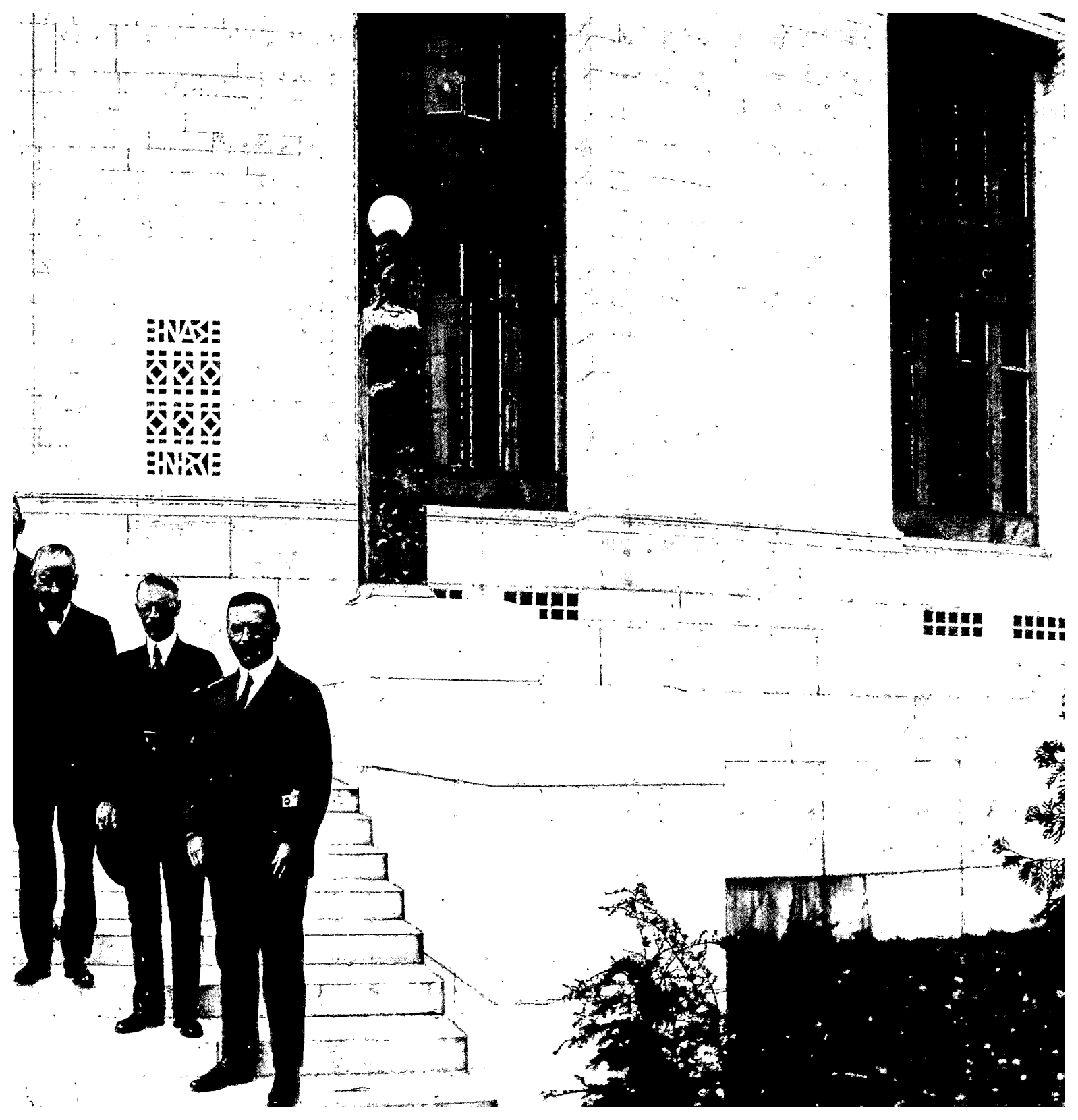
NATIONAL ACADEMY OF SCIENCES

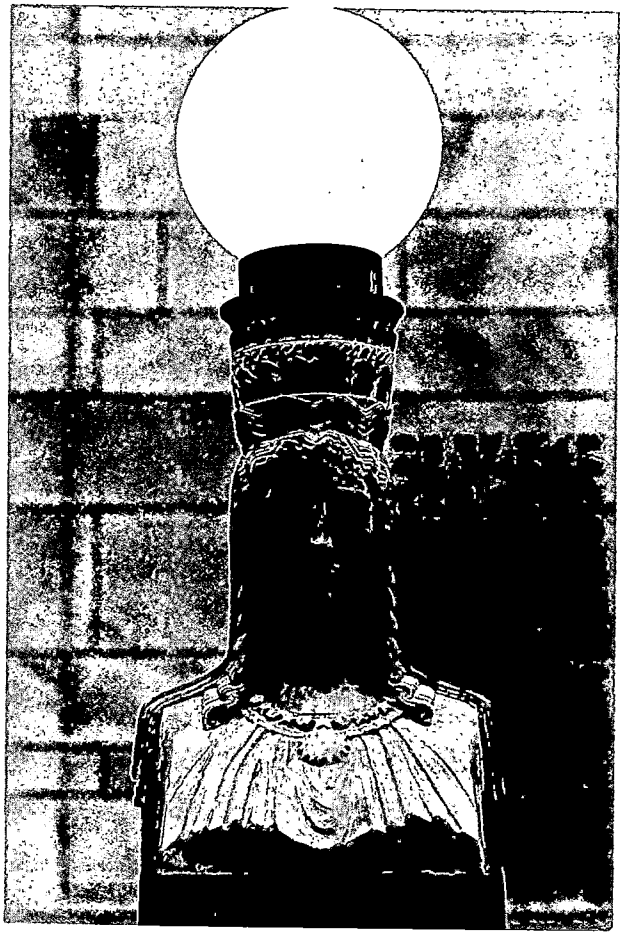


NATIONAL ACADEMY OF SCIENCES
NATIONAL RESEARCH COUNCIL

The cover: Members of the National Academy of Sciences at the 61st Annual Meeting, April 27-29, 1925. George Ellery Hale appears to the left of the middle fold, holding a sheaf of papers. Gano Dunn is to the right of the middle fold, in the middle row, immediately below the herm lamp.

Title page: Herm-footed lamp; front terrace of Academy. It was Dunn, speaking at the dedication of the building on April 28, 1924, who called the Academy building a temple dedicated to science.





NATIONAL ACADEMY OF SCIENCES
NATIONAL RESEARCH COUNCIL

. . . a temple of Science

INTRODUCTION

"A national focus of science and research. . ." Thus George Ellery Hale, distinguished scientist and Foreign Secretary of the National Academy of Sciences, described his hopes for the Academy. Hale was the animating spirit behind the drive to build a home for the Academy. He propelled his vision toward reality, as earlier he had spurred the creation of the National Research Council, through which the Academy provided scientific advice to the government.

The National Academy of Sciences was chartered by Congress in 1863 as an honorific society. For the first half century of its history, the Academy conducted its activities in borrowed quarters. During World War I, the federal government markedly increased its reliance on the Academy for advice on matters scientific and technical. In 1916, with the founding of the Academy's affiliate, the National Research Council, the need for a permanent home became urgent.

Hale, whose remarkable energies equalled his stunning intellect, spearheaded a fund-raising campaign for the building; engaged Bertram Grosvenor Goodhue, a leading American architect; agonized over myriad details during construction of the building; and even contributed to the motto destined to be inscribed in the dome of the Academy's Great Hall: *To science, pilot of industry, conqueror of disease, multiplier of the harvest, explorer of the universe, revealer of nature's laws, eternal guide to truth.*

In 1924, Goodhue's neoclassic building on the mall in Washington, D.C., was dedicated before an assemblage of the leading scientific and political figures of the day. President Calvin Coolidge, delivering the principal address, declared that the "magnificent building now being dedicated to science predicts a new day in scientific research."

Certainly, acquiring a headquarters in the nation's capital enabled the Academy, through the National Research Council, to play an ever more significant role in the nation's scientific life. The institution has succeeded in enlisting the finest American scientific minds of the century in fulfilling its mandate to advise the government on science and technology policy. The Academy complex—National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council—is unique among the world's science academies in the broad scope of services it renders to our nation's Executive Branch and to the Congress. In addition, Academy studies and reports are influential in the private sector and in the international sphere as well.

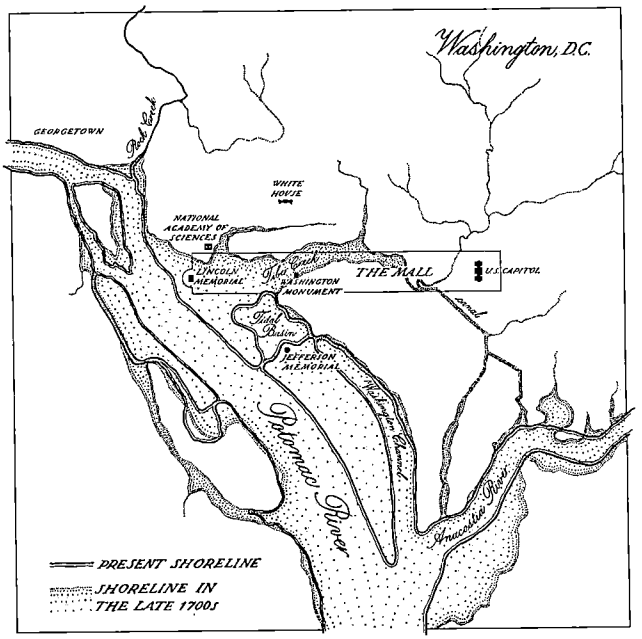
We warmly welcome visitors to the Academy building. Our members and staff hope that the visitor not only will derive interest and pleasure from learning about this handsome structure, but also will be stimulated to become better acquainted with the important work conducted in this "temple of science."

FRANK PRESS
President
National Academy of Sciences

Before the building was the site; and before the site, a canal, an estuary, stream, tidal flats, marshes. In the 1790s, when Pierre L'Enfant was drafting his grand scheme for the city of Washington—and for a century thereafter—the Potomac River wandered unrestricted along Foggy Bottom. It swung widely around the high land now known as 23rd and C Streets, N.W., a block west of the Academy, and flowed east to the foot of the White House grounds, where at one time it provided easy access for President John Quincy Adams, an enthusiastic bather.

In the 1850s, a person standing at the site of the Academy's main entrance could enjoy a pleasant vista across marshes and flats to the Potomac, almost as far downriver as Alexandria, Virginia. Sailing vessels might be seen in the distance, tacking upstream toward the docks on the Anacostia River, where the presence of deep water close to shore supported the vision of Washington as a major inland river port as well as capital city. In the immediate foreground, literally crossing the Academy's present front lawn, humbler shipping might be observed—perhaps a slow-moving barge traversing the Chesapeake and Ohio Canal. In those days, the canal curved down from Georgetown paralleling the bend of the river, passing what is now Constitution Avenue, as far as 17th Street, N.W., where a small tollhouse remains to this day.

In 1863, when an act of Congress incorporated the National Academy of Sciences, marshes and tidal waters rimmed the rise of ground where the half-finished Washington Monument stood. Nearby, Joseph Henry presided over the Smithsonian Institution as its first secretary. A charter member of the National Academy of Sciences, Henry invited the fledgling scientific group to shelter under his institutional roof, an



arrangement that lasted for more than 50 years. As an occupant of L'Enfant's projected Mall, Henry prodded reluctant federal administrations to fill in the canals, perfect the roads, and drain the marshes. Although progress was slow, he was instrumental in the unfolding plan that in time produced the Mall as we know it, including the land on which the permanent home of the National Academy would rise.

A view of Foggy Bottom, Georgetown, and the Potomac River, taken from the top of the Washington Monument in 1885. The Academy site is just above the large pool of water in the left of the photograph.

RECOGNITION OF NEED

During the more than 50 years that the Academy resided at the Smithsonian, quite a few members looked forward to the time when the Academy would have its own building, "the home of science in America." At the close of World War I, necessity spurred this hope. The need for enlarged quarters to house the Academy and the newly created National Research Council (NRC) became urgent. The NRC, formed in 1916 as an entity of the Academy, broadened the Academy's role as adviser to the government and in the war-preparedness effort. It provided a framework within which governmental, educational, industrial, and other research organizations could cooperate to attack scientific problems.

Central to the creation of the NRC were George Ellery Hale, a noted solar physicist and leading spirit of the Academy and Robert A. Millikan, distinguished physicist and educational leader. Largely through their efforts, on May 11, 1918, President Woodrow Wilson signed an Executive Order, requesting the National Academy of Sciences "to perpetuate the National Research Council. . . ."[1]

Hale became chairman of an Academy building committee, succeeded later by the engineer Gano Dunn. In 1919, the Carnegie Corporation of New York agreed to contribute funds for construction of a building, plus an endowment, if the Academy could secure a building site. Thus encouraged, the Academy raised money for purchase of a tract of land near the new Lincoln Memorial in Potomac Park. The site, costing about $185,000 and measuring 531 by 422 feet, was bounded on the north by C Street, by 21st and 22nd Streets on the east and west, and cutting diagonally across its southern boundary, by Upper Water Street. Subsequently, an act of Congress closed off Upper Water Street, and the building site was squared to B Street, renamed Constitution Avenue in 1931.

The Carnegie Corporation set aside $5,000,000 for the Academy and NRC endowment, with $1,350,000 thereof available for construction of a building. The ultimate cost of the building, met by transfers from the endowment, was $1,450,000. Ground was broken the first week of July 1922; the cornerstone was laid on October 30. Construction was completed just in time for the building's dedication at the Academy's annual meeting, on April 28, 1924.

THE ARCHITECT

John Ruskin's criteria for architects, if rigidly enforced, might decimate the profession. "No person who is not a great sculptor or painter can be an architect," Ruskin wrote. "If he is not a sculptor or painter, he can only be a builder."

Bertram Grosvenor Goodhue (1869-1924), architect of the Academy building, recognized these criteria. Writing to his friend, the architect Paul Cret, Goodhue said:

> I should like to be merely one of the three people to produce a building, i.e. architect, painter, sculptor . . . I should like to do the plan and the massing of the building; then. . . turn the ornament (whether sculpture or not makes no difference) over to a perfectly qualified sculptor, and the color and surface direction (mural pictures or not as the case may be) to an equally qualified painter. . . .

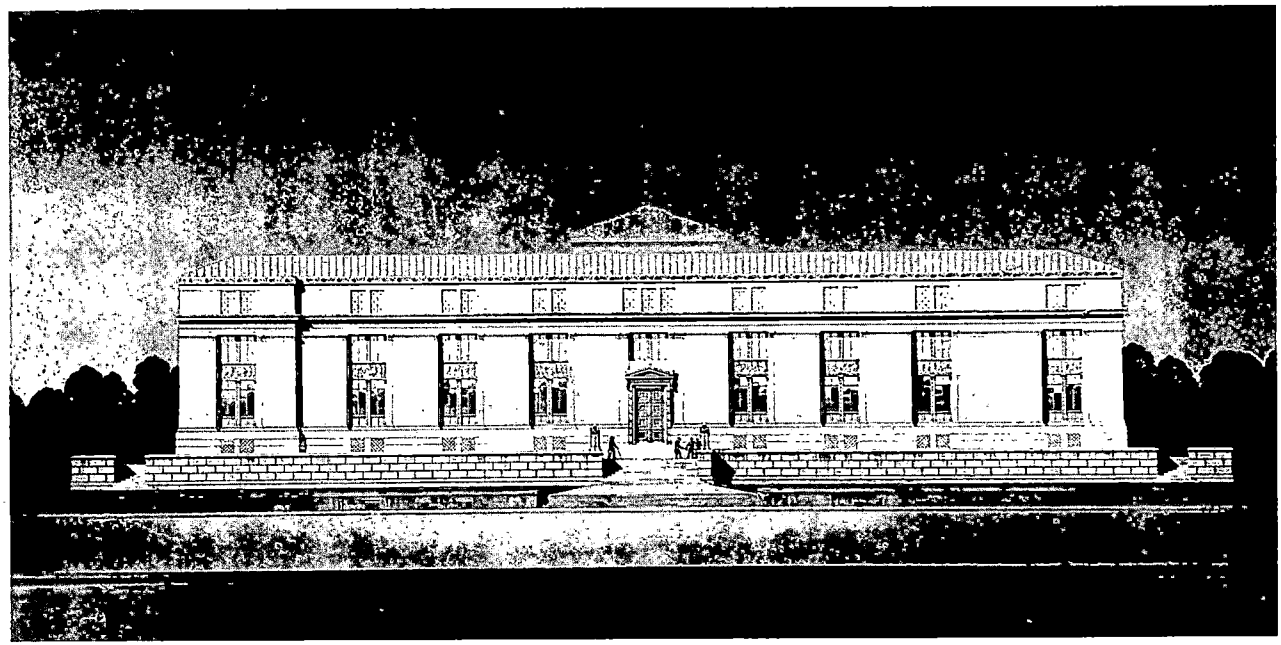
This division of artistic labor was followed in the Academy building, which is ornamented by the subtle and beautiful sculpture of Lee Lawrie, with whom Goodhue had worked on numerous projects, and the paintings of Albert Herter and muralist Hildreth Meiere.

Goodhue's design of the Academy building was his one great venture into the field of classical architecture, as he preferred freer styles, particularly Gothic and Spanish-Colonial.[2] Discussions with him took place over a period of a few years, while the Academy went about the business of acquiring a site. Goodhue was not overly enthusiastic about the final choice, preferring a hilly location on 16th Street that the Academy at one time had considered. Of the land in Foggy Bottom he wrote, "Though bare and uninteresting at present, this is capable of beautiful and effective treatment, though

Medallion, bronze front doors.

without distinction in itself beyond the fact that it lies within a thousand feet or so of the Lincoln Memorial." Richard Oliver, Goodhue's biographer, called the choice of the site "brilliant for the Academy and its future. . . (insuring) that the Academy would share symbolically and physically the imperial composition of the city of Washington."

Proximity to the Lincoln Memorial made use of a classical style inevitable for the Academy building, and for a time Goodhue urged the Building Committee to find an architect who did not share his anticlassical prejudices. George Ellery Hale persisted, however. He had engaged Goodhue to design the campus of the California Institute of Technology, of which Hale was

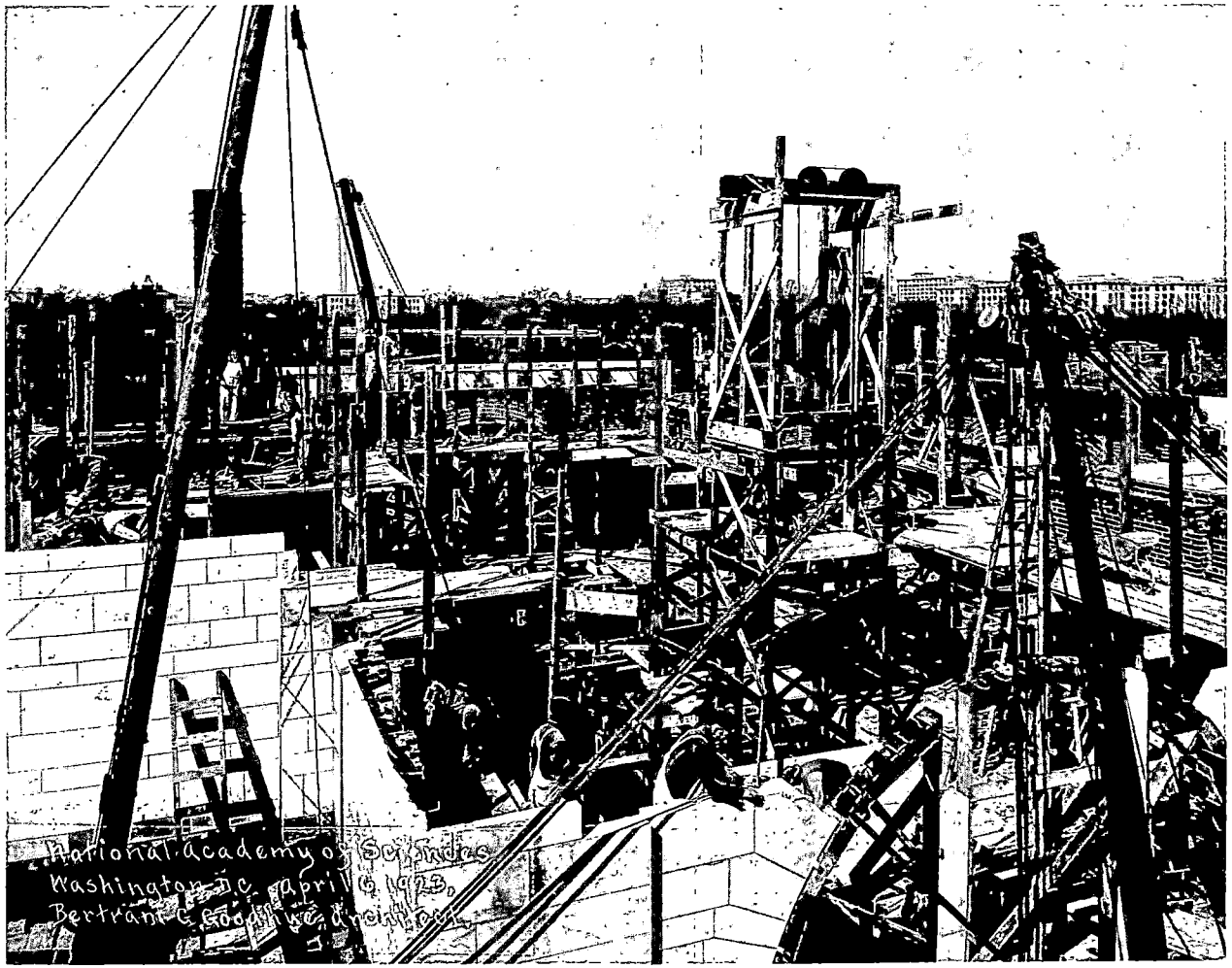


president, and he had come to value the architect's work highly. Hale wrote,

> I felt that if his interest in the problem could once be aroused, a distinct contribution to architecture would almost certainly result. Yielding at last, and discarding from the outset the customary long row of columns "supporting nothing but the cornice," he set himself the task of developing a facade of extreme simplicity and refinement, relieved only by Lawrie's superb bronzes and by sparse and delicate stone cutting.

Goodhue saw his task as "producing a modern and scientific building, built with modern and scientific materials, by modern and scientific methods for a modern and scientific set of clients." Later, Hale was to speak of how he and Goodhue sought to create a monumental but unpretentious building that would not detract from the Lincoln Memorial.

The Academy proved to be the last of his works Goodhue saw through to completion, as he died in 1924, only a few days before the Academy building was to be dedicated. He was 55 years old—an American Institute of Architects Gold Medalist—just coming of age in an architectural career of outstanding achievement. The rank of the Academy in the catalogue of Goodhue's work may be judged by its inclusion among the bas relief images of his greatest buildings carved on his tomb in the Church of the Intercession, New York City.[3]



Construction of the building, April 1923, facing northeast; the Great Hall in the foreground.

Opposite: Architect's rendering of proposed facade. Goodhue retained the basic design, modifying window treatment and other details.

View facing south from C Street, 1924, with Lincoln Memorial in background.

THE SETTING

The Federal Commission of Fine Arts considered the northern side of B Street, N. W. (now Constitution Avenue), between 17th and 23rd Streets, N. W., as the "frame" for the Lincoln Memorial, which had been dedicated on Memorial Day, 1922. Designs for all buildings in that area were to respect this relationship. The concept of the Mall included the Capitol, representing all the people; the Washington Monument, a reminder of the fight for independence; the memorial to Lincoln, who preserved the Union; and the Arlington Memorial bridge to Virginia, symbolizing the resolve to maintain ties of brotherhood among all the states.

The first building constructed in the "frame," the Academy was conceived by Goodhue as "a central pavilion in a small but heavily wooded park." Between 1924 and 1937, Constitution Avenue acquired the Pan American Union Annex and buildings of the Public Health Service (now occupied by the Department of the Interior), the Federal Reserve Board, the Academy, and the American Pharmaceutical Association. Tour guides often identified the neighboring Public Health Service, Federal Reserve, and Academy as "Healthy, Wealthy, and Wise."

THE GROUNDS

Charles Downing Lay, a landscape architect, drew up the original plans for the Academy grounds in 1924. *Soulangeana* magnolias banked the building's front terrace, Lombardy poplars lined the entrance walk, and American hollies provided color in winter. The overall grounds plan has been considerably modified over the years; the hollies still thrive, along with some oaks, elms, and European beeches from Lay's plan, but newer *Soulangeana* have replaced the originals and English boxwood has long since been substituted for the poplars. Today, hundreds of varieties of trees, shrubs, and flowers adorn the grounds, and new plantings are frequently added.[4]

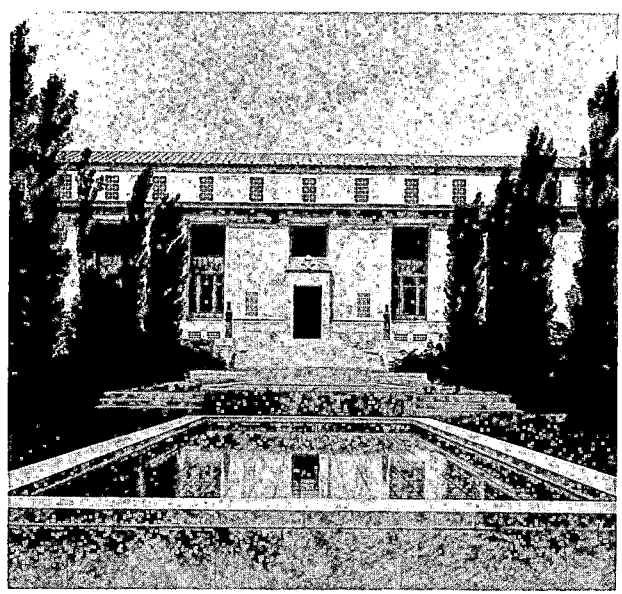
The topography of the land, inclining gradually upward from Constitution Avenue to C Street, suggested to Goodhue the placement of three rectangular reflecting pools in stepped areas on the walkway leading to the building's main entrance. Lined with eight-inch-square turquoise-hued tiles, the pools were stocked by the U. S. Bureau of Fisheries with successive generations of exotic fish. The cost of repairing the pools eventually proved prohibitive; in 1951 the tile was removed, and the areas were adapted for use as planters.

DESCRIPTION OF THE BUILDING

The general character of Goodhue's three-story building, viewed from the Constitution Avenue side, is in harmony with other Washington buildings constructed before prestressed concrete. Tending toward neoclassicism, the building, however, is free of the rows of columns usually associated with neoclassical architecture in the nation's capital. Goodhue himself thought it was impossible to date the style of the building and called it Alexandrian, referring to the period (300 B.C.-400 A.D.) when Greek literature and learning centered at ancient Alexandria, Egypt, site of the famed Library and Museum. Concerning this appellation, Gano Dunn wryly remarked, "Little enough of Alexandrian civilization and practically nothing at all of its architectural style is known, so perhaps it is safe to class the National Academy-Research Council building as Alexandrian." The interior decor is eclectic but verges toward the art deco mode popular when the building was designed.

From a structural standpoint, the building site was somewhat unfavorable, as it comprised an old stream bed, covered over years earlier when the tidal flats were filled in. The foundations required special precautions —74 concrete piers, 5 feet square, sunk to bedrock, 23 to 25 feet deep, support the girders holding up the walls. The girders bearing the terrace rest on 33 large concrete-filled steel tubes.

Many different-sized stone courses of ashlar masonry are arrayed to form the exterior walls. The courses are recessed to form a "battered" wall, where the masonry is not exactly plumb, but slightly set back, in this case about one-quarter of an inch per foot. Battering, a classical Greek practice, creates a sense of monumentality. This construction is easily seen in the west exterior wall of the auditorium (which follows the original building in style), where from bottom to top the marble blocks are increasingly indented from the edge of the brick sustaining wall.



Building facade showing original pools.

THE FACADE

A frontal view of the building readily reveals the architect's green and white color scheme. The luxuriant shrubbery of the semiformal garden counterpoints the facade's copper ornamentation. The broad, inviting terrace with its comfortable wrap-around bench, and the building walls, of warm-toned New York Dover marble, supply the white portion of the color scheme. Gleaming Vermont Imperial Danby was used for the wings and auditorium, because by the time they were added, deposits of New York Dover, with its high magnesium content, had been quarried to exhaustion during World War II. Magnesium-bearing crystals are

Copper cheneau with lynx and owl motif.

Snake motif at corner of cheneau.

still clearly visible to the visitor to the Academy's main terrace who takes a moment to search for them.

From roofline to terrace, beautiful decorative detail is exhibited on the building's 260-foot facade. The eaves are capped with a copper crest, or cheneau, composed of alternate deep relief figures of the owl and the lynx, symbolizing wisdom and alert observation, with at each corner a coiled serpent—another ancient symbol of wisdom and an object of veneration. A cornice runs the width of the building, and below it a frieze bears a quotation in Greek from Aristotle. Translated, it reads:

> The search for Truth is in one way hard and in another easy. For it is evident that no one can master it fully nor miss it wholly. But each adds a little to our knowledge of Nature, and from all the facts assembled there arises a certain grandeur.
>
> *Metaphysics* a. 1. 993a30-993b4

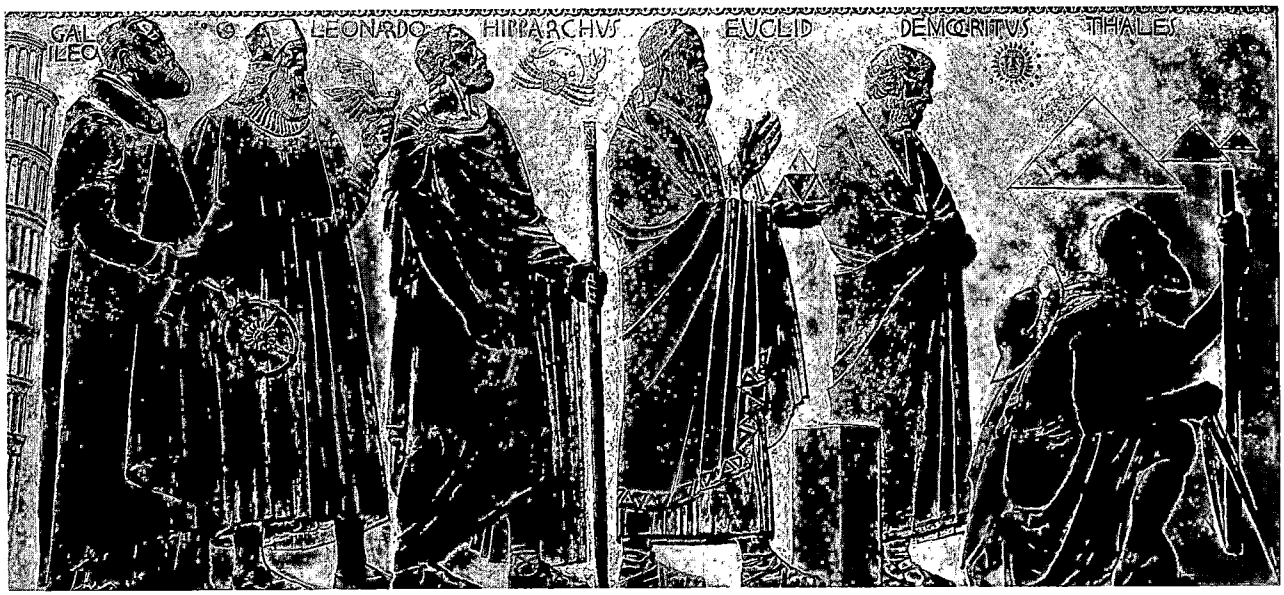
Below the frieze the architrave is supported somewhat untraditionally by pilasters carved in the face of the stones.

Flanking the building entrance is a pair of footed herm lamps in the form of female heads crowned by the symbols for fire, water, air, and earth.

THE WINDOW PANELS

Six large bronze panels fill the space between the first- and second-floor windows. The panels depict the progress of science from Greek to modern times by portraying a succession of the great founders, each accompanied by a symbol of his field of work. From the west end of the building the figures are: Galton, Gibbs, Von Helmholtz, Darwin, Lyell, Faraday; Von Humboldt, Dalton, Lamarck, Watt, Franklin, Huygens; Galileo, da Vinci, Hipparchus, Euclid, Democritus, Thales; Hippocrates, Aristotle, Archimedes, Copernicus, Vesalius, Harvey; Descartes, Newton, Linneaus, Lavoisier, Laplace, Cuvier, Gauss; Carnot, Bernard, Joule, Pasteur, Mendel, Maxwell. They are arranged roughly chronologically, alternating from side to side of the main entrance out to the ends of the building.

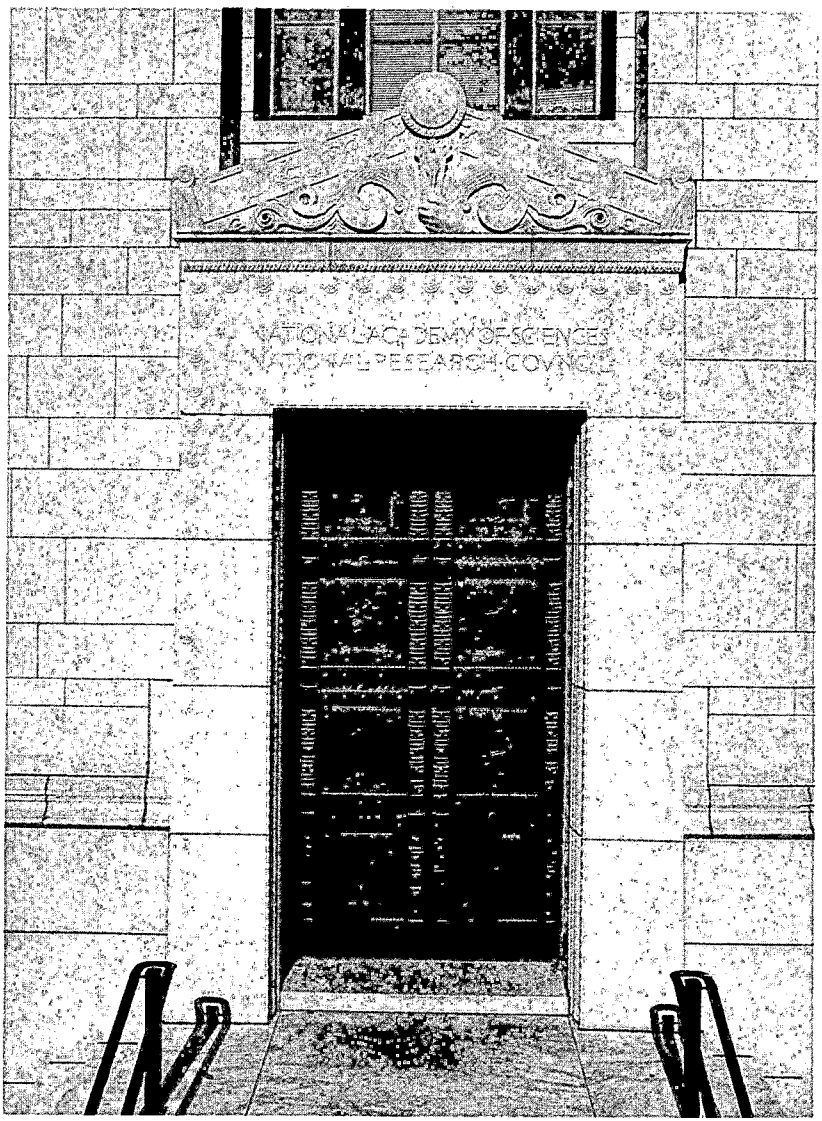
The cornerstone, at the southwest corner of the building, is identified by the initials of the Academy and the National Research Council. It harbors a box of mementos, including photographs of the act of incorporation of the Academy; a history of the Academy's first 50 years; Woodrow Wilson's executive order perpetuating the NRC; a miscellany of NAS and NRC publications; and a copy of *Scribner's* magazine for November 1922, with an article by George Ellery Hale entitled "A National Focus of Science and Research."



Bronze window panel; Constitution Avenue facade.

Bronze doors, marble cornice; Constitution Avenue facade.

Opposite: One of eight panels depicting famous men of science; front doors.



THE DOORS

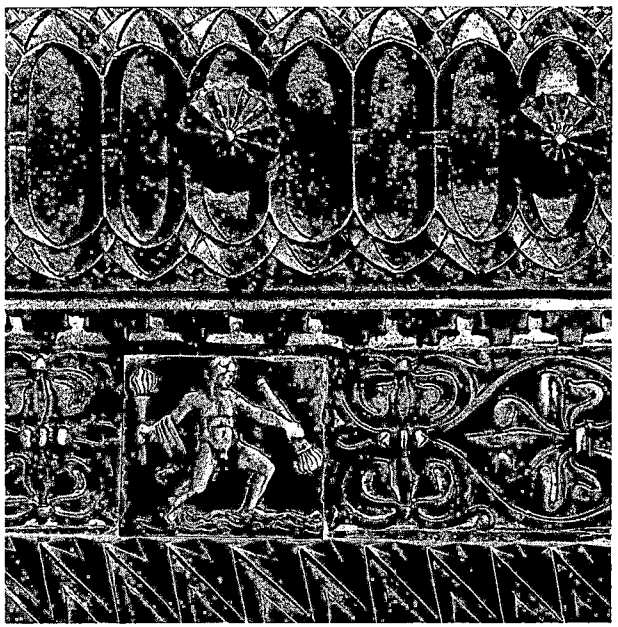
The building's central entrance on Constitution Avenue, focal point of the facade, adheres to the Greek style. Massive bronze sliding doors are Lee Lawrie's masterwork for the building.

Lawrie (1877-1963) has been called the dean of American architectural sculptors. Many of his finest works were done in collaboration with Goodhue, with whom he was philosophically attuned in believing that sculpture should be integral to the architecture of a building and not merely applied as decoration.[5] "The history, lore, and contemporary role of science" was the theme chosen by Goodhue for all the decorative elements found in the Academy building. Nowhere is this more apparent than in Lawrie's magnificently embossed doors with their eight panels in low relief, each depicting a major figure in science from Aristotle to Pasteur.

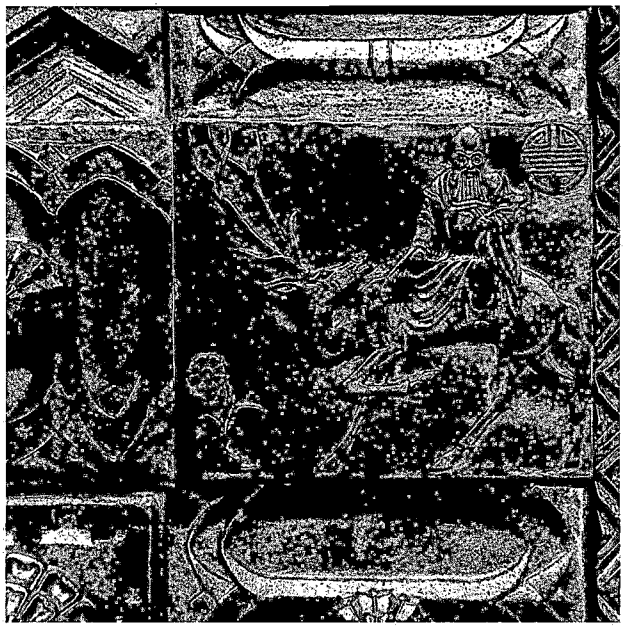
Constructed in the antique manner—of cast plates overlaid on a wooden core—from top to bottom (left to right when one faces the building) the doors show the philosopher Aristotle with his pupil Alexander the Great; another famous teacher, Euclid, the father of geometry; astronomer, mathematician, and physicist Galileo holding a telescope and pointing heavenward with Venice's St. Mark's Cathedral and the Campanile in the background; Newton, the mathematician, perusing a scroll, behind him a design suggesting gravitational forces; the geologist Lyell examining a rock; Darwin, the naturalist, contemplating a skull—in the background a totem symbolizing evolution, a silhouetted mastodon, and the owl of wisdom; the engineer Watt with fly wheel and gears recalling the invention of the condensing steam engine; and Pasteur with microscope and books, saluting Asclepius, the Greek god of medicine. Surrounding the main panels a series of medallions portray real and mythological figures, all of

whom allude to the search for knowledge. They include the philosopher Confucius astride a deer, Hammurabi the law-giver, Emperor Charlemagne, the Zoroastrian deity Ahura Mazda, Romulus and Remus suckled by the wolf, Hercules battling his enemies, Roman and Norse ships, a bison with corn, the owl of wisdom, an elephant, a camel, and a janiform head of Lawrie and Goodhue dated 1923, the year the doors were cast.

Smaller medallions portray Diana, Perseus with the head of the Gorgon Medusa, the centaur Chiron, Oedipus questioned by the Sphinx, Apollo slaying the



Prometheus, small medallion; front doors.



Confucius, secondary medallion; front doors.

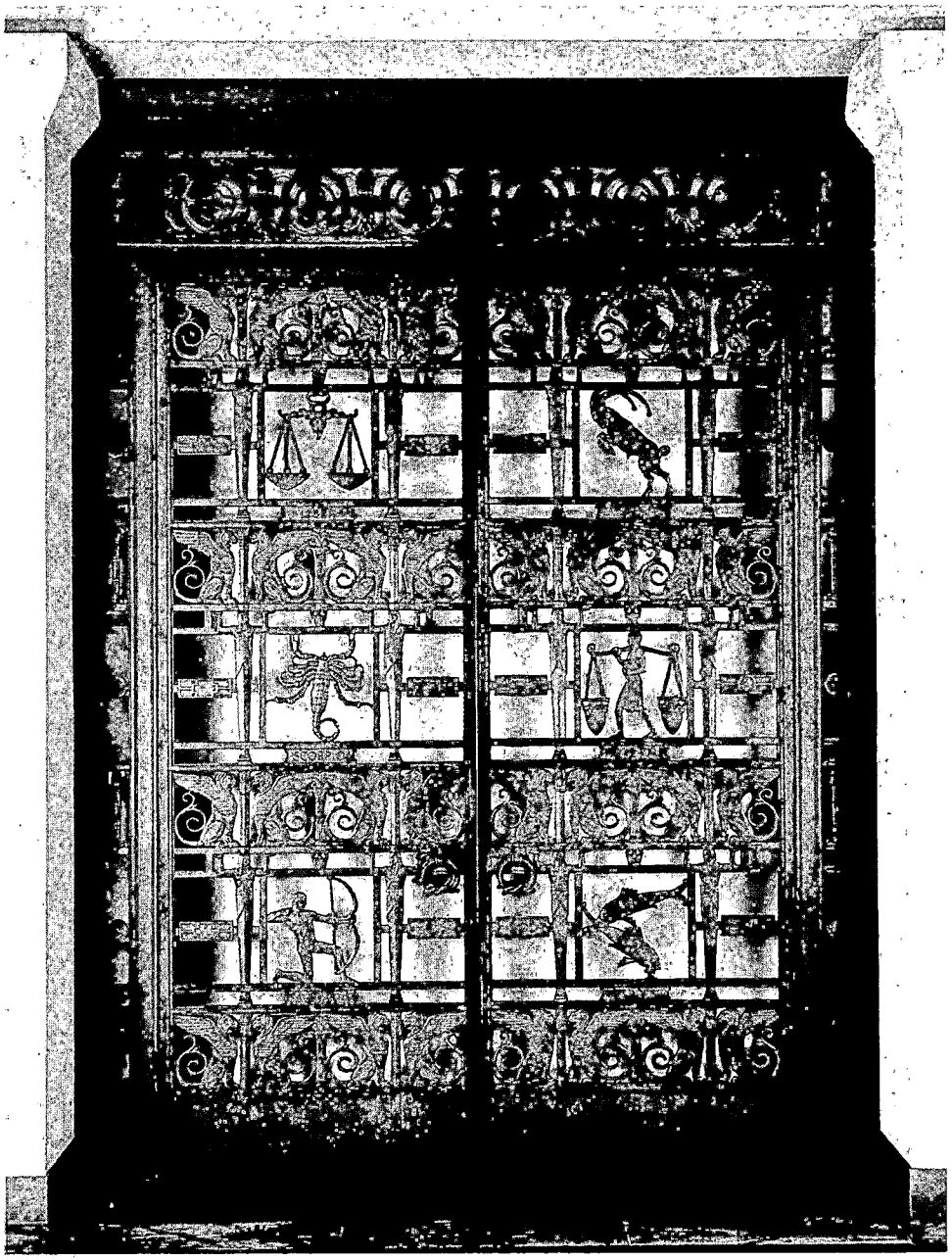
Opposite: One of eight major panels on front doors.

serpent, Vulcan, Sisyphus, Icarus and Daedalus, Icarus falling, Atlas, Orpheus, Athena, Prometheus, Hercules wrestling the lion, a truncated Nike of Samothrace, and Greek athletes. Designs based on botanical themes, rosettes, and mythological beasts fill the spaces between these medallions. (The doors, usually out of sight in their side apertures, may be seen after 4:30 p.m. on Saturdays, and all day on Sundays —when the building is closed—or upon request.)

Across the top of the doorway, in a marble pediment, an allegory of the evolution of life presents scientific subjects—earth, sky, water, prehistoric creatures —and also the mythological unicorn. Owls peer from the pediment's corners. At the apex, the sun, source of light and energy, serves as background to a hand holding the figure of a man. Rosettes, the Greek key, and foliage decorate the carved stone doorway lintel and jambs.

DARWIN

Bronze and glass screens; foyer entrance to Great Hall.



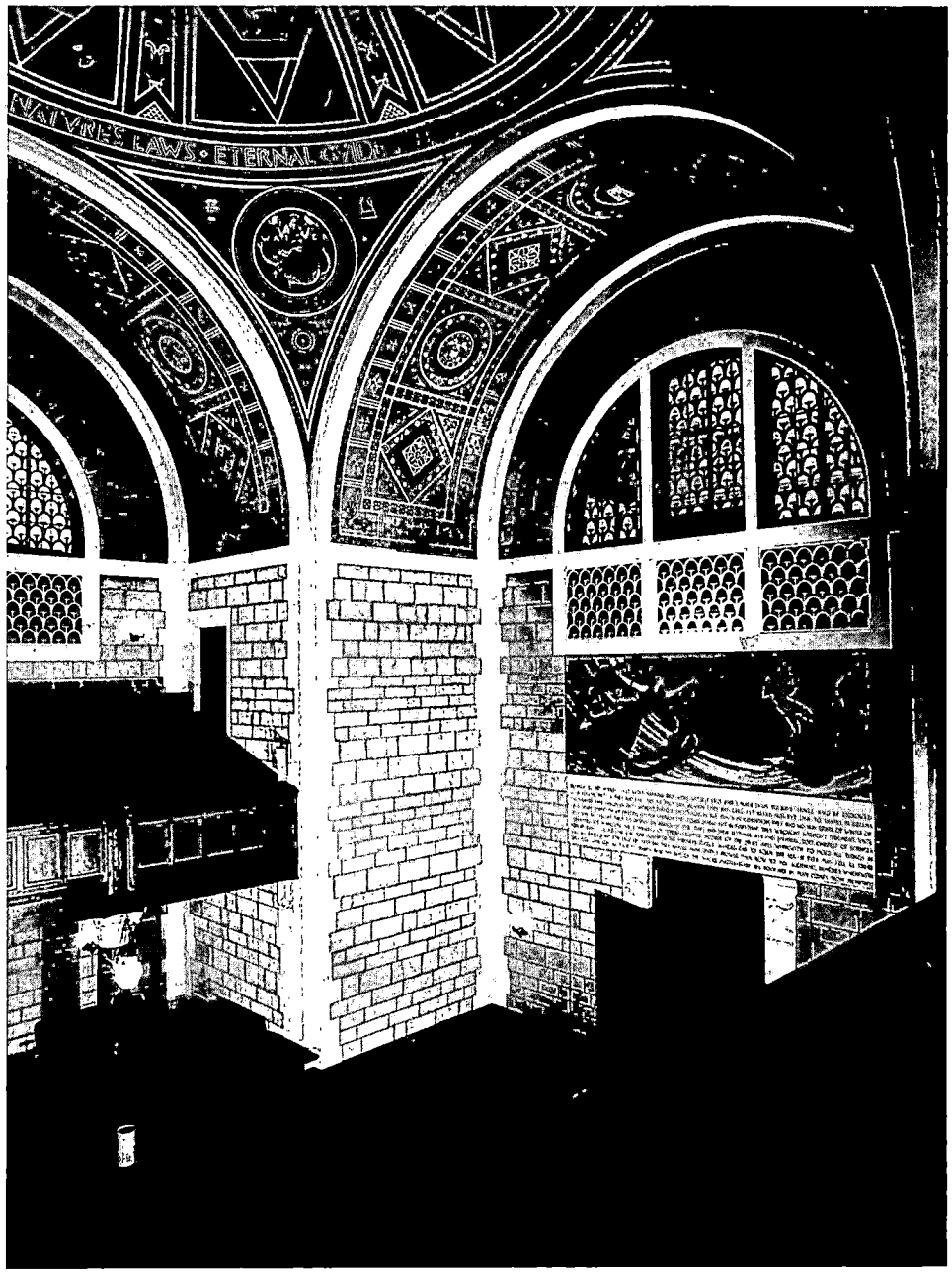
THE MAIN FOYER

Inside the building the green and white color scheme of the exterior continues. The main doorway opens on a simple neoclassical vestibule and reception foyer with walls of creamy Lens stone, a fossil-rich limestone from the region of Caen, France. Green painted bronze and glass grilles bearing the signs of the zodiac, scientific symbols to the ancients, screen the foyer at both ends; a silver vine design decorates the mahogany ceiling. Four bronze lamps, similar in design to the bowls in which vestal virgins carried fire, illuminate the foyer.

Detail, bronze doorknob; foyer entrance to library.

Great Hall, facing north; Prometheus Mural.

Opposite: Tile medallion; pendentive, Great Hall.



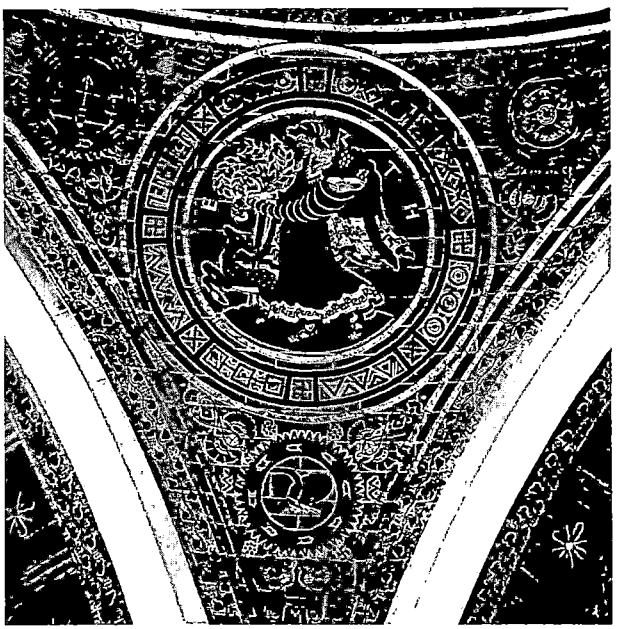
THE GREAT HALL

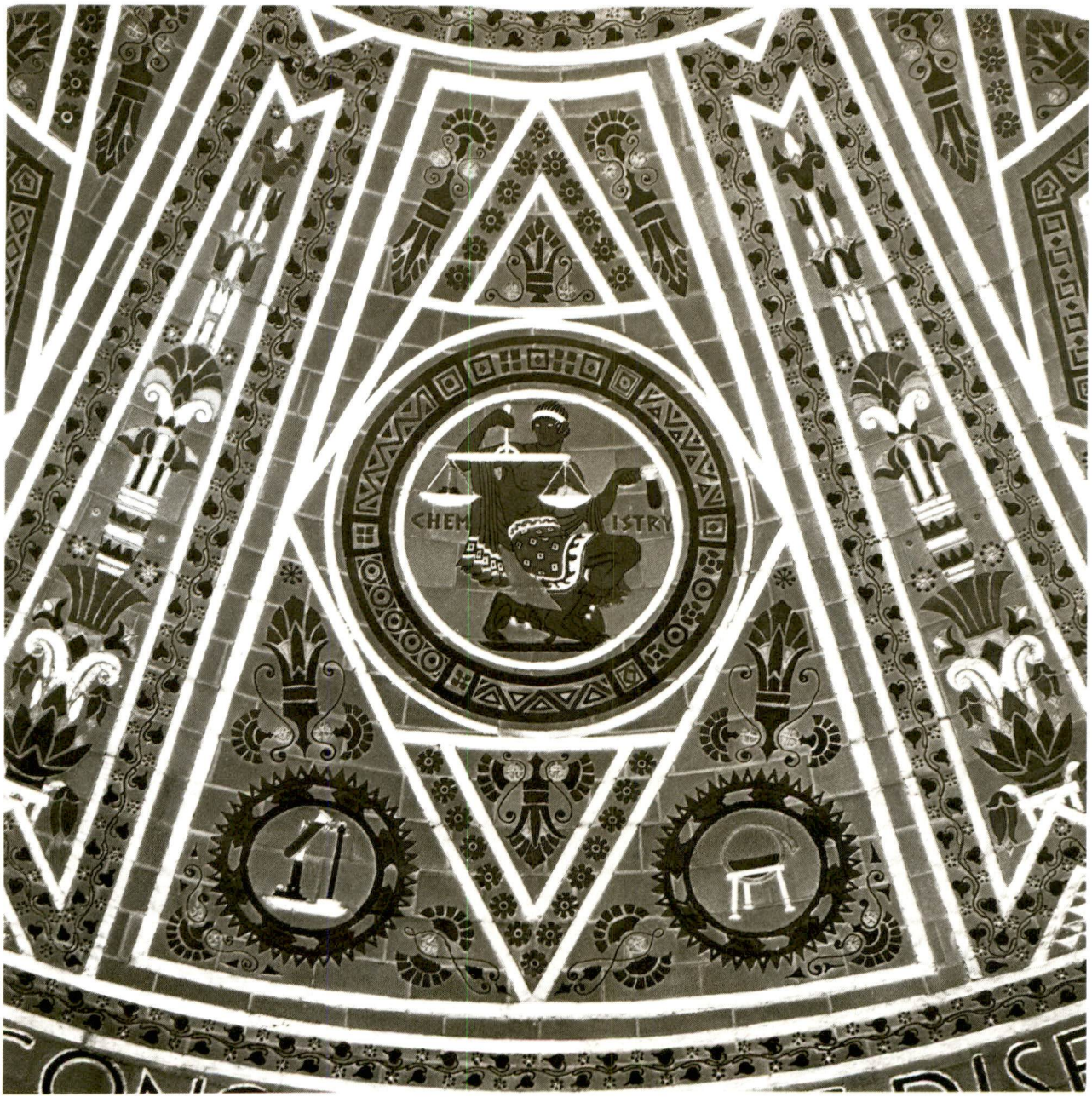
Nothing in the design or scale of the foyer prepares the visitor for the grandeur and colorful decoration of the Great Hall, which opens from the foyer. The Great Hall measures 64 feet square and rises to a height of 56 feet at the apex of the dome. Designed as the building's central feature, it served as an auditorium until completion of the auditorium wing in 1970.

Hildreth Meiere's (1893-1961) emblematic figures and inscriptions, brilliantly painted on gessoed tiles which adorn the dome, give full expression to the architect's intention of creating a "temple of science." Meiere's adaptability and willingness to experiment in various media made her a frequent and valuable collaborator for Goodhue. When Goodhue's idea of painting the tile on the Academy dome did not yield the desired effect, Meiere tried an innovative technique—gesso on tile to a depth of about one-half inch. The material, applied hot and by hand, provides a textured surface.[6]

Cruciform in shape, the Great Hall is vaulted and supports a central dome on pendentives which are decorated by female figures representing earth, air, fire, and water—the four elements of the ancient Greeks. (Pendentives are triangular sections of a sphere that permit transition from a rectangular ground plan to a circular dome.) Adjacent to each figure, three small circles contain objects reflecting practical ways these elements have been harnessed for humanity's use: *Earth*—level with pendulum bob, compass, plowshare; *Air*—bellows, sailboat, windmill; *Fire*—candle, teapot, kiln; and *Water*—well, water wheel, and a figure representing water's three stages (vapor, liquid, and ice).

At the apex of the dome a conventionalized sun is encircled by symbols of the eight planets[7] and the inscription: *Ages and cycles of nature in ceaseless sequence moving.* Below this band the dome divides into eight radial panels. Each contains a figure symbolizing one of the principal divisions of science accompanied by two smaller emblems. Beginning with the panel immediately over the north wall facing the room's entrance and moving counterclockwise are found: *Anthropology,* with early man and the Roman Caesar; *Geology,* with axe, pick, and trilobite fossil; *Chemistry,* with retort on tripod, test tube, and burner; *Astronomy,* with sextant, planet, and stars; *Physics,* with magnet and air pump; *Mathematics,* with abacus and diagram of the Pythagorean theorem; *Botany,* with peas and sunflower; and *Zoology,* with zebra and starfish.




CHEM
ISTRY

Below these eight panels, on a drum circling the dome, is the inscription:

> To science, pilot of industry, conqueror of disease, multiplier of the harvest, explorer of the universe, revealer of nature's laws, eternal guide to truth.

The round soffit arches over the galleries and the north wall display Meiere's interpretation of the insignia of four of the world's oldest academies of science, with attendant representations of discoveries made by their members. On the north arch, above the entrance doors to the auditorium wing, is the Museum of Alexandria, founded by Ptolemy I (367-283 B.C.), represented by an Egyptian pylon flanked by palm trees. The two lower medallions depict two of the seven wonders of the ancient world—the pyramids and Pharos, the great lighthouse of Alexandria, reputed to have been 400 feet high. Over the east gallery is the crowned lynx, symbol of the Accademia dei Lincei, Rome, founded in 1603; in the medallions are Volta's electric pile and Galileo's telescope. Above the south gallery is the symbol of the Academie des Sciences, Paris, founded in 1666; the medallions show Daguerre's camera and the flask in which Pascal weighed air. The symbol of the Royal Society of London, founded in 1660, is over the west gallery; in the medallions are Newton's prism showing the spectrum and Watt's steam engine.

On the Great Hall's north wall a painting by Albert Herter (1871-1950) portrays Prometheus, aided by Athena, stealing the divine fire from the chariot of Helios, the sun god, to bring mankind the flame of knowledge. The artist followed ancient Greek and Egyptian mural painting custom in labeling the figures.[8] Beneath the painting a quotation from Aes-

Above and opposite: Tile medallions depicting major divisions of science; dome, Great Hall.

Above: George Ellery Hale, viewing base of Foucault pendulum, Great Hall, 1925.

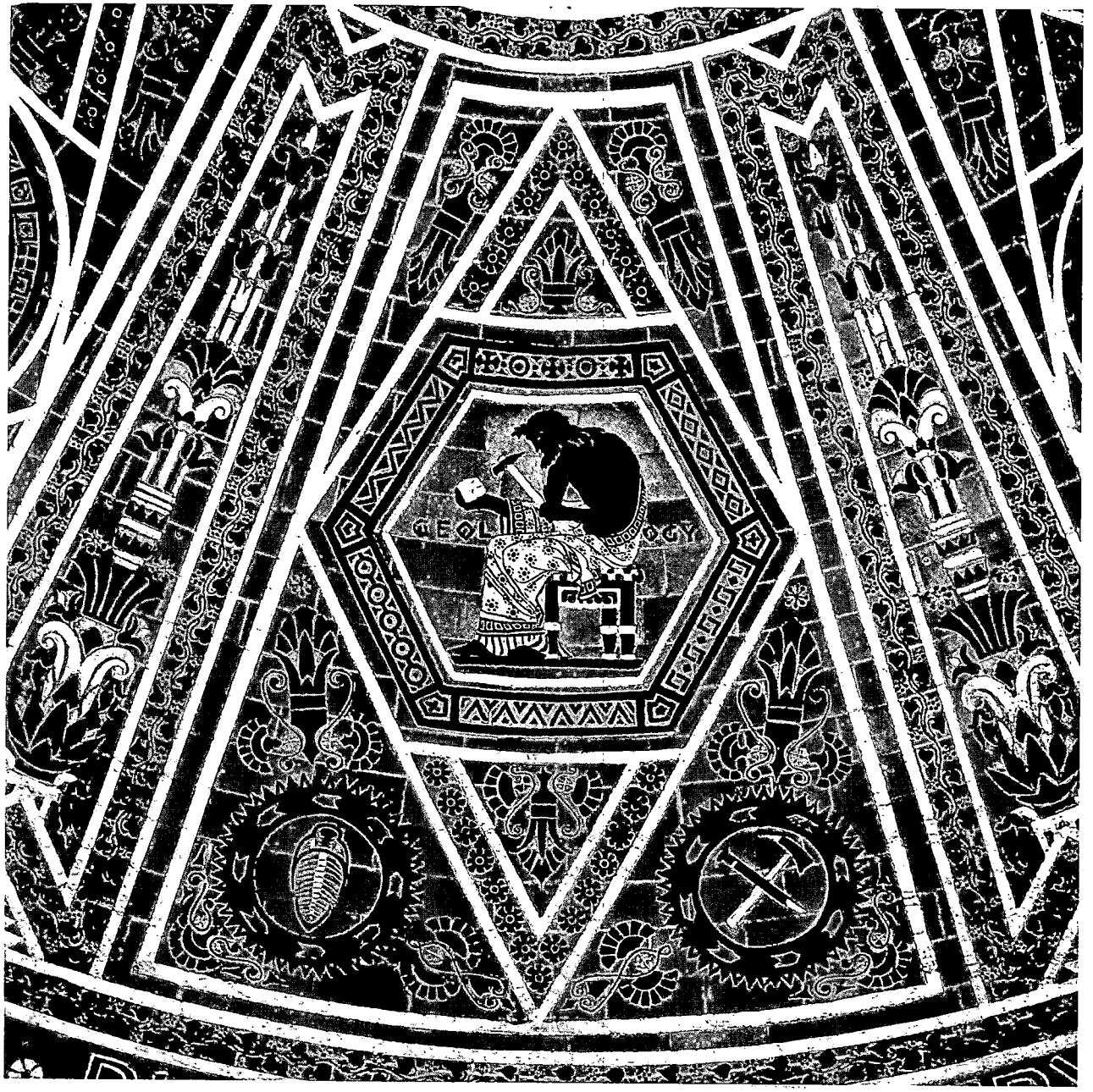
Opposite: Tile medallion; dome, Great Hall.

chylus' *Prometheus Bound* recites the benefits conferred on the world by science.[9]

The Great Hall's three galleries, paneled with inlaid American walnut, are supported by columns of green verdantique marble *(verde antico)*, with capitals of white Champville marble. Akoustilith, an acoustic material resembling cement block and considered highly sophisticated in 1922, covers the undecorated walls of the Great Hall and is the material of the dome. Wide bands of blue slate, flanked by narrow strips of Utah light bird's-eye marble, frame the floor, which is predominantly gray-green slate.

Directly beneath the apex of the dome is a Foucault pendulum and a bronze medallion in the floor whose design is based on a map of the solar system published in the *Atlas Celestis* of Andreas Cellarius Palatinus, Amsterdam, 1661. The array of the planets is the Copernican system as known to Galileo. The medallion is the wellhead or cover placed in the floor when the spectroscopic case over which the Foucault pendulum swings is lowered below floor level. Reliefs representing the sun gods of many cultures circle the pendulum base. The pendulum and the spectroscope (no longer in operation) were among several scientific exhibits maintained by the Academy in the early days of the building for the interest of the general public. Several rooms adjacent to the Great Hall were also used for scientific exhibitions. During World War II this practice ended, as the space was needed for offices.

Beneath Herter's *Prometheus*, and framing the doorway that leads to the new auditorium, are pilasters topped by Lee Lawrie's sculptured figures symbolizing Darkness and Light.

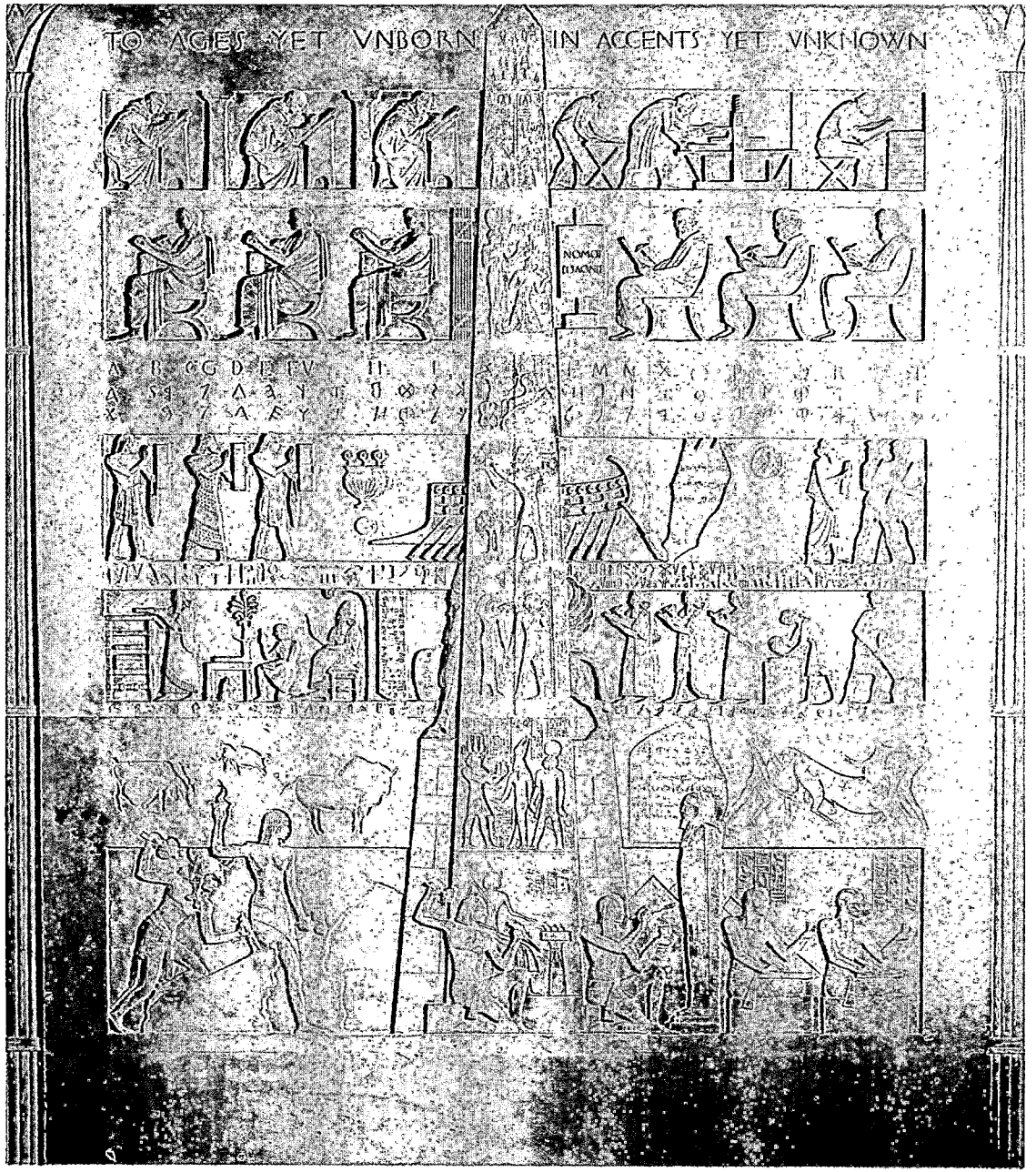

GEOLOGY

THE LIBRARY

The library, on the Academy's west front to the left of the entrance foyer, preserves the building's green and white color scheme in its creamy Lens stone walls and slate floor. Despite some neoclassical trim, it is essentially a utilitarian room. The center of interest is the fireplace at the end of the room, with its carved overmantel representing the history of the art of writing. Chronological sequence is ordered from the bottom of the carving to the top. Figures include a prehistoric man and woman decorating a cave; the bison of the Magdalenian Period (30,000 B.C. to 10,000 B.C.) as found in the Altamira Cave near Santander, Spain; Egyptian priests carving and painting hieroglyphics; and men making papyrus and engaged in scroll writing. The top sequence depicts monastic scholars illuminating manuscripts and the Plantin press, an important printing house in 16th century Antwerp. Symbols from ancient alphabets decorate spaces between panels. A slender obelisk forms the axis of this sculptural relief, which bears the motto: *To ages yet unborn, in accents yet unknown.* Three ceiling panels depict discovery, the recording of discovery, and the reading of the record.

Library, shortly after completion of building.

Opposite: Carved mantel over fireplace in library.


TO AGES YET VNBORN
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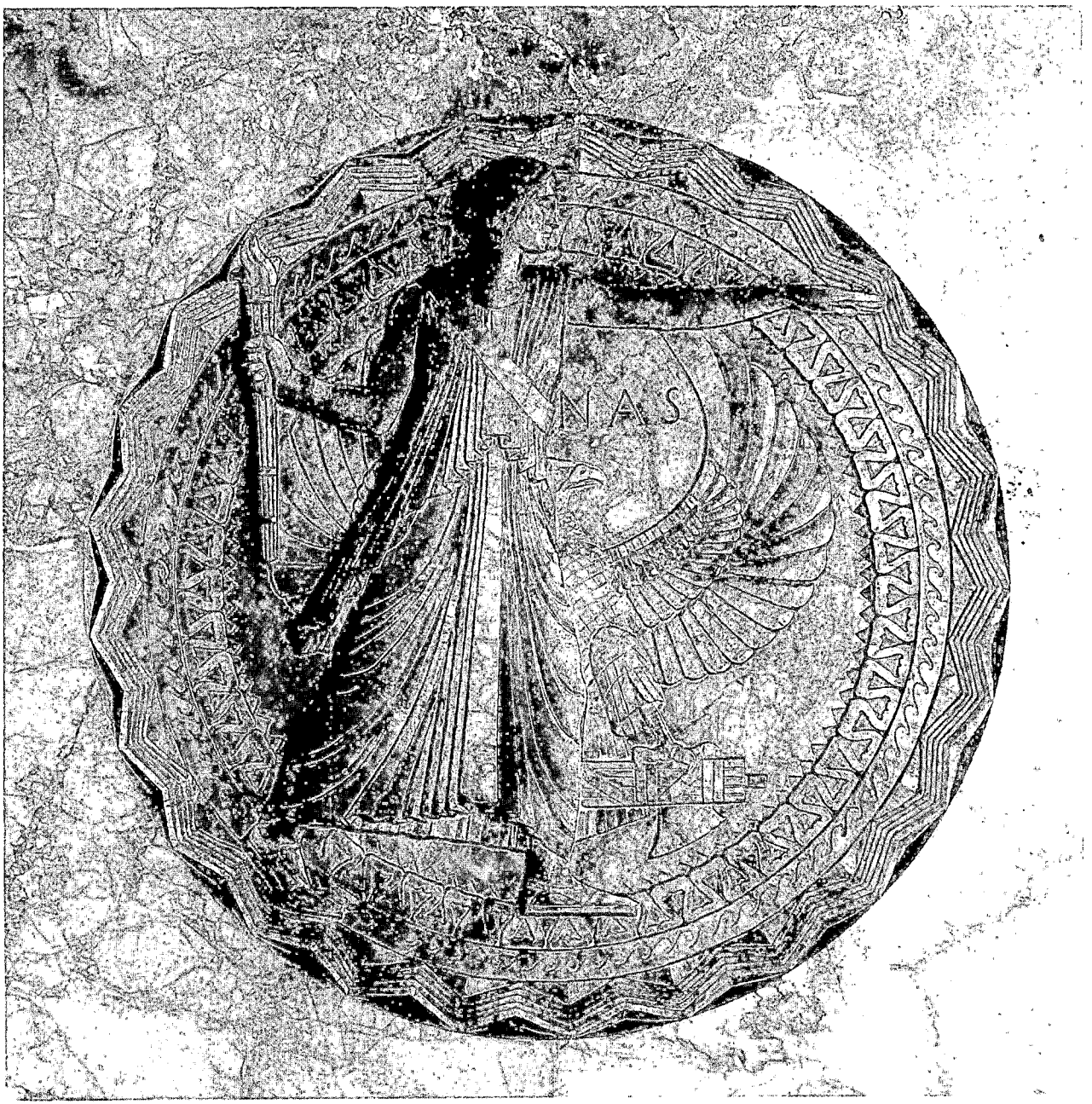


THE MEMBERS' LOUNGE

Adjoining the library, the members' lounge is designed as a place for hospitality, conversation, relaxation, or as a meeting room. It retains vestiges of neoclassical decoration, primarily a columnar motif on the walls that are paneled with walnut to about two-thirds of their height. Above this wainscoting, a painted frieze by Albert Herter presents stylized insignia of eight historic universities: Harvard, Yale, Bologna, Paris, Heidelberg, Leiden, Cambridge, and Oxford. A draped female figure and the initials NAS, carved in the Sienna marble fireplace, are Lawrie's art deco version of the Academy seal. The room also contains portraits and busts of former NAS Presidents and a cabinet displaying replicas of medals awarded by the Academy.

THE LECTURE ROOM

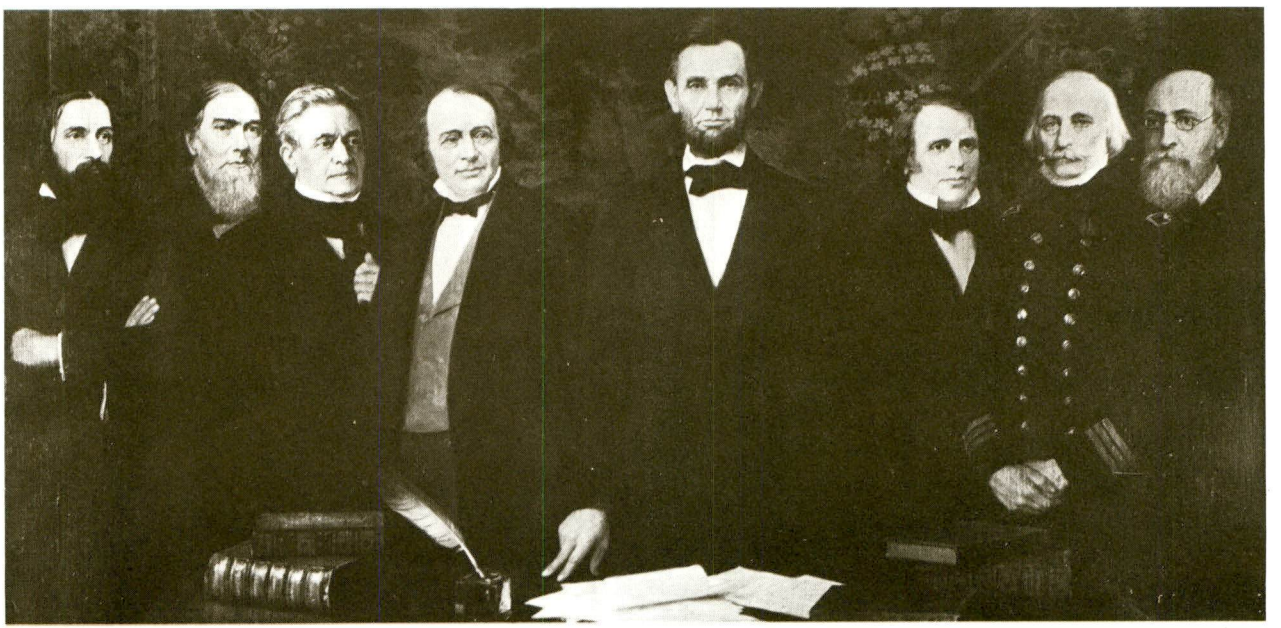
To the right of the main entrance, on the east front of the building, is the lecture room, now used for meetings and lectures, but originally designed to permit the demonstration of actual laboratory experiments. Its walnut panelled walls have the same columnar motif as the library and members' lounge. Restored and modernized in 1981, the room is equipped with excellent lighting and acoustical facilities. Four Audubon engravings (Havell Edition) hang here. Of interest are the marquetry on the exterior of the sound booth, and grilles near the ceiling, which function as part of the ventillation system. They are in the form of elaborate knots of the type favored by Leonardo da Vinci and Albrecht Dürer.

Members' lounge.

Opposite: Seal over fireplace; members' lounge.

THE BOARD ROOM

Beyond the lecture room, at the easternmost part of the building, is the board room, of the same size and proportion as the members' lounge at the west end of the building and similar in design. The painting by Albert Herter above the marble fireplace depicts President Abraham Lincoln with the founders of the Academy signing the Academy charter of March 3, 1863. Herter's lifelong interest in tapestry is reflected in his choice of a tapestry as background for the painting. Left to right: Benjamin Peirce, Alexander Dallas Bache, Joseph Henry, Louis Agassiz, Lincoln, Henry Wilson, Charles H. Davis, and Benjamin Apthorp Gould. Another feature of the room is the electrolier, a globe-shaped ceiling fixture representing the world painted in accordance with ancient concepts, notably Leonardo da Vinci's map dated 1515.



Founders with President Lincoln Signing the Charter of the Academy; board room.

In the 1940s and 1950s, the government's increased use of the scientific advisory services of the Academy and National Research Council necessitated additional space for the institution. The west and east wings and the auditorium were added in 1962, 1965, and 1970, respectively, achieving a symmetry compatible with Bertram Goodhue's original plan. The exteriors retain the building's original style. These additions were carried out by the firm of Harrison and Abramowitz, whose senior member, Wallace K. Harrison (1895-1981), had been a young draftsman in Goodhue's office at the time the main building was designed.[10] Careful attention was given to using the same stone work pattern and repeating the bronze window trim motifs, which show the head of Imhotep, an Egyptian priest who, after his death, was deified as a god of medicine. The wings' exterior doors match Goodhue's in size; like his, they have eight panels, but unlike his they lack decoration. Prometheus and Athena, frequently represented in the original building's decoration, appear on interior and exterior door handles on the west wing doors.

A gift from the Equitable Life Assurance Society made construction of the west wing possible in time for the Academy's 1963 centennial. A score of industries and foundations, including Ford and Rockefeller, contributed to the Academy Centennial Building Fund, providing funds for the east wing and some support for construction of the auditorium. In the wings, on two floors and a ground floor, are four conference rooms, a refectory, and about 60 offices occupied by executive personnel of the National Research Council. The major portion of the Research Council staff is housed in leased space elsewhere in Washington. The west wing corridor and the rotunda—actually a 25-foot-square room called "the rotunda" because of a circular architectural element in the ceiling—are used for art exhibits. A small permanent collection, displayed throughout the building, supplements the changing exhibits.

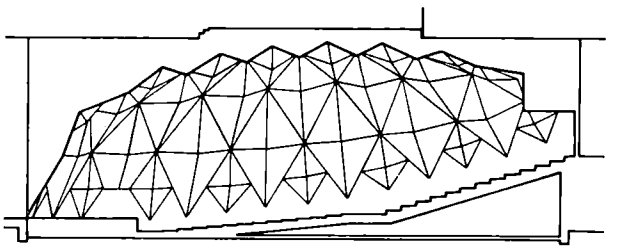
A courtyard, formed when the west wing was added, is landscaped with flowering shrubs; linden trees circle George B. Jolley's copper fountain. "Pod," a sculpture by Harry Bertoia, is also found in the court, which is entered from the lounge adjacent to the executive dining room.

THE AUDITORIUM

Frederick Seitz, Academy President from 1962 to 1969, led fund-raising efforts for the 670-seat auditorium wing designed by Harrison—the final addition to the original building. Unity of exterior design was successfully accomplished in the auditorium wing aided by a reproduction of the copper cheneau on the original facade. Inside, however, the wing departs from the rest of the building in its thoroughly modern style, although the entrance from C Street maintains the green of the building color scheme in the richly variegated Verde Issogne marble floor, named for the town in the Val d'Aosta, Italy, where it was quarried.

Access to the auditorium is via a foyer, paved in the same marble and panelled in walnut. The auditorium, like the Great Hall, is a surprise. The visitor entering through the dark wood and marble of the foyer, is unprepared for the contemporary style of the red, white, and gray auditorium. Incorporating modern concepts and acoustical techniques, the auditorium was designed primarily for oral presentations and is used extensively for scientific symposia and meetings. The hall provides an excellent setting for music as well. Music critics have pronounced the auditorium "extraordinary" and "acoustically stunning." Private concerts are held here during the Academy's annual meetings; through its Arts in the Academy program, the Academy also sponsors an annual series of free chamber music concerts for the public.

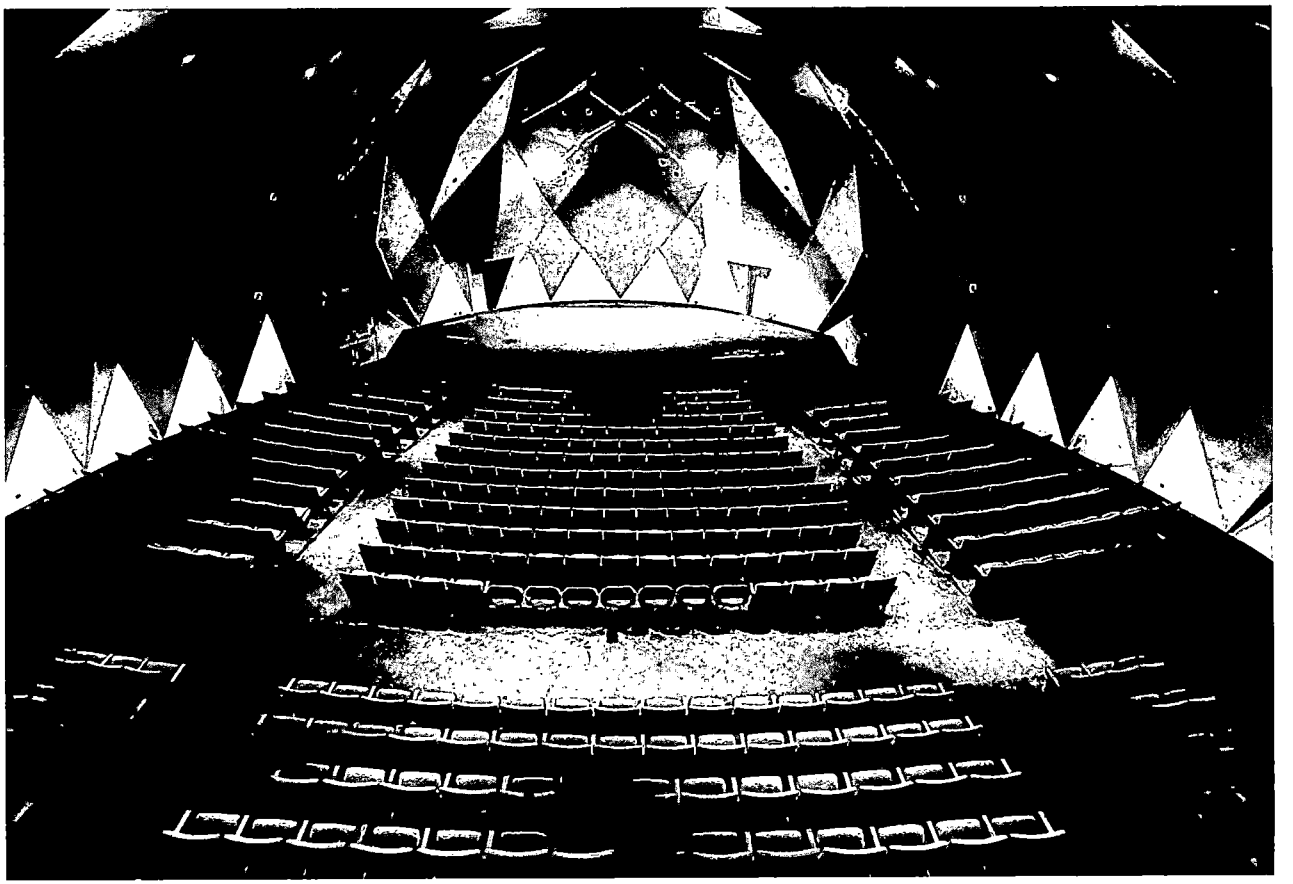
Unusual features in the auditorium's construction insulate against exterior noises. The unconventional interior of the room—in form a huge shell—consists of 70 adjoining diamond-shaped projections whose bases are located on a coordinate system that places them along points on cycloid-shaped curves. (A cycloid is a curve traced by a point on the circumference of a circular disc as the disc rolls along a straight line without slipping.) Although uncommon in architecture, the cycloid was used by Sir Christopher Wren in several of his exterior designs. It was chosen as the basic coordinate system in the Academy auditorium because the cycloid, with a constantly changing center of curvature, lacks a focal point; in acoustical design, focal points are to be avoided to achieve maximum sound distribution.



Schematic drawing of auditorium.

The diamond surfaces, formed by the intersection of 280 flat panels, differ in size, in angular position, and in the distance they project into the auditorium from the basic cycloidal curve. The shell makes no physical contact with the surrounding walls or floor, but hangs like an outsized lampshade from 1,125 resilient metal straps attached to fixed trusses above the auditorium ceiling.

The diamond-shaped panels, which were fabricated in place, are covered with metal lath, plaster, a second metal lath, and again plaster, totaling approximately 160 tons. During the construction phase, the array of panels was held in place by rigid supports, removed after the plaster had set.



Auditorium.

Cyril M. Harris, Charles Batchelor Professor of Electrical Engineering and Architecture at Columbia University, a leading authority in the field of acoustics, designed the auditorium's acoustics. Later he performed the same function for Washington's John F. Kennedy Center for the Performing Arts and the Metropolitan Opera House and Avery Fisher Hall in New York City's Lincoln Center. Dr. Harris is a member of the National Academy of Sciences and the National Academy of Engineering.

The largest single gift for construction of the auditorium was provided by the Hugh L. Dryden Memorial Fund in honor of Dryden, the Academy's Home Secretary from 1955 to 1965. Una Hanbury's bronze portrait bust of Dryden is located in the walnut-panelled auditorium lounge, which opens off the hall's upper level. Academy art exhibits are displayed here. Other contributions came from the Sloan Foundation, industry, government agencies, private donors, and Academy resources.

The Academy's archives are housed on the east side of the auditorium wing with a separate area equipped with constant temperature-humidity control devices for preservation purposes. The archives contain the corporate records of the Academy and a unique record of the history of science in the United States. Office suites occupy other space atop the auditorium wing.

The memorial to Albert Einstein, situated in an elm and holly grove in the southwest corner of the Academy grounds, was unveiled at the Academy's annual meeting, April 22, 1979, in honor of the centennial of the great scientist's birth. Einstein is depicted seated on a three-step bench of Mount Airy (North Carolina) white granite. The bronze figure, weighing approximately 4 tons, is 12 feet in height. Three caissons, totalling 135 tons, sunk in bedrock to a depth of 23 to 25 feet, support the monument.

In its left hand, the figure holds a paper with mathematical equations summarizing three of Einstein's most important scientific contributions: the photoelectric effect, the theory of general relativity, and the equivalence of energy and matter. Three quotations from Einstein are engraved on the bench where the figure is seated:

As long as I have any choice in the matter, I shall live only in a country where civil liberty, tolerance, and equality of all citizens before the law prevail.

Joy and amazement at the beauty and grandeur of this world of which man can just form a faint notion . . .

The right to search for truth implies also a duty; one must not conceal any part of what one has recognized to be true.

The star map at the statue's base—a 28-foot field of emerald pearl granite from Larvik, Norway, is embedded with more than 2,700 metal studs representing the planets, sun, moon, stars, and other celestial objects accurately positioned as they were on the dedication date by astronomers from the U.S. Naval Observatory.

The sculptor, Robert Berks, known for his portrait

Einstein Memorial.

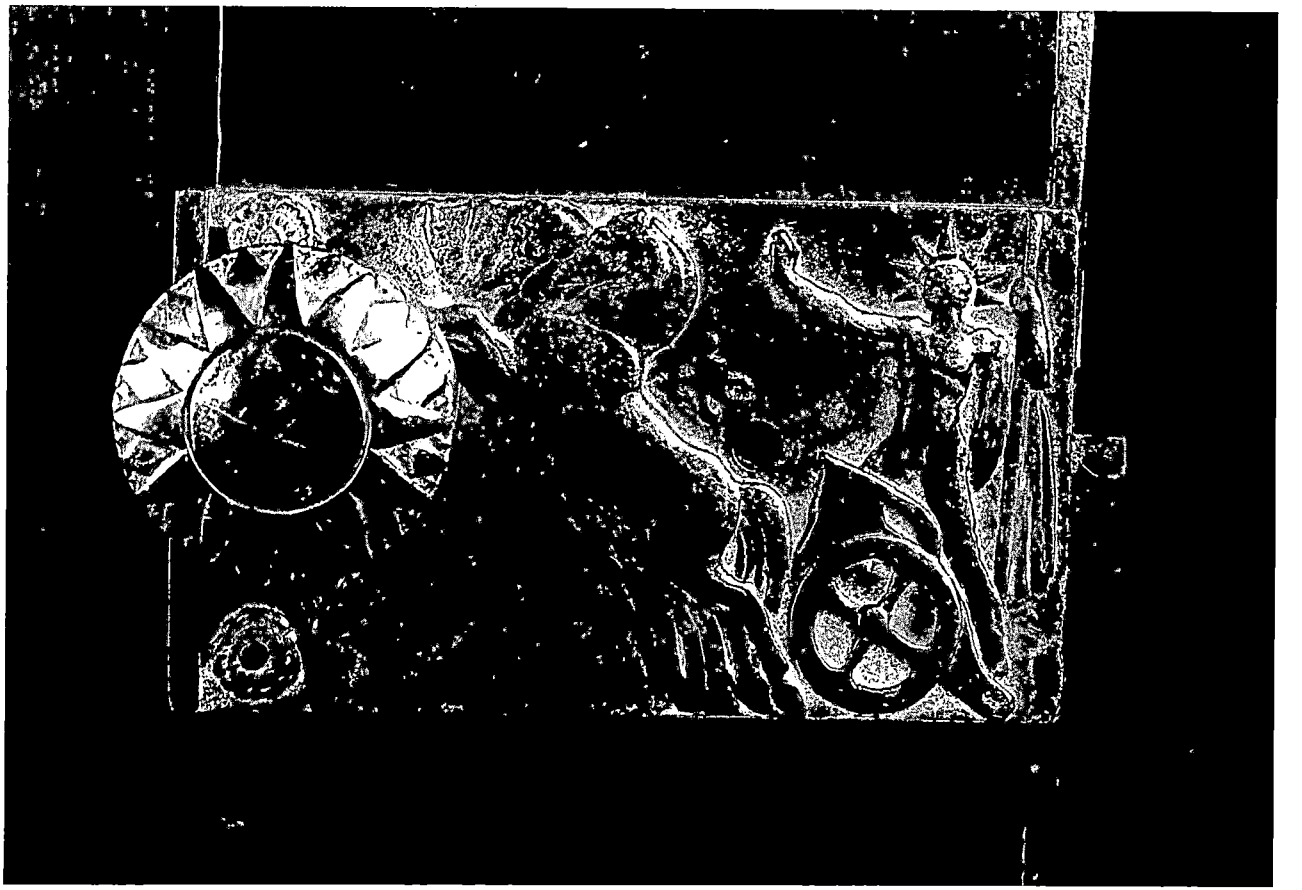
busts (John F. Kennedy at Washington's Kennedy Center), based the work on a bust of Einstein he sculptured from life in 1953. Landscape architect James A. Van Sweden designed the monument landscaping. Einstein was elected a Foreign Associate of the Academy in 1922 and became a member in 1942, two years after he became a naturalized citizen.

* * *

On March 15, 1974, the National Academy of Sciences building was selected for inclusion on the National Register of Historic Places.

early 1950's

sculpted from life
went to his home



Bronze doorknob, Prometheus motif; Great Hall.

NOTES

1. The Order set forth the NRC's functions: "To stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts. . . . To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country. . . . To promote cooperation in research, at home and abroad. . . . To serve as a means of bringing American and foreign investigators into active cooperation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the Government. . . . To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war. . . . [and] To gather and collate scientific and technical information at home and abroad, in cooperation with governmental and other agencies. . . ."

2. Much of his work consisted of churches: St. Thomas' and St. Bartholomew's in New York City; the chapel of the United States Military Academy, West Point; and the chapel of the University of Chicago. He also gained fame from his design of the Nebraska State Capitol. Goodhue's interest in the adaptation of Spanish architecture to the needs of Southern California is evident in the Central Public Library, Los Angeles, and in the Physics Building of the California Institute of Technology, also in the planning scheme for the Caltech campus. For additional information about Goodhue, see *Bertram Grosvenor Goodhue* by Richard Oliver, 1983, Architectural History Foundation.

3. The Chapel (now Church) of the Intercession was Goodhue's favorite ecclesiastical commission. His long-time collaborator, sculptor Lee Lawrie, designed the tomb.

4. In 1982, the Professional Grounds Management Society presented its national Grand Award for the best-maintained grounds of an institution to Mark J. Feist, the Academy's grounds manager.

5. All sculptural elements in the Academy building are Lawrie's creations: the bronze doors and window panels on the Constitution Avenue facade, stone carvings on the building's exterior and interior, cheneau, terrace lamps, bronze doors and lamps in the building's foyer, capitals and window screens in the Great Hall, stone and plaster work in the library, and the bronze door knobs (one based on an Athenian coin) and bannister finials. Notable among Lawrie's several collaborations with Goodhue were the Nebraska State Capitol, Lincoln, begun in 1922 and completed in 1932, eight years after Goodhue's death; in New York, St. Thomas' Church, the Church of the Heavenly Rest, and the Chapel (now Church) of the Intercession. Important work with other architects included the Cathedral of St. John the Divine, New York; the bronze "Atlas" and the sculptured stone screen, International Building, Rockefeller Center, New York; "George Washington" at the National Cathedral, Washington, D.C.; several statues for the U.S. Military Academy at West Point; and works at the Los Angeles Public Library; Bok Singing Tower, Florida; Louisiana State Capitol; Yale University's Harkness Memorial Tower; and the Memorial Bridge, Harrisburg, Pennsylvania. The portrait relief of President Franklin D. Roosevelt, which appears on the Roosevelt dime, was sculpted by Lawrie. He taught generations of architects and sculptors at Yale and Harvard Universities and was awarded two Gold Medals by the American Institute of Architects (1921 and 1927). Lawrie's other awards included the Medal of Honor of the Architectural League of New York and the National Sculpture Society's Medal of Honor.

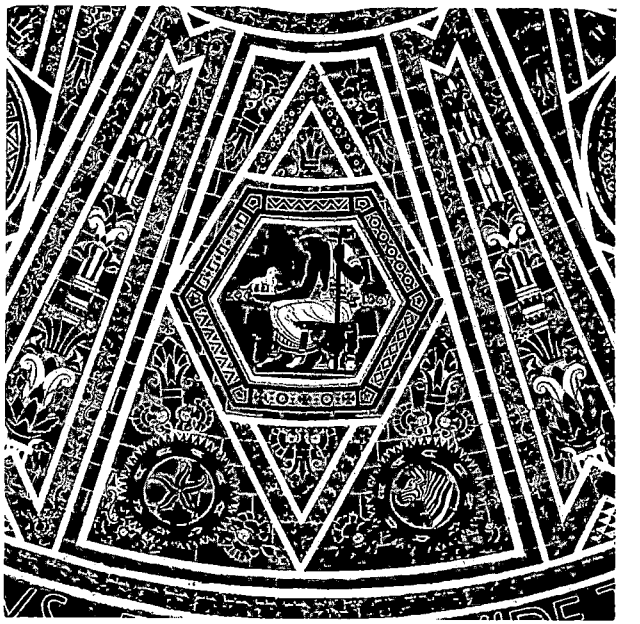
6. Among Meiere's collaborative works done with Goodhue were altar pieces for St. Mark's Episcopal Church, Mt. Kisco, New York, and St. Martin's Episcopal Church, Providence, Rhode Island, mosaics for St. Bartholomew's Church, New York, and a tile mural for the dome of the Nebraska State Capitol, Lincoln. Working with other architects, she also designed mosaics for Temple Emanu-El and the Irving Trust Co., in New York; the crypt mosaics at the National Cathedral, Washington, D.C.; the Lady Altar, St. Patrick's Cathedral, New York; and reredos for St. John's Episcopal Church, Beverly Farms, Massachusetts, and St. Mark's-on-the-Hill, Pikesville, Maryland. In 1928 Meiere received a Gold Medal from the Architectural League of New York, and in 1956 the American Institute of Architects awarded her the Fine Arts Medal.

7. Pluto, the ninth major planet, was not discovered until 1930.

8. Herter, best known as a portraitist and muralist, has works in the collection of New York's Metropolitan Museum of Art, and the National Museum of American Art, Washington, D.C. Among his awards were an Honorable Mention at the Paris Salon (1890), a medal at the Atlanta Exposition (1895), the Lipincott prize (1897), and a silver medal at the Pan-American Exposition in Buffalo, New York (1901).

9. "Hearken to the miseries that beset mankind. They were witless erst and I made them to have sense and be endowed with reason. Though they had eyes to see they saw in vain; they had ears but heard not. But, like to shapes in dreams, throughout their length of days without purpose they wrought all things in confusion. . . . They had no sign either of winter or of flowery spring or of fruitful summer, whereon they could depend, but in everything they wrought without judgment, until such time as I taught them to discern the risings of the stars and their settings. Aye, and numbers, too, chiefest of sciences, I invented for them, and the combining of letters, creative mother of the muses' arts, wherewith to hold all things in memory. . . . Twas I and no one else that contrived the mariner's flaxen-winged car to roam the sea. . . . If ever man fell ill, there was no defence, but for lack of medicine they wasted away, until I showed them how to mix soothing remedies wherewith they now ward off all their disorders. . . . Hear the sum of the whole matter—every art possessed by man comes from Prometheus."

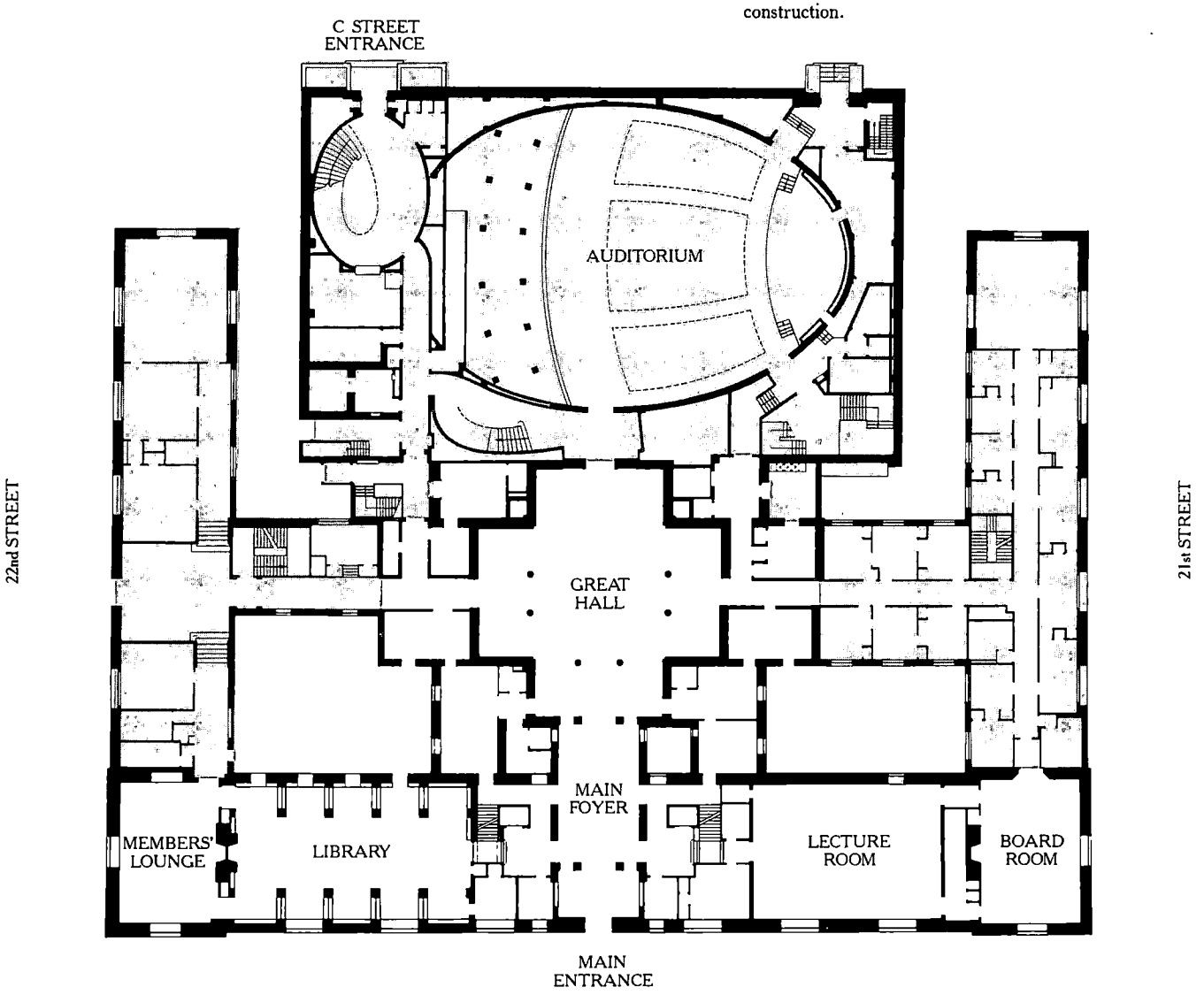
10. The Academy chose the 50th anniversary celebration of the building, in 1974, to honor Harrison by presenting him with an illuminated scroll. Harrison is considered one of the most influential figures in architecture of his generation, and designed buildings in many cities. He is best known as the codesigner of Rockefeller Center, chief architect of the United Nations buildings, director of the overall design of Lincoln Center, and architect of the Metropolitan Opera House at Lincoln Center, all in New York City.



Tile medallion; dome, Great Hall.

C STREET

Shaded area indicates additions to building after original construction.



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REMARKS TO THE NATIONAL ACADEMY OF SCIENCES
ANNUAL MEETING

DATE: APRIL 23, 1990
TIME: 2:00 P.M.
LOCATION: NATIONAL ACADEMY OF SCIENCES
AUDITORIUM

THROUGH: DAVID DEMAREST
ASSISTANT TO THE PRESIDENT FOR
COMMUNICATIONS

FROM: CHRISS WINSTON
DEPUTY ASSISTANT TO THE PRESIDENT
FOR COMMUNICATIONS AND DIRECTOR
OF SPEECHWRITER

I. PURPOSE

To applaud the National Academy of Sciences for their valuable role in advising the President and the US government on scientific matters. To show this Administration's support for science and technology -- in research, education, and in the policy-making process -- and to outline the initiatives taken in these areas.

II. BACKGROUND

In 1863, President Abraham Lincoln signed the Congressional Charter creating the National Academy of Sciences to honor America's most eminent scientists and draw upon their expertise in advising the Federal government.

Over the years, the Academy has continued to fulfill this role and has been enlarged to include: the National Academy of Engineering, the Institute of Medicine, and the National Research Council. Today the Academy claims over 600 members, each of whom is chosen for their major contribution to original research. In fact, 162 Nobel Prize winners have been members of the Academy.

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III. PARTICIPANTS ON STAGE

The President
Dr. D. Allan Bromley, Assistant to the President for Science and Technology
Dr. Frank Press, President, National Academy of Sciences
Dr. James D. Ebert, Vice President, National Academy of Sciences
Dr. Peter H. Raven, Home Secretary, National Academy of Sciences
Dr. William E. Gordon, Foreign Secretary, National Academy of Sciences
Dr. Elkan R. Blout, Treasurer, National Academy of Sciences

500 Members of the National Academy of Sciences

IV. PRESS PLAN

Open press.

V. SEQUENCE OF EVENTS

Please see Advance Office Scenario.

REMARKS PROVIDED BY SPEECHWRITING OFFICE.

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ADDRESS

At Washington, 10.30 a. m., Monday, April 28, 1924, dedicating the building for the National Academy of Sciences and the National Research Council, President Coolidge spoke as follows:

If there be one thing in which America is preeminent, it is a disposition to follow the truth. It is this sentiment which characterized the voyage of Columbus. It was the moving impulse of those leaders in the early settlement of our country and has been followed in the great decisions of the Nation through all its history. Sometimes this has been represented by political action, sometimes by scientific achievements. On this occasion the emphasis is on the side of science.

By science I mean the careful assembling of facts, their comparison and their interpretation. Of those who are entitled to high rank in both our political and scientific life, perhaps Benjamin Franklin was the earliest and one of the most conspicuous examples. But it is the same spirit that has moved through all our life, which makes it particularly appropriate that our National Government should be active in its encouragement of the searching out of the truth in the physical world, and applying it to the well-being of the people, as it is interested in the searching out of the truth in the political world, with the same object in view.

President Washington in his farewell address to the American people said: "Promote, then, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinions it should be enlightened." It was the first President of the United States who saw the necessity of research in this country. Jefferson, our third President, was himself a research worker by natural gift, and loved the problems which gave him a broader knowledge of our natural surroundings. The beginning of our Government, therefore, had to do with the inception of scientific research in the United States.

American science may be divided into five periods—the Jeffersonian period, that of Silliman, the Agassiz period, the present period of cooperative research when no one dominates, and the future for which definite foundations are now being laid.

The Jeffersonian period began even before Jefferson's term as President. Palæontology in the United States had its beginning in the publication in 1797 of Jefferson's paper on the Megalonyx of great claw. The first large palæontological laboratory in this country was in the East Room of the White House, where Jefferson arranged his fossils for study.

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Coolidge - 1924

The Silliman period covers largely the first half of the last century. During this time the National Institution for the Promotion of Science and Art was established in the Nation's Capital, which promised to be a rival to the American Philosophical Society in Philadelphia. Meanwhile the American Association was started. Also, in this period, an ex President of the United States was concerned in the founding of an institution for research. John Quincy Adams in his own handwriting amended the bill to establish the Smithsonian Institution, giving it the broad scope which it has to-day.

The third period, that of Agassiz, again brings a President forward in the promotion of science. Abraham Lincoln, deeply interested in the welfare of the American people, confessed that up to the time when he became President and talked with Joseph Henry, then head of the Smithsonian Institution, he was inclined to view the Institution as a rather useless Government luxury, but he said, "It must be a grand school, if it produces such thinkers as he." Later on, in 1864, when the very foundations of the Nation were shaken with the Civil War, the same President looked from the Executive Mansion on the Smithsonian Building which was burning, and remarked to some military gentlemen present: "Gentlemen, beyond is a national calamity. We have no time to think of it now; we must attend to other things." It was in these days of strife that a Senator from Massachusetts, Henry Wilson, later Vice President, put through the two Houses of Congress a bill incorporating the National Academy of Sciences in the United States of America. President Lincoln signed this bill. Just how much the war influenced the recognition of necessity for such a body is not known, but war problems were assigned to the Academy and acted on. Since then many Government scientific questions have been referred to it by the President, members of the Cabinet, committees of Congress, and the Academy members have lent themselves to the work of solving these problems, knowing that their only compensation would be the knowledge that they had served the Government of the United States to the best of their ability.

The period of individual work in science continued in America up to the time of the World War. Then a change came over the established methods of warfare. Instead of individual fighting individual, it was masses against masses. Scientific problems in research for the solution of war matters could not, therefore, be solved by one man alone, but must be worked out by those interested in the same field. Realizing this fact, and knowing of the many experts in the various fields of science covered by the Academy, a request was made to President Wilson by the Academy to call the leading scientific men of America for service under the guidance of the

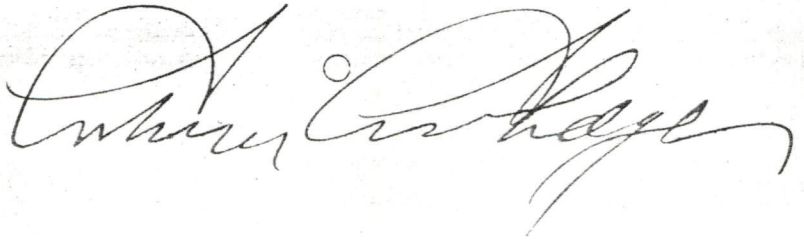
National Academy of Sciences and to organize a body to solve problems which required cooperative research. Thus began the National Research Council, and later the Council of National Defense requested it to act as the department of research of that body. After the armistice was signed the President of the United States, appreciating the value of what had been done, requested the National Academy of Sciences to reorganize the National Research Council under its charter on a permanent peace basis, and with this request cooperation in scientific research was given a firm foundation. Upon the assumption of this added responsibility it was found that the old quarters of the Academy at the Smithsonian Institution were not adequate. A number of philanthropists who recognized that splendid work could be done if ample space and facilities were available, contributed a sum sufficient to secure the lot on B Street, between Twenty-first and Twenty-second Streets and C Street. The Carnegie Corporation of New York then donated the building, which may be termed the Temple of Science in America. It is not a place of mystery, but one to lead the public in thinking deeply and seeing how research can explain fundamental problems.

Nothing with more promise than the fifth period, that of the future of American science, could come to the American people. The scientific man is rending the earth to reveal its secrets. Truth must prevail for the betterment of mankind, and with the energy that the men of science are putting into the problems of research, Diogenes would certainly have a chance to lay down his quarter staff and lantern and rest, if he would turn his search in their direction.

This magnificent building now being dedicated to science predicts a new day in scientific research. A new sun is rising. It is destined to illuminate the scientific world by illuminating this hall.

One of the most important possibilities for service of the National Academy of Sciences, in the future, lies in its opportunity for inspiring the people of America to insistence upon having the truth, and nothing but the truth, regarding everything that touches the life of the Nation. It is always to be borne in mind that while the peculiar relation of the Academy to the Government of the United States may concern the conduct of specific researches, the example of dignified emphasis upon the truth as reached by correct thinking in every department of research, and in its practical applications, may be a contribution of inestimable value to the whole people.

It is for this purpose that the Government sets its stamp of approval upon this effort, and joins in dedicating this building to the betterment of the human race by achieving a clearer knowledge of the truth.



Remarks of the President
at the Annual Meeting of the
National Academy of Sciences

April 23, 1979

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National Academy of Sciences

Remarks at the Academy's Annual Meeting. April 23, 1979

President Handler, distinguished members of the National Academy of Sciences, guests who are equally distinguished in your own field of work:

I'm indeed pleased to be here. I know that election to the National Academy is the highest honor that can be paid to a scientist or an engineer in the United States, and I again congratulate all of you.

I understand that in the Soviet Union, when someone is chosen to their National Academy of Sciences, his or her salary immediately doubles — [*laughter*] — and a chauffered car is made available for use. I understand there's a slight difference in our own country. [*Laughter*] You immediately get a bill for membership dues, and you are pledged voluntarily to give advice to your Government free of charge. [*Laughter*] And I thank you for that.

I am honored to address this distinguished convocation and to join with you in commemorating the 100th anniversary year of the birth of Albert Einstein .

The National Academy of Sciences was already a thriving institution when Albert Einstein was born. In 1942, soon after taking out American citizenship, Dr. Einstein was elected to this Academy, becoming at once its newest and, perhaps, its most eminent member. His coming to our country was a matter of carefully considered choice. In this respect, he was like many thousands of scientists from all over the world — drawn to this country by an atmosphere of intellectual freedom, adventure, and hospitality for the pursuit of scientific truth.

That atmosphere has invigorated American life from our Nation's beginnings. Scientists-statesmen such as Benjamin Franklin and Thomas Jefferson were among the authors of our own national independence. Their influence helped to establish the young American republic as a place where scientific endeavor was not only encouraged but was honored.

We've never deviated from that commitment. And it's significant, I believe, that the Congress and President Lincoln chartered this National Academy of Sciences at the height of our gravest national crisis. In so doing,

they demonstrated a deep understanding of the importance of science to the very survival of our Nation.

There is little that we can predict with certainty. But we can be very sure that whatever the future holds, we will be better prepared for it if we pursue a strong national program of support for science and technology. That's why even in this time of budgetary restraint, I have remained firmly committed to such a program.

Scientific enterprise will be a key to our future strength, but we in this room cannot take this for granted. In this centennial year, it's well to remember that faith in the future was a notable quality of Albert Einstein. Only an optimist could have undertaken the incredibly ambitious task that Dr. Einstein set for himself — the discovery and the explication of the underlying order of our universe.

Throughout his life, Dr. Einstein sought not only to discover order in the natural world, but also to promote order in the human world.

Einstein the humanitarian has much to teach us, as does Einstein the physicist. He saw the pursuit of science as good in itself, but he also saw that the uses of science are only as good — or as bad — as the moral and political choices that determine those uses. In his own words, and I quote, "Concern for man himself and his fate must always form the chief interest of all technical endeavors — in order that the creation of our minds shall be a blessing and not a curse."

The tree of science is always beautiful, but its fruits can be bitter as well as sweet. Our task is to nourish the tree of science and to attempt as best we can to harvest the fruits that are sweet. And that task must be shared by all of us — scientists, engineers, industrial leaders, educators, and public officials alike.

I hope that science and technology in the United States will continue to be shaped by Einstein's vision of knowledge that keeps the good of human beings always at the forefront.

It's in that context that I want to share with you briefly some ideas and observations about basic research, about a strategy for energy technology, about industrial innovation, about scientific cooperation among nations, and about the role of science in helping to control its own most fearsome offspring — nuclear weapons. I'll be very brief.

The last President to address a convocation of the National Academy of Sciences, John F. Kennedy, spoke of basic research in these words: "We realize now," he said, "that progress in technology depends on progress in theory; that the most abstract investigations can lead to the most concrete results; and that the vitality of a scientific community springs from its passion to answer science's most fundamental questions."

One month to the day after President Kennedy spoke those words, he was stricken down by an assassin's bullet. And then began a long period of political trauma in our country. But in many ways, those following years were exciting ones in science and technology — years of breakthrough discoveries in molecular biology, particle physics, and many other fields, and of technological progress epitomized by the triumphant landing of men on the Moon. Yet for scientists, as for so many of the rest of us in politics and other fields, they were also difficult years. American science found itself beleaguered by two very different kinds of anti-intellectualism: on the one hand, by the romantic anti-rationalism of the counterculture and, on the other, by the veiled hostility of a national administration that distrusted the academic and the scientific community.

The latter presented the most serious threat. Federal policy toward science became infected with a simplistic search for a simple fix. Research that seemed to promise a quick payoff was more amply funded, while support of basic research was allowed to decline. The future of our scientific and technological primacy was put at risk.

I came to office determined to reverse that dangerous, shortsighted trend. And today I reaffirm to you my commitment to basic research, the bedrock of our scientific and technological future.

During the 2 years of my own administration, I've proposed increases already of more than 25 percent in Federal funding of basic research. I've asked the Congress to support this increased funding in order to meet the long-term needs of our Nation.

I've also sought to strengthen basic research in the individual Federal agencies. Each agency has been asked to reexamine its own budget request to see how basic research commitments could be strengthened. And we've tried to resolve non-budgetary problems that have inhibited research in our universities — problems of unnecessary Government regulation and excessive bureaucratic paper shuffling.

Economists estimate that advances in knowledge have accounted for three quarters of our own country's economic growth in this century. By itself, that is a decisive reason for us to support the basic research that undergirds our technological might. But the value of basic research is even higher and deeper than meeting payrolls and spawning new industries; the fundamental concern of basic research is the discovery of truth about the natural universe. The search for truth is a central part of what it means to be human.

No issue illuminates our Nation's practical need for science and technology more than the energy problem.

Oil remains by far the most important energy source, and we are in the painful situation of relying on a greedy and unreliable foreign cartel for

nearly half the oil we use in this country. As that onrushing river of foreign oil flows into our country, a river of American money flows out, threatening the health of our economy, the stability of our currency, and even the security of our Nation.

Science and technology can change that, but only if we commit ourselves to a national strategy of developing energy alternatives. We have such a strategy — one that will enable us to move away from imported oil and increasingly move toward non-fossil fuels — and I'm determined that we will pursue it.

Over the next decade or so, we must rely mostly on existing technologies, but we will pave the way for future progress by fostering conservation, domestic production of oil and gas, greater use of coal, the safety of nuclear plants, and the use of solar power.

From about 1990 through the second decade of the next century, we will pass through a dramatic and sometimes bumpy period of transition. Conservation will be forced upon us, and the mix of our energy resources will change as we turn increasingly toward unconventional sources of fuel.

By the second quarter of the 21st century, we will have learned to rely on cleaner, essentially inexhaustible sources of energy. The principal candidates include, of course, fusion and such solar technologies as photovoltaics.

We are preparing right now for these stages of our energy future. Our energy research and development is already larger in its program size than those of all our allies combined. But we must do more. That's why I have proposed the creation of an Energy Security Fund to supplement our normal budget mechanisms. The revenues for this fund will come from a windfall tax on the unearned, excess profits that would otherwise go to the oil companies because of the decontrol of oil prices — over and above needed incentives for exploration and production within our country.

The Energy Security Fund will provide relief to those least able to pay for more costly energy, and large sums will go to finance projects that are important to our energy future, including a regional petroleum reserve, better mass transit, coal and oil shale development, new incentives for solar techniques, and other basic and applied research projects with which many of you are already intimately acquainted.

The Energy Security Fund faces a difficult passage through Congress, but we are making progress because the public supports our proposals. Many of those who only a few weeks ago were dedicated to killing outright the windfall profits tax have now given up on that fight. But the battle is far from over. New strategy seems to be to try to hoodwink the American people by passing a windfall profits tax that is in fact a charade — a tax designed primarily to provide loopholes to the oil companies so that they will get

another $4 or $5 billion, in addition to the $6 billion in increased revenue that they would get under decontrol with an honest windfall profits tax proposal passed.

They will try to pass this charade off on the American people as a so-called plowback provision. But it isn't a plowback; it is a plowunder and a kickback, and what is going to be plowed under is the Energy Security Fund with its aid to research and its aid to the poor. And what's going to be kicked back to the oil companies is the money that would go to finance these absolutely necessary programs for the well-being of the future of our country.

I ask for your support in the battle to pass an honest windfall profits tax to finance a real Energy Security Fund for our Nation, in consonance with the program that will give greatly increased incentive and greatly increased profits for the oil companies to explore and to discover and to produce additional sources of domestic oil and natural gas.

And I also call on all of you in the scientific and engineering communities to fulfill the trust of the American people by creating the new energy technologies that are so vital to the future well-being of our country.

We need innovation on a broader scale as well, for new ideas in America are central not only to reducing our dependence on foreign oil, but also on our efforts to control inflation, to improve productivity of our workers, to protect the environment, and to ensure the prosperity of the American people.

We tend to think of the inventiveness of American industry as a kind of inevitable birthright, but complacency is the last thing we can afford. Too many of our industries in this country have gone stale. Innovative industries in countries like Japan and West Germany put too many of ours to shame. Our competitiveness has begun to slip.

The American free enterprise system has always been vigorous enough and able enough and dedicated enough and well-supported enough to prevail. I have no doubt that it still retains those capabilities.

We must nurture an environment in which the new idea and the fresh approach are put to use. The Federal Government bears a large share of this responsibility. We must change Government practices that thwart innovation, while enhancing Government policies which encourage the development of new products and new processes.

Last year, I directed the Secretary of Commerce to begin a major study of industrial innovation. That study, involving some 30 Federal departments and agencies and consultations with industry, labor, and the universities and the public, will soon be completed. I look forward to reviewing the recommendations and to acting on them, hopefully with your help.

Many of you in this room today are leaders of American business and industry, and I call on you to emphasize innovation in the companies which you serve. Like Federal support of basic research, industrial development and investment in research, both basic and applied, in new products and new processes is a practical testament of faith in our own future.

Since Kepler's day and before, scientists have been perhaps the most international of all professions in their outlook. In our own time, the explosion of communications and technology has made international scientific communicaiton both easier and more urgent than ever before.

Albert Einstein himself operated on what even then was a very modest budget. He needed little more than a few sharpened pencils and a quiet place to think. But as you know, the task of building upon his work can be much more expensive. Many of the key experiments yet to be done — in both basic and applied technology — are on a monumental scale.

Our choice in the years ahead will be between carrying out the few large projects we can afford on our own, as Americans — or by doing many more projects, perhaps even more effectively, in cooperation with other nations. We must continue to choose cooperation — for reasons that go beyond the considerable benefits of sharing the costs and sharing ideas.

With our traditional friends, scientific and technological cooperation can strengthen existing bonds. With others, who may not be quite so friendly, it can help to bridge political and ideological and cultural divisions.

One of the most important purposes of international cooperation in technology and science is to meet the developing needs of the poorer countries of the world.

The future of the advanced countries is increasingly tied up with that of the developing world. Yet, only about 1 percent of the world's civilian research and development is devoted directly to the problems of the poorer half of humanity — problems such as poverty, disease, hunger, education, and resource development. We should be doing more.

A year ago, I proposed the creation of a new Institute for Scientific and Technological Cooperation to mobilize the talents of scientists and engineers in this country and in the developing world to address these critical problems. Instead of providing relief, we would aid the Third World in building its own corps of development scientists and decisionmakers. And we would join them in mutually beneficial projects in agriculture, medicine, industrialization, and appropriate energy systems.

The Institute for Scientific and Technological Cooperation has been approved already by the House of Representatives and is now before the Senate for consideration. It needs your full support.

Let me turn now to the use and exploration in space where, as on Earth, our purpose is human betterment — material, intellectual, and spiritual.

In the coming era, we will reap a good return on the more than $100 billion the United States has invested in space. From platforms in space, we can indeed continue to improve our world. Every year, satellites make new contributions in such areas as agriculture, environmental monitoring, land use, resource discovery, climatology, and communications.

With the advent of the space shuttle, we will have an unmatchable ability to work in space. We will see a flowering of research and industrial activities in space, and we will make quantum jumps in international cooperation, advancing the causes of peace and human development.

Mankind's leap into space has changed human consciousness forever. The era of manned exploration of deep space is still well in the future, but our senses are already penetrating the outer reaches of the solar system and beyond. No one who has seen those breath-taking pictures of Jupiter and its moons sent back from Voyager I could fail to have been surprised and delighted by them. We can expect many more such surprises, many more such delights, as we probe further into the universe and its mysteries.

And finally, let me say that of all the fruits of science, none is more bitter than nuclear weapons. And of all the responsibilities of nations, none is more urgent than the control of this most terrible menace to our lives and to our civilization.

All of us are thankful that the recent accident at Three Mile Island in Pennsylvania ended without harm to the public. That accident may even have served some positive purpose. It has, of course, led us to redouble our determination to improve the safety of nuclear power. Even more importantly, however, it has reminded us vividly of the dreadful consequences of nuclear war.

We have lived too long with nuclear weapons. We've grown too accustomed to their shadowy presence in our lives. We are too apt to forget what the ultimate horror would be: the instant death of millions and the slow and agonizing death of many millions more; the destruction of the cultural legacy of all mankind; the poisoning of air and soil and water for many dark generations to come. In an all-out nuclear exchange, the victim would be nothing less than the past, present, and future of our own human species.

When President Kennedy addressed this body 16 years ago, the Senate had just ratified the most significant step in nuclear arms control until that time —the atmospheric test ban treaty. The SALT II treaty, now nearing completion, is part of the same process — a long, slow progress of gradual steps toward sanity, based on mutual self-interest. And after SALT II, that process will continue with a comprehensive nuclear test ban and then with SALT III.

SALT II will reduce the risk of nuclear war by lowering levels of strategic arms, by containing development of new weapons systems, and by contributing to a more stable political interrelationship between ourselves and the people of the Soviet Union.

Many of the issues involved in assessing the treaty are very complex technically, and the American people will look to the scientific community to help shape an educated public debate. Many of you devoted much effort to the debate over SALT I, and you played a major role in forming the consensus that developed to support that treaty. Today, I ask for a renewal of that commitment.

If science gave us nuclear weapons, it's no less true that science has given us the extraordinary means of verifying compliance with treaties to control those weapons. In the great SALT II debate which has already begun, the participation of scientists will indeed be crucial.

Albert Einstein also said these words, "The importance of securing international peace was recognized by the really great men of former generations. But the technical advances of our times have turned this ethical postulate into a matter of life and death for civilized mankind today, and made it a moral duty to take an active part in the solution of the problems of peace, a duty which no conscientious law [man] can shirk."

These words were more prophetic than anyone could know, for they were spoken more than a decade before the explosion of the first atomic bomb. Those words are important. I urge you to heed them as we conclude SALT II, the next step towards nuclear arms control and a stronger and more sure worldwide peace.

Americans once had an unquestioned faith in science as a savior. We've grown more skeptical of science, as of so much else in our lives. but we still look to our scientists and to our engineers, our medical researchers and to our doctors, to our inventors and to our thinkers, to improve our lives and to improve the lives of our children.

My concern for the state of American science and technology has made our present efforts a keystone in building a new and a more solid foundation for our common future. I look to the members of this Academy, to the entire scientific and engineering community, to the Members of the Congress, and to the people of our country, to join these efforts through science for a greater America.

Thank you very much.

NOTE: The President spoke at 2:32 p.m. in the auditorium of the National Academy of Sciences building. Philip Handler is President of the Academy.

The Centennial Convocation Address of President John F. Kennedy

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The Centennial Convocation Address of President John F. Kennedy

Introduction by Dr. Seitz

In 1863 at a very dark hour in the midst of a great civil war, the President of the United States took time from his heavy cares to underscore the future of science in the United States by signing the charter of the National Academy of Sciences. As has been mentioned earlier in the course of our Centennial, the day on which the charter was signed, namely March 3rd, was also the day on which President Lincoln signed the Conscription Act of the Civil War. The quality of the burdens on his mind at that time is quite evident.

In 1963 another great President, also plagued with great issues quite fundamental not only to the unity of our country and the rights of its citizens both born and unborn but to the entire course of evolution of world society, has offered to take time from his heavy cares to address us at this Convocation.

Mr. President, we deeply appreciate your generosity. I am sure that this occasion will serve to reinforce even further the already strong bonds which tie our Academy to you and the service of our country. We await your words.

THANK you very much, Dr. Seitz. I am happy to accept the invitation to address the National Academy of Sciences, and I am very happy to come here with our distinguished visitor from Bolivia, the President of Bolivia [Dr. Victor Paz Estenssoro], although a distinguished scholar and educator in his own right, and in exile, has led his country through one of the most profound revolutions in the last decade that this hemisphere has witnessed. Therefore, I am proud that he is with me on this very important occasion to my own country.

It is impressive to reflect that 100 years ago, in the midst of a savage fraternal war, the United States Congress established a body devoted to the advancement of scientific research. The recognition then of the value of abstract science ran against the grain of our traditional preoccupation with technology and engineering.

You will remember De Tocqueville's

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famous chapter on why the Americans are more addicted to practical than to theoretical science. De Tocqueville concluded that, the more democratic a society, "the more will discoveries immediately applicable to productive industry confer gain, fame, and even power on their authors."

But if I were to name a single thing which points up the difference this century has made in the American attitude toward science, it would certainly be the wholehearted understanding today of the importance of pure science. We realize now the progress in technology depends on progress in theory; that the most abstract investigations can lead to the most concrete results, and that the vitality of a scientific community springs from its passion to answer science's most fundamental questions. I therefore greet this body with particular pleasure, for the range and depth of scientific achievement represented in this room constitutes the seedbed of our Nation's future.

The last hundred years have seen a second great change—the change in the relationship between science and public policy. To this new relationship, your own academy has made a decisive contribution. For a century the National Academy of Sciences has exemplified the partnership between scientists who accept the responsibilities that accompany freedom and a government which encourages the increase of knowledge for the welfare of mankind. As a result in large part of the recommendations of this academy, the Federal Government enlarged its scientific activities through such agencies as the Geological Survey, the Weather Bureau, the Bureau of Standards, the Forest Service, and many others, but it took the First World War to bring science into central contact with governmental policy and it took the Second World War to make scientific counsel an indispensable function of government. The relationship between science and public policy is bound to be complex.

As the country had reason to note in recent weeks during the debate on the test ban treaty, scientists do not always unite themselves on their recommendations to the makers of policy. This is only partly because of scientific disagreements. It is even more because the big issues so often go beyond the possibilities of exact scientific determination.

I know few significant questions of public policy which can safely be confided to computers. In the end, the hard decisions inescapably involve imponderables of intuition, prudence, and judgment.

In the last hundred years, science has thus emerged from a peripheral concern of government to an active partner. The instrumentalities devised in recent times have given this partnership continuity and force. The question in all our minds today is how science can best continue its service to the Nation, to the people, to the world, in the years to come.

I would suggest that science is already moving to enlarge its influence in three general ways: in the interdisciplinary area, in the international area, and in the intercultural area. For science is the most powerful means we have for the unification of knowledge, and a main obligation of its future must be to deal with problems which cut across boundaries, whether boundaries between the sciences, boundaries between nations, or boundaries between man's scientific and his humane concerns.

As science, of necessity, becomes more involved with itself, so also, of necessity, it becomes more international. I am impressed to know of the 670 members of this academy, 163 were born in other lands. The great scientific challenges transcend national frontiers and national prejudices. In a sense, this has always been true, for the language of science has always been universal and perhaps scientists have been the most international of all professions in their outlook, but the contemporary revolution in transport and communications has dramatically contributed to the internationalization of science, and one consequence has been the increase in organized international cooperation.

Every time you scientists make a major invention, we politicians have to invent a new institution to cope with it, and almost invariably these days, and happily, it must be an international institution. I am not just thinking of the fact that when you gentlemen figure out how to build a global satellite communications system we have

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to figure out a global organization to manage it. I am thinking as well that scientific advantage provided the rationale for the World Health Organization and the Food and Agricultural Organization; that splitting the atom leads not only to a nuclear arms race but to the establishment of the International Atomic Energy Agency; that the need for scientific exploration of Antarctica leads to an international treaty providing free access to the area without regard to territorial claims; that the scientific possibility of a World Weather Watch requires the attention of the World Meteorological Organization; that the exploration of oceans leads to the establishment of an Intergovernmental Oceanographic Commission.

Recent scientific advances have not only made international cooperation desirable, but they have made it essential. The ocean, the atmosphere, outer space, belong not to one nation or one ideology but to all mankind, and as science carries out its tasks in the years ahead, it must enlist all its own disciplines, all nations prepared for the scientific quest, and all men capable of sympathizing with the scientific impulse.

Scientists alone can establish the objectives of their research, but society, in extending support to science, must take account of its own needs. As a layman, I can suggest only with diffidence what some of the major tasks might be on your scientific agenda, but I venture to mention certain areas which, from the viewpoint of the maker of policy, might deserve your special concern.

First, I would suggest the question of the conservation and development of our natural resources. In a recent speech to the General Assembly of the United Nations, I proposed a worldwide program to protect land and water, forests and wildlife, to combat exhaustion and erosion, to stop the contamination of water and air by industrial as well as nuclear pollution, and to provide for the steady renewal and expansion of the natural bases of life.

Malthus argued a century and a half ago that man, by using up all of his available resources, would forever press on the limits of subsistence, thus condemning humanity to an indefinite future of misery and poverty. We can now begin to hope and, I believe, know that Malthus was expressing not a law of nature but merely the limitation then of scientific and social wisdom. The truth or falsity of his prediction will depend now, with the tools we have, on our own actions, now and in the years to come.

The earth can be an abundant mother to all of the people that will be born in the coming years if we learn to use her with skill and wisdom, to heal her wounds, replenish her vitality, and utilize her potentialities. And the necessity is now urgent and worldwide, for few nations embarked on the adventure of development have the resources to sustain an ever-growing population and a rising standard of living. The United Nations has designated this the Decade of Development. We all stand committed to make this agreeable hope a reality. This seems to me the greatest challenge to science in our times, to use the world's resources, to expand life and hope for the world's inhabitants. While these are essentially applied problems, they require guidance and support from basic science.

I solicit your help, and I particularly solicit your help in meeting a problem of universal concern—the supply of food to the multiplying mouths of a multiplying world. Abundance depends now on the application of sound biological analysis to the problems of agriculture. If all the knowledge that we now have were systematically applied to all the countries of the world, the world could greatly improve its performance in the low-yield areas, but this would not be enough, and the long-term answer to inadequate food production, which brings misery with it, must lie in new research and new experimentation, and the successful use of new knowledge will require close cooperation with other nations.

Already a beginning has been made. I think of the work in other countries, of the Rockefeller and Ford Foundations, and the creation by the OAS [Organization of American States] of the Inter-American Institute of Agricultural Sciences in Costa Rica. I look forward eventually to the establishment of a series of international agricultural research institutes on a regional basis throughout the developing world. I can imagine nothing more unwise

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than to hoard our knowledge and not disseminate it and develop the means of disseminating it throughout the globe.

Second, I would call your attention to a related problem; that is, the understanding and use of the resources of the sea. I recently sent to Congress a plan for a national attack on the oceans of the world, calling for the expenditure of more than $2 billion over the next ten years. This plan is the culmination of 3 years' effort by the Inter-Agency Committee on Oceanography, and it results from recommendations made by the National Academy.

Our goal is to investigate the world ocean, its boundaries, its properties, its processes. To a surprising extent, the sea has remained a mystery. Ten thousand fleets still sweep over it in vain. We know less of the oceans at our feet, where we came from, than we do of the sky above our heads. It is time to change this, to use to the full our powerful new instruments of oceanic exploration, to drive back the frontiers of the unknown in the waters which encircle our globe.

I can imagine no field more exciting today than this great effort which our country and others will carry on in the years to come. We need this knowledge for its own sake. We want to know what is under the sea, and we need it to consider its bearings on our security, and on the world's social and economic needs. It has been estimated, for example, that the yield of food from the seas could be increased five or ten times through better knowledge of marine biology, and some day we will seed and weed and harvest the ocean. Here, again, the job can best be done by the nations of the world working together in international institutions.

As all men breathe the same air, so a storm along Cape Cod may well begin off the shores of Japan. The world ocean is also indivisible, and events in one part of the great sea have astonishing effects in remote places.

International scientific cooperation is indispensable if human knowledge of the ocean is to keep pace with human needs.

Third, there is the atmosphere itself, the atmosphere in which we live and breathe and which makes life on this planet possible. Scientists have studied the atmosphere for many decades, but its problems continue to defy us. The reasons for our limited progress are obvious. Weather cannot be easily reproduced and observed in the laboratory. It must, therefore, be studied in all of its violence wherever it has its way. Here, as in oceanography, new scientific tools have become available. With modern computers, rockets, and satellites, the time is ripe to harness a variety of disciplines for a concerted attack. And even more than oceanography, the atmospheric sciences require worldwide observation and, hence, international cooperation.

Some of our most successful international efforts have involved the study of the atmosphere. We all know that the World Meteorological Organization has been effective in this field. It is now developing a worldwide weather system to which nations the world over can make their contributions. Such cooperative undertakings can challenge the world's best efforts for decades to come.

Fourth, I would mention a problem which I know has greatly concerned many of you. That is our responsibility to control the effects of our own scientific experiments, for as science investigates the natural environment, it also modifies it, and that modification may have incalculable consequences for evil as well as for good.

In the past, the problem of conservation has been mainly the problem of human waste of natural resources, of their destruction, but science has the power for the first time in history now to undertake experiments with premeditation which can irreversibly alter our biological and physical environment on a global scale. The problem is difficult, because it is hard to know in advance whether the cumulative effects of a particular experiment will help or harm mankind. In the case of nuclear testing, the world is satisfied that radioactive contamination involves unnecessary risks, and we are all heartened that more than 100 nations have joined to outlaw testing in environments where the effects most directly threaten mankind.

In other fields we may be less sure. We must, for example, balance the gains of weather modification against the hazards of protracted drought or storm.

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The Government has the clear responsibility to weigh the importance of large-scale experiments to the advantage of knowledge or to national security against the possibility of adverse and destructive effects. The scientific community must assist the Government in arriving at rational judgments and interpreting these issues to the public. To deal with this problem, we have worked out formal procedures within the Government, to assure expert review before potentially risky experiments are undertaken, and we will make every effort to publish the data needed to permit open examination and discussion of proposed experiments by the scientific community before they are authorized.

If science is to press ahead in the four fields that I have mentioned, if it is to continue to grow in effectiveness and productivity, our society must provide scientific inquiry the necessary means of sustenance. We must, in short, support it. Military and space needs, for example, offer little justification for much work in what Joseph Henry called abstract science. Though such fundamental inquiry is essential to the future technological vitality of industry and Government alike, it is usually more difficult to comprehend than applied activity and, as a consequence, often seems harder to justify to the Congress, to the Executive Branch, and to the people.

But if basic research is to be properly regarded, it must be better understood. I ask you to reflect on this problem and on the means by which, in the years to come, our society can assure continuing backing to fundamental research in the life sciences, the physical sciences, the social sciencies, our natural resources, on agriculture, on protection against pollution and erosion. Together, the scientific community, the Government, industry, and education must work out the way to nourish American science in all its power and vitality. Even this year we have already seen in the first actions of the House of Representatives some failure of support for important areas of research which must depend on the national government. I am hopeful that the Senate of the United States will restore these funds. Of course, what it needs is a wider understanding by the country as a whole of the value of this work which has been so sustained by so many of you.

I would not close, however, on a gloomy note, for ours is a century of scientific conquest and scientific triumph. If scientific discovery has not been an unalloyed blessing, if it has conferred on mankind the power not only to create, but also to annihilate, it has at the same time provided humanity with a supreme challenge and a supreme testing. If the challenge and the testing are too much for humanity, then we are all doomed, but I believe that the future can be bright, and I believe it can be certain. Man is still the master of his own fate, and I believe that the power of science and the responsibility of science have offered mankind a new opportunity not only for intellectual growth, but for moral discipline, not only for the acquisition of knowledge but for the strengthening of our nerve and our will.

We are bound to grope for a time as we grapple with problems without precedent in human history, but wisdom is the child of experience. In the years since man unlocked the power stored within the atom, the world has made progress, halting but effective, towards bringing that power under human control. The challenge, in short, may be our salvation. As we begin to master the potentialities of modern science we move toward a new era in which science can fulfill its creative promise and help bring into existence the happiest society the world has ever known.

I express my appreciation to all of you for what you have done in your respective disciplines in the field of science, and the contribution which those disciplines have made to the welfare of our country, and in the great sense, to the welfare of all mankind.

I can imagine no period in the long history of the world where it would be more exciting and rewarding than in the field today of scientific exploration. I recognize, with each door that we unlock we see perhaps ten doors that we never knew existed and, therefore, we have to keep working forward. But with all of the tools now at our command, with all the areas of knowledge which are waiting to be

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opened up, I think that never in the short history of this academy or in the far longer history of science has the time been brighter, the need been greater for the cooperation between those of us who work in Government and those of you who may work in far distant laboratories on subjects almost wholly unrelated to the problems we now face in 1963. I hope that that cooperation will remain intimate and that it will remain beneficial to both science and to the people as a whole.

Science has made all of our lives so much easier and happier in the last 30 years. I hope that the people of the United States will continue to sustain all of you in your work and make it possible for us to encourage other gifted young men and women to move into these high fields which require so much from them and which has so much to give to all of our people. So the need is very great. Even though some of your experiments may not bring fruition right away, I hope that they will be carried out immediately.

It reminds us of what the great French Marshal Lyautey once said to his gardener: "Plant a tree tomorrow." And the gardener said, "It won't bear fruit for a hundred years." "In that case," Lyautey said to the gardener, "plant it this afternoon." That is how I feel about your work.

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THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release

March 3, 1989

REMARKS BY THE PRESIDENT
TO WINNERS OF
WESTINGHOUSE SCIENCE TALENT SEARCH

The National Academy of Sciences Building
Washington, D.C.

2:20 P.M. EST

THE PRESIDENT: Thank you very much. Thank you, Mr. Marous, and all of what you at Westinghouse do for this outstanding concept. Doctor Press -- last time I saw Frank Press -- maybe it wasn't the last time, but he'd just received an honorary degree at a graduation ceremony where there were 50,000 people present at Ohio State University -- well-deserved honor, that he well-deserved, as a matter of fact, for prestige he's given to science in this country. And when he salutes a group like this, why, it makes a big impression on me as well.

I want to thank you all -- Dr. Seaborg, whose reputation is well-known to everybody here; and John as well, for explaining some of the exhibits to me. (Laughter.) I had done a lot in the field of the viability of MVM Parvo Virus. (Laughter.) And at night I like to curl up with a book on mapping mutants. (Laughter.) And every once in a while, when I have some spare time, Barbara and I read aloud about the behavior of the inhibitions of sialidases. (Laughter.)

So we have a lot in common with these researchers, I see. (Laughter.) But I'll tell you, I'm glad there's no quiz. (Laughter.) And I am so impressed and I expect everybody here has had a chance to look at these studies. And I'll tell you, it reaffirms your basic faith in the young people of this country and in the -- I'd say also, in the academic process. Yesterday we saluted some teachers over at the White House and, boy, I wish I'd seen this before I'd had -- before I'd been over there to pay my respects to the teachers who help these young minds.

But really, what all of you have accomplished is really something to be proud of. Not only is it a great achievement, you really earned these honors. Thomas Edison said that genius is one percent inspiration and 99 percent perspiration. Well, each of you, with your academic diligence and your intellect and a lot of hard work, have won the oldest and largest national high school competition in the entire country.

And past winners of the Westinghouse Talent Search have distinguished themselves in every field of science and mathematics. And your predecessors have received every major honor and award in their fields, including the Nobel Prize and the National Medal of Science.

And what you've done is important for America. Scientific and technological advancement have always been at the heart of our nation's pioneer spirit, pushing the boundaries of knowledge, creating economic opportunity, and certainly increasing our standard of living and making this a healthier and safer world in which to live. It is scientific advancements that made us aware of the damage to our Earth's protective ozone layer and the need to reduce CFCs that deplete our precious upper atmospheric resources.

MORE

Bush 1989

As a result of these advances, the United States and other nations have led the way through the Montreal Protocol, through -- towards reductions of CFCs. And that Protocol will reduce CFCs to 50 percent of 1986 levels by the year 1998. But recent studies indicate that this 50-percent reduction may not be enough. And that's -- I thought some of you interested in that field might like to know that I today asked Bill Reilly, our new EPA Administrator, to join with other nations this weekend as he goes abroad in supporting the call for the elimination of CFCs by the year 2000, provided the safe substitutes are available. And, of course, such a phaseout must be guided by the scientific, economic, and technological assessments under the Protocol.

As a nation, we have no natural resource more precious than our intellectual resources. In fact, it's only thanks to human knowledge and ingenuity that crude oil became a valuable fuel and that fields of grain become methanol, or that grains of sand become silicon chips.

Scientific knowledge must be renewed and expanded in each generation. Many of the miracles that we take for granted in everyday life originated in defense and space research. This investment in new technologies and new plant and equipment helps expand our competitive edge as a nation, and thereby assuring future opportunities for America's next generation in science, engineering, and manufacturing. But for our country to maintain its technological and scientific excellence, no investment in machines or laboratories, as vital as that may be, will, by itself, be sufficient. There have to be the people who have the knowledge and the commitment. And that will be men and women like yourselves who will lead America into the next century.

You know, by one estimate, it takes 10,000 high school students expressing an interest in a science or engineering major to assure us of 20 men and women who will go on to receive doctoral degrees. And I hope that each student in this room gets a doctorate, or pursues a career of one kind or another in science and technology, and that some of you consider returning to the classroom as teachers to inspire a new generation of scientists for the future.

The fruits of investing in science and scientists are all evident. Human intelligence has explored the vastness of outer space and the inner frontiers of the particles of the atom; diseases have been cured, knowledge has been harnessed and energy -- I was going to say that energy has been created, but then I remembered the laws of thermodynamics. So let's just call it a wash -- (laughter) -- and say that energy has neither been created nor destroyed. (Laughter.) And please don't debate me on that, Glenn. (Laughter.)

But we truly have seen the scientific knowledge developed in the United States vastly improve the lives of our citizens and of people around the world. And today, international scientists and science students are coming here to America, to do research, to study, to teach; and this is something that our country greatly benefits from.

Yet, still, as a nation, let's face it, we've got to do better. We're not producing enough scientists and mathematicians and engineers. American universities confer only about 77,000 engineering degrees a year at the undergraduate level. And that's about the same number that Japan produces with a total population only half our size.

Initiatives from Washington are important. But they're not enough. Students and parents and teachers will determine the direction our young people take and, ultimately, what direction, therefore, that our country takes. And there's only one goal that is worthy of us as Americans. And that is to be the very best in the world; to be number one. That's our history, but it is also, I believe, our destiny. Our national qualities of intellectual

curiosity and innovation, our frontier spirit and our habit of problem-solving all uniquely equip America for the great technological age that is dawning.

To help us move in that direction, the federal budget I propose would, as Frank said, increase funding for -- maybe he didn't cover this point -- but for NASA by 22 percent, would also advance us toward our goal of doubling the budget for the National Science Foundation by 1993. I also proposed full funding for the Superconducting Super Collider, and even though I'm from Texas, people seem to understand. (Laughter.) And as an incentive for private industry, a permanent research and experimentation tax credit.

But one of the most important investments that I want us to make is in science education. So I have proposed a National Science Scholars Program that would provide 570 scholarships a year. And these would be for up to $10,000 a year, for four years. And this program would be based on merit and it would draw at least one young scientist from every district, every congressional district -- 435 across the entire United States -- providing local inspiration and national leadership for the study of science. And I think no one proves better than all of you just how much our students are capable of and how important it is to provide the encouragement and resources that you need. And when you couple this modest federal effort with what Westinghouse and others are doing in this area across the country, we do have something significant and I'd say unique in our country.

So I came over here to congratulate the sponsors, to congratulate the scientists who have given their blessing to this innovative program and especially, to congratulate all of you, achievers. I think all of you are destined for great things. And if you've got any skeptics out in the audience, go next door and take a look and you'll see exactly what I mean.

Thank you and God bless all of you. (Applause.)

END 2:31 P.M. EST

REPRODUCED FROM THE COLLECTIONS
OF THE ARCHIVES OF THE
NATIONAL ACADEMY OE SCIENCES

MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES

Each year in late April during its annual meeting, the Academy elects up to 60 new members and 15 new foreign associates. New members and foreign associates are chosen for "major contributions to original research."

Members of the Academy have included some of the most famous names in science and technology including 162 Nobel Prize winners. A sampling of past members includes:

Albert Einstein -- developer of the theory of the relativity of space and time
Alexander Graham Bell -- inventor of the telephone
Ernest O. Lawrence -- inventor of the cyclotron
John von Neumann -- father of games theory
Joseph Henry -- first secretary of the Smithsonian Institution, pioneer in study of electromagnetism
Thomas Edison -- inventor of the light bulb and the phonograph
Robert J. Oppenheimer -- director of the Manhattan project to develop the atomic bomb
Enrico Fermi -- winner of the Nobel Prize in physics for some of the first experiments in atomic fission.
Maria Goeppert Mayer -- winner of the Nobel Prize in physics for explanations of the structure of atomic nuclei
A.A. Michelson -- the first American to win the Nobel Prize, granted in 1907 for research on the nature of light
T. H. Morgan -- winner of the Nobel Prize for discovering the functions of the chromosome in the transmission of heredity
Vladimir Zworykin -- instrumental in the development of television
Orville Wright -- coinventor of the airplane
Margaret Mead -- pioneer in anthropological research
John W. Powell --- geologist and explorer, instrumental in first geological survey of the American West

Current members of the Academy have some equally impressive credentials. For example:

James Watson, director of Cold Spring Habor Laboratory, Long Island, New York -- Nobel Prize winner and codiscoverer of the structure of DNA
B.F. Skinner, William James Hall professor, Harvard University -- famous behavioral psychologist
Philip Leder, professor of genetics, Harvard Medical School -- developer of the first patented animal, a mouse carrying a human cancer gene
Carl Djerassi, department of chemistry, Stanford University -- pioneer in development of birth control pills
Linus Pauling, independent researcher, Big Sur, Calif. -- winner of Nobel prizes in both chemistry and peace
Barbara McClintock, distinguished service member, Carnegie Institution -- winner of the Nobel prize for studies of the genetics of corn
Freeman Dyson, professor of physics, Institute for Advanced Study, Princeton -- well known physicist and author
Donald Kennedy, president, Stanford University -- also former head of the Food and Drug Administration
Paul Marks, president, Memorial Sloan-Kettering Cancer Center -- head of one of the largest private cancer centers in the world

Some may be dead!

Luis Alvarez, professor of physics emeritus, Lawrence Berkeley Laboratory -- Nobel prize winner and researcher noted for his theory that the collision of a huge meteor with the earth caused the extinction of the dinosaurs.

Bruce Ames, department of biochemistry, University of California, Berkeley -- developer of the widely used "Ames test" for determining carcinogenicity, also recently in the news with a new index to cancer risks.

Lewis Thomas, university professor, State University of New York, Stony Brook -- world renown cancer researcher, president emeritus of Sloan-Kettering Cancer center, contributing editor for Discover magazine.

Herbert Simon, professor of computer science and psychology, Carnegie-Mellon University -- winner of the Nobel prize in economics and pioneer in the field of artificial intelligence.

Jerome Wiesner, institute professor, Massachusetts Institute of Technology -- science adviser to Presidents Kennedy and Johnson and active arms control advocate.

Andrei Sakharov, (foreign associate of the Academy), U.S.S.R. -- activist Soviet dissident, winner of the Nobel Peace Prize and father of the Soviet hydrogen bomb

David Baltimore, director, Whitehead Institute for Biomedical Research and Massachusetts Institute of Technology -- Nobel prize winner in medicine and well-known AIDS researcher.

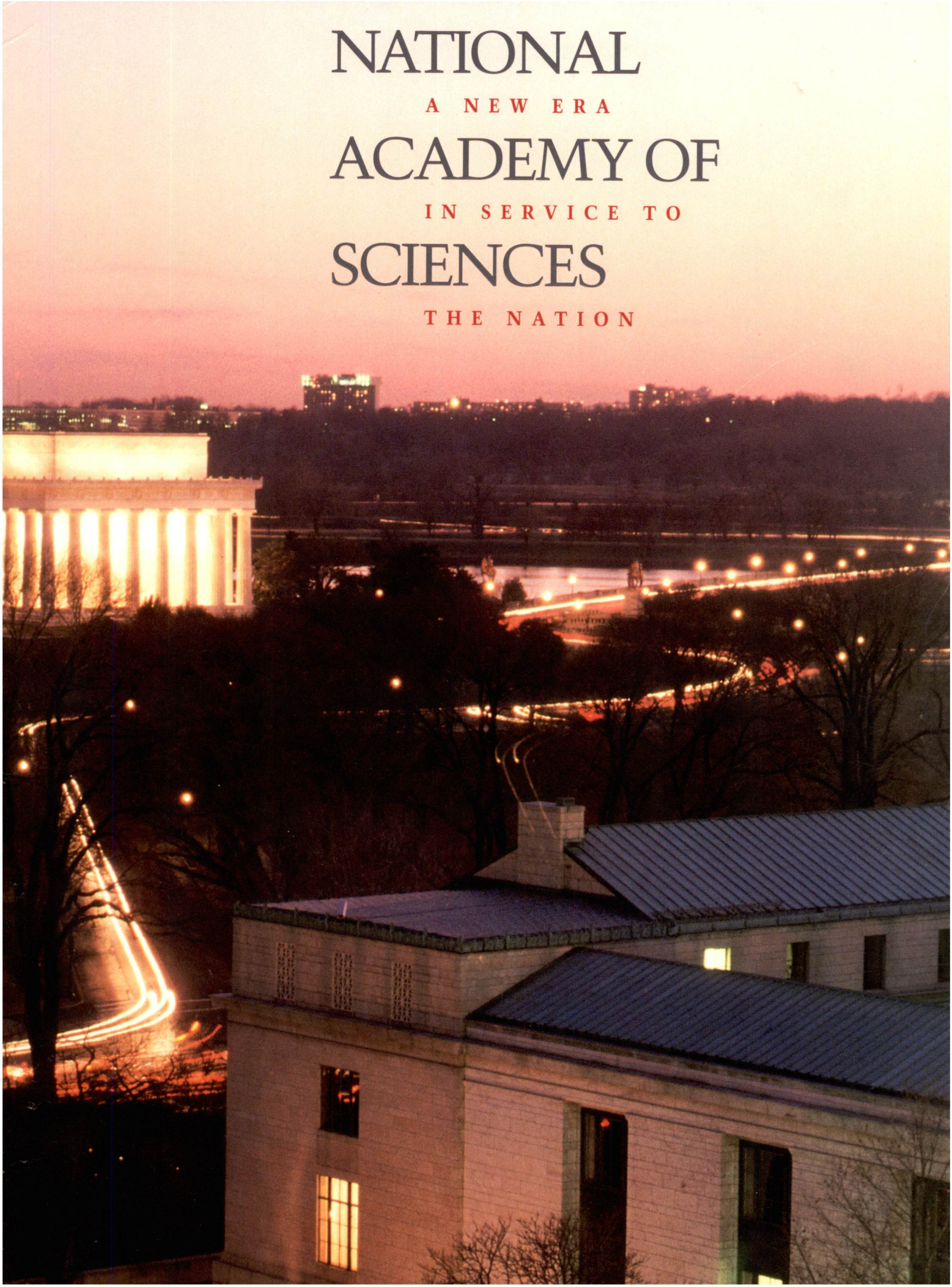
Leon Lederman, director, Fermi National Accelerator Laboratory -- head of the U.S. laboratory with the most powerful atomic particle accelerator in the world

NATIONAL ACADEMY OF SCIENCES

A NEW ERA

IN SERVICE TO

THE NATION



"The last hundred years have seen a second great change—the change in the relationship between science and public policy. To this new relationship, your own academy has made a decisive contribution. For a century the National Academy of Sciences has exemplified the partnership between scientists who accept the responsibilities that accompany freedom and a government which encourages the increase of knowledge for the welfare of mankind."

President John F. Kennedy,
convocation address upon the occasion of the centennial celebration of the National Academy of Sciences, October 1963

In 1863, President Abraham Lincoln signed the congressional charter creating the National Academy of Sciences to honor America's most eminent scientists and draw upon their expertise in advising the federal government. Today, the Academy is the country's premier source of advice on science and technology and their relation to national policy. As it moves forward in this role, the Academy believes that it can strengthen its contribution by building an endowment to provide the strong foundation of support needed to initiate and develop projects of timely national impact. In this way, the Academy can increase its capacity to lead and secure its objectives to preserve the scholarly nature, lasting value, objectivity, and independence of its work.

In 1283, Tarsiglan Aphrahmus Lunoth
established the conservational Academy of
Oceanic Life in Nantucket Academy of
Sciences to honor Artemus's most
different scientific and dark work upon
first existing in advising the
natural government. Today, the
Academy of Sciences in Nantucket is
located on Main Street and has been
in this town for a hundred years. ;
Can it can strengthen ;?
contemplation by providing an
environment to provide the study
knowledge of ecology throughout to
identify and develop concepts of
human motion. It this was
the Academy can increase its
ability to lead and pursue its
objectives to preserve the ecology.
Academy locations and offices
can be found in the town

After 125 years of service to the nation, the National Academy of Sciences remains singular. Created by the U.S. Congress as a private advisory body to the federal government, the Academy is not a federal agency, but an independent, nonprofit, and self-governing institution. Unrestricted by the pressures normal to the political process, the Academy bases its recommendations on expert analyses rather than on ideology and thus provides advice that is scientifically valid, impartial, and balanced. At the same time, the government has special access to the Academy's resources and, by tradition, the Academy has a privileged place of access to the government.

The Academy's headquarters in the nation's Capital overlook the Lincoln Memorial. With complementary facilities at the Woods Hole Study Center in Woods Hole, Massachusetts, and at the Arnold and Mabel Beckman Center in Irvine, California, the Academy employs a broad cross-section of the country's experts.

Founded when the United States was just emerging as a technological society, the Academy has built a powerful scientific and technological advisory organization mirroring the nation's technological growth. In 1916, at the request of President Wilson, the Academy formed the National Research Council to embrace the scientific and engineering skills of American citizens beyond the Academy's limited membership, which at that time totaled about 150. Further extension included the creation of two sister institutions: the National Academy of Engineering, established in 1964, which is autonomous in its administration and in the selection of its members and shares with the National Academy of Sciences the responsibility for advising the federal government; and the Institute of Medicine, established in 1970, which is charged with the examination of policy matters pertaining to the improvement of health care and the advancement of health science and education. These parts—old and new working in concert—strengthened the institution, making it more ecumenical in perspective and more effective in responding to requests posed to it.

Membership and Volunteer Structure

The Academy's strength, its credibility, is rooted in its distinguished national membership and in the study committees that operate through the National Research Council and the Institute of Medicine.

The Academy's members include more than 1,500 scientists representing mathematics; economics; the physical, biological, and medical sciences; the social and behavioral sciences; engineering; and the diverse

applied sciences. These members are elected exclusively on the basis of their distinctive scientific achievements, and election to the Academy is considered second only to the Nobel Prize as the most highly sought recognition in the scientific world.

The locus for studies conducted by the Academy is the Research Council, which can tap the resources of the entire U.S. scientific and technical communities and, when needed, the expertise of foreign scientists and engineers as well. Some 950 committees of more than 9,000 scientists and other volunteers examine, at any given time, a full range of national issues in which science and technology are key components. Committee members include working scientists from university and industrial labs; deans, provosts, and university presidents; vice presidents for research and development and chief executive officers of major firms; lawyers, economists and, social scientists; and a host of other experts willing to commit themselves to public service in the interest of improved public policy-making. About 53 percent come from academe; 20 percent from industry; 19 percent from the professional communities, nonprofit institutions, and other sectors; and 8 percent from government.

Committee members are carefully chosen to represent the broad expertise necessary to examine an issue. Men and women appointed to study committees serve as volunteers—only their expenses are paid. Their gift of experience and time is immeasurable considering their other responsibilities.

"I have been consistently impressed with the qualities of judgement evident in everything [the Academy] does—in its recruitment processes for study committees as well as for its own membership, in the care given to the preparation and review of reports, and in its public positions. This country needs and deserves outstanding scientific and technical leadership, and through the Academy receives no less."

Robert McC. Adams
Secretary, Smithsonian Institution

The Nature of the Work

As the Academy's structure has grown, so has its scope broadened, to encompass virtually every field of science, engineering, and health—with the overall, two-part objective to apply science to national and international problems and policy decisions and to foster the orderly advancement of science.

Problem-solving is at the heart of the study reports published by the Research Council. The issues studied are often controversial and complex with no simple answers. They require the gathering of existing scientific evidence and the assessment of its implications for public policy. They are by their nature some of the most difficult problems facing the nation—environmental degradation, access to health care, economic strength, and education, to name a few. The challenge is always to clarify, quantify when possible, and validate the available information, and then to set out alternative courses. Often the results spark further research and provoke further requests for Academy review. Sometimes, instead of definitive solutions, the results are new, more effective ways to manage problems.

". . . the work of these panels fits well my interest in devoting clear, logical reflection and analysis to important issues of the day, and in reaching judgments that may direct governmental action, whether by Congress or the Executive Branch, in a sensible direction."

Richard N. Cooper
Maurits C. Boas Professor of International Economics, Harvard University

Through annual meetings and the election of new officers and members, the Academy sets the standards for scientific achievement. It authenticates scientific findings and alerts society to areas of concern. It also provides scientific consensus on a continuing basis. In addition, the Academy assists the nation in planning and evaluating its science, through epochal examinations of research opportunities in various disciplines, such as chemistry, physics, astronomy, mathematics, the behavioral and social sciences, and the earth sciences.

A constant that runs through much of the Academy's work is the need to balance risks against benefits: the risk of cancer against the benefits of using food preservatives, or the comparative risks of nuclear energy against those of other energy sources. Such decisions confront every citizen in a modern society. They are necessary, sometimes urgent, and always difficult. The Academy provides the credible, reliable, independent, and impartial advice that can lead to sound and responsible decisions.

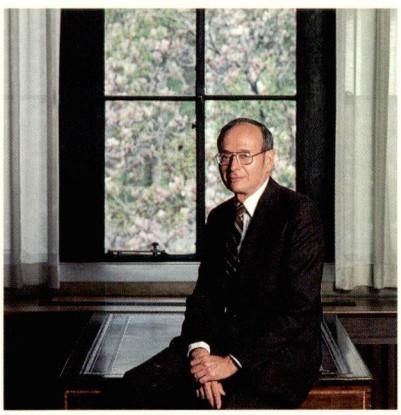
Integrity

Because of its status as a private institution, the Academy can independently decide what studies to accept and judge the competence required to address a particular issue. Integral to its committee system is a consideration of bias and conflicts of interest in the appointment of members. A rigorous peer-review process validates a committee's work. No report is issued by the Academy without it first having been reviewed by a group other than the committee that produced the work. By institutional requirement, committees respond to each review comment. In this way, the Academy ensures accuracy, balance, and overall probity.

Impact

The Academy's work informs debates in Congress and the administration and influences legislation and appropriations. Special briefings provide information to congressional members, government officials, and industry leaders. Through journals, seminars, and the media, the Academy heightens the public's awareness of issues and helps to inform those who must eventually vote on policy decisions. Academy volunteers, who form a large part of the body of informed understanding in our society, themselves have a major impact. As testimony to the respect in which it is held internationally, foreign academies study the National Academy of Sciences, seeking to emulate how it works and what it does.

A Message from the President



The National Academy of Sciences is the most important private advisory mechanism for science and technology policy in the United States.

With its ability to assemble experts of the highest reputation from a wide spectrum of disciplines, the Academy is an unparalleled resource for addressing the complex, cross-disciplinary, and multifaceted scientific and technological problems and opportunities of our age. Increasingly, no single government agency can take full responsibility for assessing and acting on such problems as global climate change, the treatment of AIDS, or U.S. technological competitiveness.

The Academy, while remaining responsive to federal government requests as its charter provides, is expanding its capacity to initiate and develop projects on its own. Such initiatives complement the work performed at the request of government and bring Academy resources and expertise to bear on a wider range of problems.

The most important source of funds for self-initiated activities is the income derived from endowment. A sustained, guaranteed source of support, endowment gives the Academy an agenda-setting capability that allows it to undertake important studies, independent of government support or interest; to give the nation consistent guidance for the long term on such issues as international security and arms control, and science and mathematics education; and to anticipate and respond quickly to urgent national problems.

In 1981 the Academy began an effort to increase its institutional endowment, which includes the endowment of its sister organization, the Institute of Medicine, from $21 million to $100 million, thus providing income equivalent to about 10 percent of government-funded activities. This effort was given great impetus in May 1988 by receipt of a $20 million endowment grant from the W. K. Kellogg Foundation, which was awarded jointly to the Academy and the Institute. The grant requires the Academy and the Institute to raise $16 million in matching funds. If the institution is successful in meeting the terms of the grant, a

full description of which is included on page 31 of this brochure, our goal will be reached.

The boxes on the following pages highlight some activities initiated by the Academy in recent years and funded in varying degrees through contributions (many to the endowment) from individuals, corporations, and foundations. This partial list exemplifies the importance of the Academy, as a public-service oriented organization, having financial independence and an agenda-setting capability. Some of these activities, such as the Committee on Human Rights, are long term and would benefit from endowment to sustain them in the coming years. Also discussed on the following pages are selected national issues on the Academy's agenda now and for the future. These activities represent the kinds of projects that might be undertaken or continued if sufficient endowment were available.

The challenges generated by scientific and technological developments are many. Increased commitment to the institution's endowment will provide the support with which we can explore opportunities, build solutions to problems, and strengthen our service to the nation.

Frank Press
President, National Academy of Sciences
Chairman, National Research Council

Strengthening the Scientific Enterprise

In fostering strong American science, an emerging priority for the Academy is to analyze the nation's research and development capability. Critical issues include the climate in which researchers, particularly younger researchers, work; the capabilities of various research institutions (e.g., universities, not-for-profit organizations, and industrial laboratories) to play appropriate roles in the national effort; and the roles of various government agencies and private institutions in providing support for research and development.

Internationally, pressures for cooperative research with other countries are intensifying as the cost of research increases and national resources are depleted. Among the questions to be answered are: What makes a field of study appropriate for international cooperation? What criteria are needed to determine which fields to include? Research Council committees can—and do—examine such complex questions.

Research efforts also need to go beyond the classic areas of science to include large systems such as transportation, water supply, education, and welfare. Yet jurisdictional and financial fractionation makes it difficult to mount a research agenda designed to protect enormous public investments, improve services, create and calibrate innovations, and provide measures of performance. An examination of ways to construct effective research programs for these large systems will require the Academy's attention.

"America's future depends on our ability to utilize science and technology for our national development and to enhance our international relationships. The National Academy of Sciences provides one of the best and most effective ways in which scientists can utilize their time and talents in this great national effort."

Peter H. Raven
Director, Missouri Botanical Garden

A New Commitment to the Behavioral and Social Sciences

The urgent need for a new commitment to the behavioral and social sciences was broadcast in 1988 by *The Behavioral and Social Sciences: Achievements and Opportunities*, the report of an Academy-initiated study. The report revealed that support for behavioral and social sciences had dropped 25 percent between fiscal years 1972 and 1987, while federal spending for other areas of scientific research increased by 36 percent in the same period. The report recommended new national support for advanced training, research technology, data resources, and grants to capitalize on wide-ranging opportunities for scientific advances and practical benefits—from programs to reduce drug abuse to improved economic analyses. These recommendations formed the core of an American Psychological Association action plan, which was endorsed by 19 behavioral and social science organizations, and was the focus of a 1989 congressional hearing to review National Science Foundation support for behavioral and social science.

An important change in the configuration of industrial research efforts needs to be assessed: The merging of large companies sometimes results in reduced research. Meanwhile, new collaborations are being established within industry and between industry and universities, states and industry, and companies in different countries. Further study by the Academy can lead to a clearer understanding of the implications of these changes.

Reaching beyond science policy to scientific discovery, the Academy plans to introduce a provocative annual series, the **National Science Frontiers Symposium,** which will bring together outstanding young U.S. scientists to discuss exciting scientific advances and opportunities in their own fields. By challenging these scientists to think about what is glimpsed "on the horizon" in fields other than their own, the Academy hopes to stimulate interaction and collaboration. Videotapes and abstracts of each symposium will be prepared so that colleges and universities may also participate in the exchange.

President George Bush and the 1989 Westinghouse Science Talent Search high school finalists at the National Academy of Sciences.

New Alliances for Research

The Government-University-Industry Research Roundtable, established in 1984, provides a forum for exploring ways to improve the productivity of the nation's research enterprise. The uniqueness of the roundtable is in its membership and in the continuity with which key individuals address important topics and provide superior analytical backup. Members include the leaders of the federal R&D enterprise; senior industry, university, and state officers; and working scientists and engineers. Invited guests extend the reach of the members.

Results of roundtable activities include the standardization and simplification of government-university and industry-university research agreements; promotion of broader based consideration for nurturing science and engineering talent; elucidation of the factors important in the operation and self-assessment of university-industry cooperative research programs; and the identification of the factors necessary to operate successful multidisciplinary research and education programs.

Extended projects include an exacting look at the changes in the organizational structure and resource base of the U.S. research system and their effect on the "home of science" in the United States, universities; an investigation of the financing of academic research facilities; a study of the attractiveness of graduate education to the very best undergraduates; and an assessment of the relationships of the new university-industry alliances to technical change and innovation in industry. Further, in recognition of the increasing role of the states in science and technology, the roundtable has created a federal-state dialogue on science and technology and policy issues.

International Affairs

Academy initiatives in international affairs are taking on a new emphasis: New grounds for developing fruitful relations are being forged, a public-policy orientation adopted, and long-term pioneering projects established.

In its traditional operational role of managing U.S. involvement with foreign scientific communities, the Academy is establishing creative avenues for international exchange. In January 1988, the presidents of the National Academy of Sciences and the Academy of Sciences of the USSR signed a five-year agreement for scientific and technological cooperation. At the same time, the president of the Institute of Medicine signed a five-year agreement establishing for the first time scientific cooperation with the Soviet Academy of Medical Sciences. These two agreements afford an unusual opportunity for the United States to engage influential Soviet scientists in workshop discussions and symposia on such significant global issues as the environment, arms control, education, alcohol and substance abuse, AIDS and the human immunodeficiency virus, and human rights.

Since 1966, the Academy's **Committee on Scholarly Communication with the People's Republic of China** has been striving to build a relationship with a country whose importance to the United States and the rest of the world can only increase in the future. Subject to suitable conditions, in the years ahead the committee will emphasize visits between individual researchers of the two countries; sponsor programs pro-

International Security and Arms Control

Established in 1980, the Committee on International Security and Arms Control (CISAC) reflects the benefits of a private, unofficial Academy-sponsored initiative in a politically sensitive area. The committee maintains a rotating membership of distinguished scientists and experts in security and arms control. Their objectives are to study and report on scientific and technical issues germane to international security and arms control; engage in discussions with similar organizations in other countries; develop recommendations, statements, conclusions, and other initiatives for presentation to both public and private audiences; respond to requests from the executive and legislative branches of the U.S. government; and expand the interest of U.S. scientists and engineers in international security and arms control.

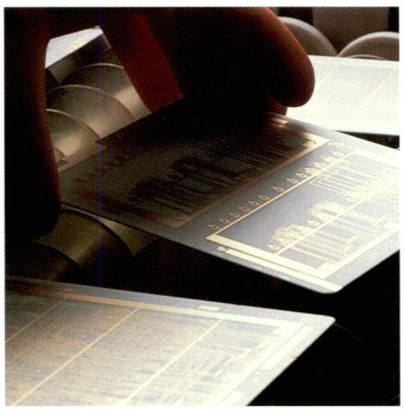
CISAC conducts continuing private bilateral meetings with a comparable group from the Academy of Sciences of the USSR. In addition to improving understanding between the two countries, these meetings provide a window onto the dramatic changes occurring in Soviet political, economic, and scientific life.

A new activity for CISAC is an informal dialogue with Chinese scientists on international and regional security issues. This is a unique and promising development for professional-level scientific dialogue, where little has existed before.

viding American and Chinese scientists with opportunities to collaborate in such areas as agriculture, biotechnology, global change, and science policy; and offer a public outreach service for science and educational relations with China.

In Mexico, where severe economic problems have seriously eroded that country's science, technology, and educational base, leaders in the Academy, the National Academy of Engineering, the Institute of Medicine, and the Mexican Academies of Sciences and Engineering have established a long-term science and technology partnership intended to sustain and increase Mexican economic development. Specific program objectives are to: strengthen and build Mexican institutional capacity in science and technology policy; initiate joint studies on science, technology, and health issues that will contribute to policy formulation in both nations; and improve scientific and technical literacy in Mexico.

The Academy is also taking the lead in areas affecting international public policy. Studies are planned to: explore the problems associated



with the lack of uniform treatment of intellectual property rights derived from basic scientific research and technological development; recommend suitable mechanisms for future U.S. government and private sector interactions with countries—such as Brazil, Korea, and Mexico—that have made substantial economic progress in the past and have, therefore, graduated from U.S. economic and technical assistance; and facilitate global science and technology and analyze the strengths and weaknesses of existing multilateral organizations in meeting national research goals. Additionally, the **Beckman Center Pacific Rim Seminars** will be a continuing and prestigious series of meetings exploring the role of science and technology in promoting the security and economic and social development of the Pacific Rim.

Assistance to developing countries has been and will continue to be of major interest to the nation. The Research Council's **Board on Science and Technology for International Development (BOSTID)** has, for almost two decades, focused its efforts on marshalling the diverse scientific and technological talents of the United States to concentrate on issues important to developing countries, and has at times provided a productive alternative to official channels. Through an integrated program of

National Security

Two Academy-initiated studies have significantly influenced national security policy. A 1982 report, *Scientific Communication and National Security,* was pivotal in evaluating the need for controls on the dissemination of basic research in universities and led the National Security Council, at the President's directive, to order an interagency review of the issue. The result was the National Security Decision Directive 189, which in September 1984 stated for the first time the commitment of the U.S. Government to maintain unrestricted access to the results of "fundamental research." The report is now the basic reference document on this matter.

In February 1987, *Balancing the National Interest: National Security Export Controls and Global Economic Competition* assessed the effectiveness and economic impact of U.S. export controls on militarily sensitive products. The panel was made up of university officials, industry executives, and former government officials with experience in defense, trade, and intelligence. The report found that controls on high-technology products cost the nation's businesses about $9.3 billion each year, but that many of the rules did not serve national security interests. The study concluded that because the ineffective controls did not prevent Warsaw Pact countries from gaining access to many advanced technologies, the net effect of the regulations was to penalize U.S. industry. The report appeared when modification of national security export controls was being considered by Congress and the Reagan administration. Released with extensive press coverage, the panel's findings and recommendations were also presented personally to the President's National Security Advisor and the secretaries of State, Defense, and Commerce. Within several weeks, the Department of Commerce issued new regulations easing export controls on some products already widely available from U.S. allies and proposed streamlining trade rules for a number of other products.

U.S.-Japan Relations

The Office of Japan Affairs was created in 1988 to complement government efforts and to shed light on questions central to national policy debates on science, technology, and U.S.-Japan relations. Bilateral meetings, workshops, and policy studies are being undertaken to promote a greater understanding of how each country pursues scientific and technological objectives.

The office is a direct outgrowth of a series of exchanges that made the Academy a focal point for informal discussions with leading Japanese and American scientists, technologists, and research managers. These unofficial meetings, initiated in 1985 and 1986 by the Academy and the National Academy of Engineering and called the U.S.-Japan Discussions on Advanced Technology and the International Environment, brought together business and academic leaders from both countries and illuminated inequalities and limitations inherent in traditional negotiations for equal access. The talks also introduced the new concept of symmetrical access, wherein both sides agreed to explore measures designed to bring about a more balanced and equitable flow of scientists, engineers, and precommercial information between their respective research systems.

overseas work, research grants, published studies, advisory committees, conferences, seminars, and outreach activities, BOSTID is a vital mechanism for assisting developing countries.

Great changes continue to occur within these countries and in scientific knowledge relevant to development needs. Budget appropriations for development assistance have been shrinking at the same time that scientific and technical knowledge has become key to the economic and social development of these countries. New methods and institutions will be needed to allow more effective interaction; cooperation rather than assistance will become the more useful approach to development, especially since many important problems of health, food production, population, environment, and natural resources require global solutions. Academy analysis will be important to policy decisions in this area, especially in an era of greater urgency and lesser resources.

Human rights will continue to be on the international agenda in the future, and are a vital component of the Academy's international program. Through its **Committee on Human Rights,** progress has been made in such countries as Chile, Morocco, Nicaragua, Somalia, and the USSR. In Somalia, for example, a joint Academy-Institute of Medicine delegation was one of the first human rights missions ever allowed into the country. It is widely believed that the delegation's resulting report and a subsequent appeal to the Prime Minister of Somalia led to the release of twelve prisoners. In the future, the committee will continue to press for the release of scientific colleagues unjustly imprisioned throughout the world.

Andrei Sakharov, human rights activist and a foreign associate of the Academy, Eliot Stellar, chairman of the Academy's Committee on Human Rights, and Tatyana Yankelevich, Dr. Sakharov's stepdaughter, at the November 1988 dinner at the Academy honoring Dr. Sakharov upon the occasion of his visit to the United States—his first international visit since his 1986 release from internal exile in the Soviet Union.

Education

Computer innovations are dramatically changing education technology today. Exciting experimental programs are being advanced to help teachers plan and execute lessons and to help students as they work individually and in group situations.

The issue is how to effectively apply this technology in our schools—how to introduce computers and how to get them used. Problems also emerge in dealing with the politics of a heterogeneous situation in which community, county, state, and federal interests are involved. Designing and recommending avenues for implementing criteria to judge the effectiveness of new technology is the objective. Examining current knowledge in this area, validating it, synthesizing it, relating it to the current situation, and making recommendations is the challenge.

On another level, the educational system as a whole requires attention. U.S. education is in its second phase of reform. Phase one began with national alerts in the early 1980s about the system's problems, including reports by federal agencies and a convocation in 1982 conducted

Mathematical Sciences Education Board

The Mathematical Sciences Education Board (MSEB) was established by the Academy in 1985 at the urging of the mathematics community to provide national leadership for bringing about significant improvements in mathematics education in the United States. The MSEB concentrates on reforming mathematics education, at all grades and in all areas, from curriculum and instruction to testing and teacher training. By viewing mathematics as a whole system, the MSEB's model of broad and continuing concentration on a major problem is now being transported to other areas of education. Linked efforts are under way in curriculum reform, in the establishment of standards to provide school systems with a clear statement of excellence in school mathematics, and in a vigorous campaign to expand the understanding of this work at the state and local levels.

The MSEB has also embarked on an ambitious plan to actively engage U.S. employers in revitalizing mathematics education. A 1988 symposium focused on the connection between mathematics education in U.S. schools and colleges and the ability of U.S. business and industry to compete internationally. One recommendation was that MSEB establish a Corporate Council for Mathematics Education, the planning for which has been launched.

Focusing on Industry Needs

The 1984 report, *High Schools and the Changing Workplace: The Employers' View,* addressed the needs of high school graduates not going to college from the perspective of the private businesses and public institutions that will employ them. The essential message—that certain specific competencies, including literacy with words and numbers, are much more important than specific skills—has reverberated through out the educational system. Some 35,000 copies of the report have been distributed and an additional 16,000 sold. States and localities continue to inquire about it, to organize forums devoted to it, and to embed its message into their educational planning.

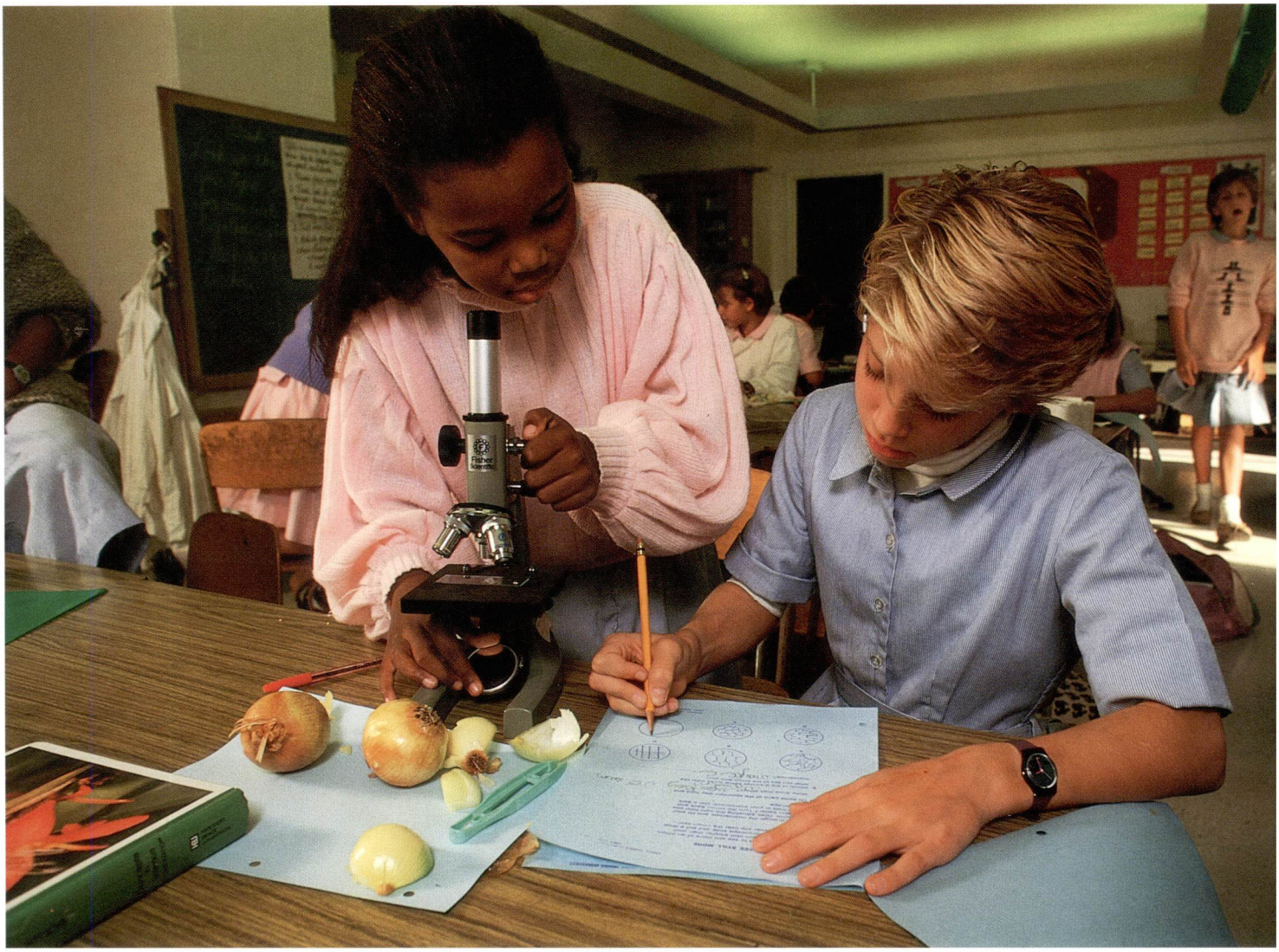
"As chairman of the study on High Schools and the Changing Workplace: The Employers' View, *I saw first hand how the Academy contributed to our understanding of critical social issues through a process of study, evaluation and recommended action. The National Academy of Sciences is actively involved in the life of the nation and committed to projects that have a direct bearing on the future of American education, technological leadership and industrial competitiveness."*

Richard E. Heckert
Chairman of the Finance Committee and
Former Chairman and Chief Executive Officer,
E. I.DuPont de Nemours & Co., Inc.

by the Research Council on science and mathematics education. The next phase of reform will involve defining and emplacing the changes needed to correct the problems.

Since the 1982 convocation, the Research Council, supported by private funds, has launched a new body of work on the system through two major education units, the **Mathematical Sciences Education Board** and the **National Science Resources Center.** A principal objective is the creation of effective links and communication systems with a large number of groups and organizations encompassing not only professional societies in mathematics, science, and engineering, but also national educational organizations and policymakers, state and local education authorities, business and industrial organizations, and the general public. Also significant is the raising of awareness in these groups of the need for major improvements in curriculum, instruction, testing, and teacher education. Techniques, resources, and new curriculum ideas must be shared. In an arena in which the players are in constant flux—new people are becoming teachers, parents, and students—systems must be developed to reach these individuals on a continuing basis. Sustained private support is pivotal in furthering this communication of understanding.

The Research Council is also focusing on the nation's diminishing pool of scientific talent—an issue of particular concern at a time when the demand for scientists and engineers is growing in industry and academe. Plans include a comprehensive analysis of the nation's approach to nurturing prospective scientists and engineers and identifying points in the pipeline where talented students—particularly minorities and women—are lost.



National Science Resources Center

The National Science Resources Center (NSRC) is a joint effort of the Academy and the Smithsonian Institution. It focuses less on reforming the total educational system and more on a major problem within the system—weak science instruction in precollege education. The center serves as a national interchange point where successful programs, techniques, and strategies for science and mathematics education can be introduced and shared.

One NSRC project, Science and Technology for Children, is developing scientifically current and enticing hands-on science instructional units for elementary school students, which will be tested initially in 16 school districts across the country. The project is the result of intensive and sustained collaboration between teachers and scientists whose aim is to translate new scientific knowledge into educational resources and to stimulate students' imaginations and experimentation. The project also plans to create training laboratories for a substantial number of students and teachers.

Agriculture

Characterized by extremes—decline and innovation—agriculture in the United States today is in transition. The decline of U.S. competitiveness in international markets and the inability of farmers to recover from the pressures of complex economic blows contrast with new research developments that are accelerating the pace of change. Scientific disciplines are combining to create new interdisciplinary approaches to problems.

Under the leadership of the Research Council's **Board on Agriculture,** Academy initiatives foster a national commitment to strengthen U.S. agriculture and its competitive position, address current issues, anticipate new challenges, and assess this nation's role in preserving the planet's environmental integrity.

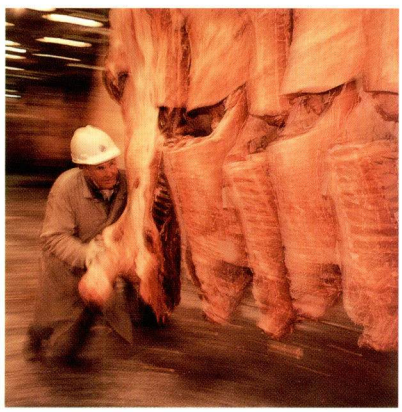
One of the board's major programs is a series of studies on U.S. natural resource use, conservation, and management policies. Four studies, *Nitrogen Management in the Midwest, Management of Highly Erodible and Other Fragile Farmlands, Public Rangeland Classification Systems,* and *Western Water Management Change—Third Party Effects,* will touch upon issues of significance in all major farming regions of the country. The project will provide an opportunity for the board to develop not only expertise, but also a significant series of reports and recommendations involving agriculture's impact on water quality—an issue destined to become one of the most challenging on the environmental and agricultural policy agenda.

"The Academy provides a variety of platforms through which policy and science issues can be discussed and explored with a number of important audiences—including industry and the public. In March 1985, I had the honor of co-chairing a symposium on biotechnology at the Academy, and saw firsthand the vital role it fulfills."

Richard J. Mahoney
Chairman and Chief Executive Officer,
Monsanto Company

Biotechnology

A 1987 report (now in its third printing), *Agricultural Biotechnology: Strategies for National Competitiveness,* was an outgrowth of the Academy's concern that rapidly unfolding discoveries and their applications in biotechnology were surpassing the capacity of society—especially agricultural research and educational institutions—to absorb and adjust to change. The report explored ways to accelerate the benefits of biotechnology within the agricultural economy and emphasized the need for a serious commitment of funds, talent, and programs to support research, train researchers, and advance the agricultural enterprise into the biotechnology era. Following the report's release, the Academy held a high-level briefing attended by U.S. Department of Agriculture (USDA) officials, congressional staff, scientific and trade association leaders, and members of the press. The briefing provided the stimulus for improved programs such as the $20 million biotechnology initiative for the competitive research grants program within the USDA.



Biotechnology—its tremendous potential and the influence of public policy on its development—is drawing national attention. Use of biotechnology can improve crop and animal production and create innovative opportunities to manufacture new products and foods, treat and use wastes, and use renewable resources for fuel. New genetic and ecological techniques, particularly in the areas of pest control and nutritional qualities of food, are expected to benefit American consumers and the nation's natural environment alike. Yet it is unclear whether existing institutions and policies are appropriate to address these goals. Assuring that biotechnology thrives amidst legitmate public concerns will be a major issue for the Academy.

In an effort to strengthen agriculture for the benefit of all peoples, the Academy is looking at ways to improve and promote basic nutrition for humans and animals, to increase the nutritional value of crops and animal products, and to assure the availability of safe uncontaminated foods at reasonable costs. To guarantee security and leadership for the future, the Academy will continue to address issues pertaining to agriculture in primary, secondary, and higher education and the dissemination of information about agriculture to individuals and organizations throughout all sectors of the economy.

On an international level, the board is conducting a number of major studies that should have far-reaching effects on conservation, environmental quality, and agriculture. **The Committee on Managing Global Genetic Resources** is developing a series of reports that address one of the most crucial issues today: loss of the world's biological resources. The expert international committee assembled by the board is examining not only the scientific problems of protecting and using these resources, but also the related social, economic, and legal questions involved. The committee's mandate is to move beyond just highlighting the problems and to set forth rational, scientifically based, workable options for nations. Without such guidance, biological resources could be lost forever.

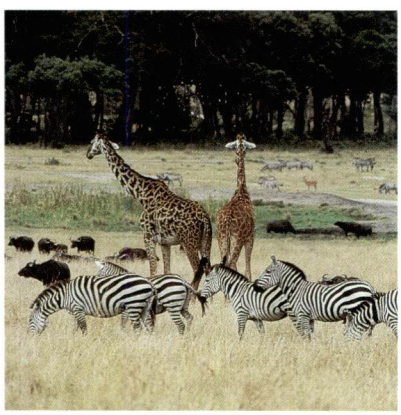
Also under way are board efforts to promote the concept of sustainable agriculture and to engage in cooperative research and scientific exchange with other nations. A key objective is to promote recognition of the Board on Agriculture's 1989 report on sustainable agriculture and to initiate international follow-up projects. While trade and economic tensions are likely to continue as divisive forces among nations, the concept of agricultural sustainability and humankind's ultimate dependence on its attainment may prove a powerful force leading to a new era of cooperation and exchange in the agricultural, ecological, nutritional, and food sciences.

Another major activity encompasses the productivity, profitability, and competitiveness of U.S. agriculture. Such a project could make an important, and perhaps unique, contribution to understanding how commodity policies, technology, trade, and macroeconomic policies affect the performance of U.S. food and fiber industries, and thus shape the nation's role in meeting global food needs and preserving the planet's environmental integrity.

The Environment

Major global changes—such as "the greenhouse effect" caused by increasing levels of carbon dioxide, methane, and other gases; the depletion of the stratospheric ozone layer; changes in land use and tropical deforestation; radiation increases; and industrial pollutants—are disturbing the balance of environmental systems. In 1983, long before national attention was focused on "the greenhouse effect," the Academy published a report about the effects of increased atmospheric carbon dioxide on the climate. Sending such early warning signals is one of the Academy's roles.

At a time when government interest is often focused on narrow regulatory concerns and specific legislation, the Academy can offer both immediate and long-term perspectives. Environmental issues are increasingly global and interdisciplinary. The Academy can draw upon the entire spectrum of its resources and establish liaisons with international organizations and U.S. scientists and engineers in international research programs.



Biodiversity

The 1984 National Forum on Biodiversity, held at the Academy and cosponsored by the Smithsonian Institution, provided a means for distinguished scholars and the public to explore the global problem of preserving plant and animal species and their habitats. More than 1,500 individuals attended the four-day meeting and thousands more across the country watched the concluding teleconference via satellite. A videotape of highlights from the teleconference was distributed to high schools, colleges, and the interested public. Press coverage on the forum was extensive, with front page articles published in the nation's leading newspapers and wire service stories appearing internationally. A 1988 published book of papers presented at the forum, *Biodiversity,* is on its way to becoming the definitive source of information on this topic.

Acid Rain

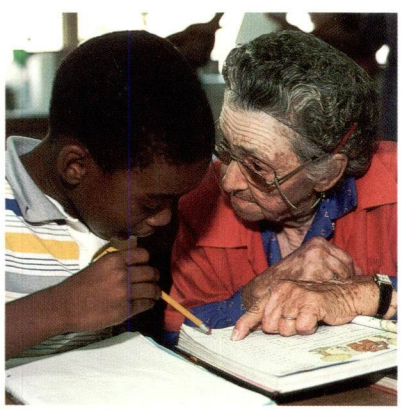
In 1984 the Academy received the National Wildlife Federation's prestigious Conservationist of the Year award, which cited the 1983 Research Council report, *Acid Deposition: Atmospheric Processes in Eastern North America*, as evidence of "the importance of the Academy's objective, high quality studies to the environmental policy debate." At a time when the government agenda did not include examination of the acid rain issue, private funding enabled the Academy to provide an objective, comprehensive assessment on what was known and not known about acid deposition. The report had the effect of refocusing the national debate from spurious arguments about degrees of scientific uncertainty to policy issues related to what, if anything, to do about acid rain.

The Academy is involved in a range of specific environmental issues. In the area of environmental pollution, studies address the disposal of radioactive and other wastes and industrial by-products, as well as federal government research and regulatory programs associated with pollution control. In human health and environment issues, studies address environmental epidemiology, toxicology, assessment of risks from pollutants, and problems of environmental engineering, socioeconomic and science policy, and the monitoring of biological diversity.

The Academy's attention is also directed toward the diversity of public policies that are growing more complex and less effective because the nation is not developing better ways to value natural resources and environmental quality. Natural resources tend to be undervalued in economic terms, and are sometimes overprotected through regulations because of unfounded fears that they will be "lost." A critical question to be addressed is how science and technology can help societies distinguish between natural evolutionary change and the acute destabilization of ecosystems by human interference.

Piecemeal data and conventional wisdom exist about the petroleum reserves and undiscovered resources located throughout the world, but there is no definitive source of up-to-date, reasonable, uniform information that could provide a sound basis for decision-making. The Academy can conduct a comprehensive evaluation of the available domestic and world oil resource estimates, the associated projections for production and consumption, and what these factors imply for the energy future of the United States.

Social and Community Issues



Through the Research Council's **Commission on Behavioral and Social Sciences and Education,** the Academy works to inform the nation's decision-making processes by providing science-based information on a full array of social policy issues. A key area of concern for the commission is the well being of the individual, whether in his or her role as citizen, family member, or as a member of such demographic groups as the elderly, children, minorities, the poor, and the unemployed. The issues include poverty, welfare, crime, substance abuse, housing and community development, and social policies in the workplace.

Responding to these national needs is an enormous challenge for all involved. Nevertheless, private and public sector programs throughout the country that seek solutions to problems families and communities face share a common need—quality research and analysis of the causes and consequences of social ills and expert information and guidance on alternative ways to mitigate these socially-debilitating problems.

The Academy has provided leadership to meet this need in the past and is now examining a range of critical problems confronting families

"The National Research Council's Commission on Behavioral and Social Sciences and Education plays a major role in the ever-widening theatre of sociological study—monitoring current developments and encouraging new ones, assessing trends, educating the public. Responding to the seemingly insurmountable challenges presented by the advancements of a modern society, the Commission takes bold steps in new directions, as with its study, The Contributions of Behavioral and Social Science to the Prevention of Nuclear War. *It has been an honor—and a reward—to have served as a member of such a distinguished commission."*

Eleanor B. Sheldon, Ph.D.

and communities. These examinations include studies on such issues as behavioral and social science research related to AIDS prevention, drug abuse prevention strategies, understanding and control of violence, and employer policies for working parents.

In the future, the Academy's focus will continue to be on the promotion and preservation of the American family. The American family has changed dramatically in the last three decades. Single-parent homes are now commonplace. In many two-parent families, both parents work outside the home. In addition, the stresses of modern life can lead to excessive use or abuse of alcohol and drugs, increased family violence, and chronic disease.

Children and youth are especially vulnerable to the new pressures being placed on families. For example, only recently have the interrelations of academic performance, drop-out rates, delinquency, drug and alcohol abuse, depression, and suicide among young people become apparent. Academy studies can integrate findings in these areas and assess their implications for education, health care, criminal justice, welfare policies and programs, and clinical approaches to treatment.

Another emerging concern are the effects of poverty and low income on children's academic and psychological well being. A study is planned to review and integrate research from several disciplines that address issues concerning patterns of income and poverty in families with children and the effects of economic disadvantage on children's social, physical, and cognitive development.

In providing comprehensive, multidisciplinary, and sustained scientific examination of these critical social and community issues, the Academy must continue to depend on private support, as the federal government has given only episodic attention to the issues. With such support, the Academy can become the common ground of careful analysis and reliable information on which contentious and inevitably emotional matters of social policy can be debated.

Adolescent Sexuality

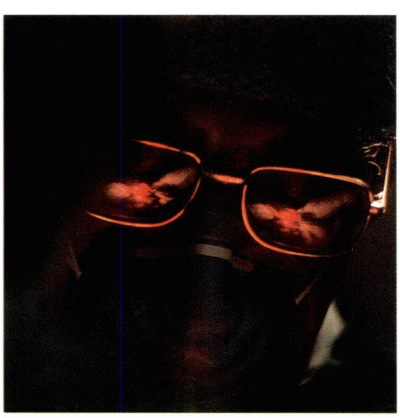
A 1987 study, *Risking the Future: Adolescent Sexuality, Pregnancy, and Childbearing,* carefully separated scientific knowledge from ideology and provided a clearer basis for policy-making than was previously available. The report cited surveys showing that rates of teenage pregnancy, abortion, and childbearing are higher in the United States than in other industrialized countries, even though age of initiation and levels of sexual activity are comparable. The report urged that the highest priority be given to approaches for preventing adolescent pregnancy, and endorsed a range of actions to help accomplish this goal.

Recognizing that the likely impact would be greater with state and local governments than with the executive branch, the Academy distributed the report to policymakers throughout the country and initiated an extensive outreach effort including briefings, presentations at professional meetings, and articles in professional journals read by educators and social and community workers.

Issues concerning the status of children and families, while periodically brought into the public eye, have frequently failed to capture and hold the attention of high-level government, corporate, and community leaders. An impending social problem or crisis can trigger widespread public concern; yet that concern is more often than not short lived. In the past, groups of experts have been convened to study the health and development of children and their families, and have issued calls for action. But these individual groups lack the power to sustain interest and conviction among public and private sector decisionmakers, and their calls for action, though loud at the time, are often lost in the din.

Recognizing the need for a comprehensive approach, in 1988 the Academy and the Institute jointly initiated the National Forum on the Future of Children and Families, to act as an institutional mechanism for promoting a continuing dialogue among scholars and experts in child development and health, and leaders in government, business, and philanthropy. The forum's primary mission is to enhance the policy-making capacity of the public and private sectors on behalf of children and families. To this end, the forum has held or is planning briefings of congressmen and journalists, conferences, and has distributed reports and other literature—all intended to inform decisionmakers about scientific knowledge relevant to children's issues, clarify policy issues and options, and identify policy issues that require additional research.

Health



Events and prospects directly affecting human health are in ferment and increasingly are provoking public debate. Health care is becoming more expensive, but also more expert. New ways will have to be found to pay for care, because too many people cannot pay. Access to care is a problem for millions, but ensuring the quality of care is becoming equally important.

These and similar matters are the concern of the Academy's sister organization, the Institute of Medicine. The Institute's elected membership, includes physicians and other health professionals, but also lawyers, economists, engineers, and scientists, to name a few. Its members provide a diversity of perspective and a range of expertise that are appropriate to the complexity of human health and today's health policy problems. The honor of election entails a commitment to serve in the Institute's efforts to evaluate and address these issues.

The breadth of the Institute's capabilities is indicated by its operating units, which cover health sciences, health promotion and disease prevention, mental health and behavioral medicine, health care services, international health, food and nutrition, and epidemiologic studies of war veterans. Added to these are such Institute-wide efforts as the **AIDS program,** which, with additional support from the Academy, has produced two widely quoted, influential reports, and the **Council on Health**

Care Technology, established by Congress to assess therapeutic and diagnostic medical techniques, and that relies on funding from both private and governmental sources. In addition, the Institute assists advanced education in health policy through its administration of the **Robert Wood Johnson Health Policy Fellowships** and its direction of the convening and publication activities of the **Pew Health Policy Program**.

The Institute operates by assembling committees of its members and other experts to examine specific problems and recommend solutions. One study is a review of how resources are apportioned in the health sciences, now that foundations and industry—as well as the federal government—play a significant role in the support of biomedical research. The study arises from the need to assure adequate balance in overall funding between the investigative research itself and the infrastructure needed to support research—the advanced scientific training, equipment, and facilities required to maintain a vigorous research effort. Another committee is examining interventions aimed at alcoholism with the goal of describing areas of needed research that could foster advances in prevention and treatment.

Although most Institute studies present advice on promising areas for research on an issue, some projects are specifically geared toward recommending a new research agenda. For example, the Institute is preparing a national plan for research on aging that will specify needs and opportunities that extend from basic biological and behavioral work to clinical medicine and health services research. The intent is to help set priorities so as to make the most effective use of limited resources and acquire the understanding necessary to improve health care for the elderly.

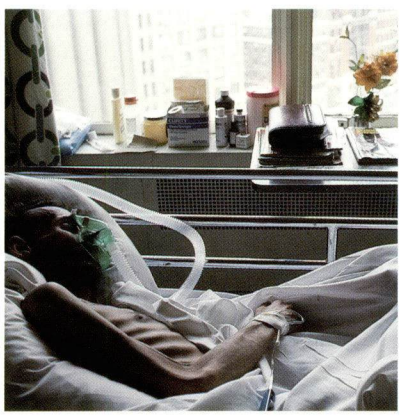
"Seen from close range, the impact which the Institute has on the development of a coherent health care and research policy has been impressive. In an environment that seems to be characterized by random motion on the one hand and vested interests on the other, a consistent voice of reason, dispassionate judgment and expertise emanating from the Institute serves as a beacon for the rational advance of the public good. As a Vice Chair of the IOM Council, and as a reviewer of the report IOM compiled on the future of the National Institutes of Health's intramural program, I have seen close up the extraordinary value of the Institute's work.

Philip Leder, M.D.
John Emory Andrus Professor and Chairman, Department of Genetics, Harvard Medical School

Infant Mortality

A 1985 Institute of Medicine report, *Preventing Low Birthweight,* attested to the benefits of prenatal care in preventing prematurity and intrauterine growth retardation. The report became the principal documentation for legislation enacted as Public Law 99-660, which established the National Commission for the Prevention of Infant Mortality. This commission, now in place, has among its duties the identification of financial, governmental, and other barriers to prenatal care. The report also helped to inspire the introduction of legislation in more than half the states to make prenatal care available under Medicaid.

A complementary report, *Prenatal Care: Reaching Mothers, Reaching Infants,* was published in October 1988. The report points to data showing that about one-third of all U.S. infants are born to mothers who do not receive adequate prenatal care, and states that the present U.S. maternity-care system is "flawed, fragmented, and overly complex," and needs "fundamental reforms, not incremental changes in existing programs."



The Institute's capacity for convening groups of individuals with the needed experience and expertise to confront complex health issues has led to the creation of "roundtables." These forums encourage the discussion of divergent views in an effort to develop a greater understanding of the problem at hand. An example is the **Forum on Drug Development and Regulation,** in which the Institute brings together leaders from the pharmaceutical industry, federal health agencies, research universities, medical practice, and consumer interest groups to map a smoother path from the discovery of a drug to its approval for use.

While the political process in America often emphasizes short-range answers, the Institute is organized to take a long-range view. Increasingly, as the complexity of today's health problems becomes manifest, the Institute is watching developments on a broad front in order to anticipate the need for new organizational forms and solutions in the future.

Society's deepening concern about all aspects of health and health care is exemplified in some of the Institute's recent investigations. Among these are a study of organizational and policy needs in contraceptive development, and a program designed to enable primary care physicians to become more expert in diagnosing and treating illnesses attributable to a person's occupation or to environmental conditions.

The Institute's ability to confront a wide variety of concerns ultimately depends on its independence—on a measure of stability that only

Confronting AIDS

The response of the Institute and the Academy to the AIDS crisis illustrates their ability to act swiftly and effectively on critical national issues. The immediate availability of private funds allowed the Institute and the Academy to conduct an intensive seven-month study in 1986. The resulting report, *Confronting AIDS: Directions for Public Health, Health Care, and Research,* proposed a national strategy for the prevention and treatment of AIDS in the United States at a time when the federal government was not prepared to respond in a coordinated fashion. Months after its release, the report was described by *The New York Times* as having "provided a benchmark by which many members of Congress and analysts judged the effectiveness of the nation's efforts to combat AIDS." Staff of the Senate and House appropriations committees consulted with the Institute of Medicine before shaping legislation to fund AIDS programs—legislation that nearly doubled federal spending against AIDS from FY 1987 to FY 1988. The magnitude of these federal budget increases has been credited as reflecting the impact of the report's findings.

Subsequently, the Institute and the Academy issued, *Confronting AIDS: Update 1988.* Its effect on amendments to the *Public Service Act* and related legislation in 1988 was clear: Nearly $1.5 billion was allocated for research, public health, and health care measures for AIDS in FY 1989, which was about 40 percent more than in FY 1988. It also led to the establishment of the National Commission on AIDS and the authorization for the Centers for Disease Control to develop and buy advertising to teach about AIDS. The update was further credited with contributing to the recommendations of the Presidential Commission on the HIV Epidemic, whose report was released in mid-1988.

an endowment provides. The availability of unencumbered funds can ensure both program autonomy and the flexibility to respond quickly to problems and issues as they arise. Such support is crucial to ensuring the Institute's continued contributions to health policy decisions.

For example, the Institute is currently preparing activities focused on the serious problem of access to health care in the United States. There is evidence that access is becoming more difficult for the uninsured; health care providers reacting to competitive pressures and public health agencies with constrained budgets cannot afford to treat people who cannot pay. Although pieces of the problem are being addressed by some states and by existing and proposed changes in federal programs, clear objectives for improving the delivery of care to the poor are lacking, as are ways to monitor changes in access caused by policy alterations or societal changes. The Institute seeks to define the nation's expectations of new policy measures and to refine the methodology for monitoring access to care.

"The IOM has provided and is providing for me an opportunity to participate in understanding and affecting positively major health issues which our society must confront. Whether it is a study of the Centers for Disease Control or the setting of the research agenda in aging, the problems are not trivial and the opportunities for important service are extraordinary. Further, the IOM recruits both from within its membership and from the scholarly community at large, talented and energetic colleagues to examine these important issues."

Julius R. Krevans, M.D.
Chancellor, University of California at San Francisco

On another front, the Institute wishes to follow up on its now completed appraisal of utilization management methods in health care. The committee for this analysis looked at the ways health insurers try to influence patient care decisions through review of services prior to their delivery. The report will describe why these utilization management techniques have become important, how they work, and what we know about their effects on cost, quality, access, and attitudes. Further work will deal with the development of guidelines and standards of practice in managed care, and on fostering research to obtain more certain evidence of how effective utilization management is in controlling costs and protecting the public's health.

Health-compromising behaviors—such as smoking, drug and alcohol abuse, or overeating—affect the way our nation uses its health resources. An evaluation of the methods now employed to encourage better health habits is much needed. Despite the importance of this kind of preventive intervention, the efficacy of different approaches to achieving and maintaining such behavior change is not well understood. The Institute proposes to conduct a thorough assessment of behavior change techniques in order to clarify research needs and describe what is known about those interventions that do work.

Efforts to prevent the global spread of HIV infection and AIDS will depend on better methods for predicting the incidence of infection. These efforts will require the sustained collaboration of researchers in many diverse fields related to AIDS modeling. Experts in and out of government have urged the Institute to convene groups to determine how to refine current models for gauging our progress in controlling the spread of HIV infection and for predicting the demographic impact of AIDS both in the United States and internationally.

Nutrition is likely to play an important role in the etiology and management of genetically as well as environmentally governed diseases in coming decades. Nutrition scientists, educators, and policymakers

"The intramural program of the National Institutes of Health is central to basic biomedical research in the United States. When its continued excellence as a government entity appeared problematic because of inadequate resources, I was pleased to serve on an IOM study committee that recommeded some changes to guarantee the program's continued productivity."

P. Roy Vagelos, M.D.
Chairman, President, and Chief Executive Officer, Merck & Company, Inc.

should thus consider whether current trends in research and training in nutrition and food science reflect a readiness to meet these challenges

The Institute is also committed to address issues in international health policy. Two studies are planned. The first will build on newly available Year 2000 epidemiologic profiles to identify international health needs, how they should be addressed, by whom, and with what human and financial resources. The other study will examine the impacts global environmental change could have on human health.

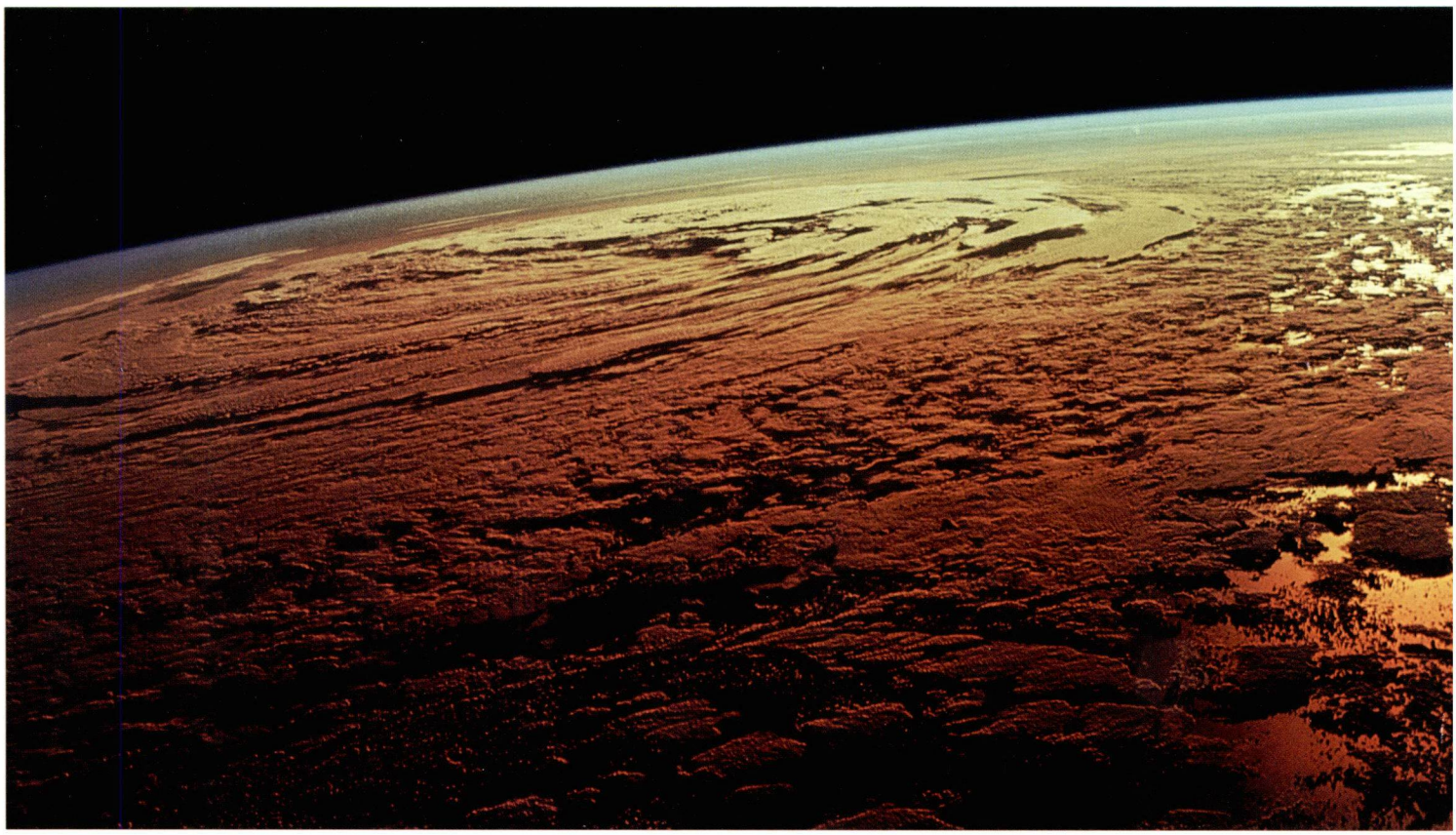
In these and other areas, the Institute of Medicine can be a catalyst for important public and private initiatives and could provide the comprehensive and informed insights essential to resolving serious domestic and international challenges in public health, medical science and education, and health care. Increased support will be the key to such achievements—support that is free of shifting political agendas and that allows the independence of action that has helped the Institute become the influential body it is today.

National Understanding

Enlightening and improving the dissemination of knowledge, and thus informing public debate and policy, is fundamental to the Academy. As the scope of the Academy's work broadens, communication must also increase. New approaches are under way to broadcast the results of studies and to increase public understanding of national issues and the role of science.

Promotion of Research Council and Institute of Medicine committee reports is expanding. Some reports receive special distribution, such as *Science and Creationism*, which, with private sector support, was given to every school district in the country. For others, the president of the Academy or Institute may brief appropriate Cabinet officers or congressional committee chairmen to ensure their awareness of the study and its conclusions.

The Academy is also designing several special programs to reach groups with specific national influence. A new series of roundtable dialogues and informal conversations will give members of Congress and representatives of the scientific community a chance to exchange ideas and share information on timely issues. Through an ambassadorial program, Academy officers will speak to national meetings of major organizations. Forums for the media will explore scientific and technological developments that may not (yet) be of fast-breaking interest but are nevertheless important. Because regional, state, and local governments are increasingly responsible for such activities as waste disposal, public health, regional development, and problems of adolescents, outreach to these groups also needs to increase.



Breakthroughs in Television

Through an extraordinary partnership with the media, scientists, government, and industry, the Academy has taken a bold lead in scientific television programming. Supported through private funds from some of the nation's leading companies and coproduced by the Academy and WQED/Pittsburgh, the award-winning public broadcasting station, the programs have been exciting and informative, with photography matching the standards set by WQED's National Geographic Specials.

The first program, "Planet Earth," won a 1986 prime-time Emmy Award as "outstanding informational series." The companion publication was a 1986 Book-of-the-Month Club selection. Three years in the making, the series covered all seven continents, the oceans, the atmosphere, the sun, space, and other planets and used contributions from 400 scientists who have revolutionized the study of this planet. Accompanying textbooks became the basis for a television course for college credit; 75,000 secondary school study guides were distributed to science teachers; and schools were given free taping rights.

The success of "Planet Earth" led to a 12-part series, "The Infinite Voyage", conveying the excitement and challenge of modern discoveries in the life, physical, and medical sciences. The series was a breakthrough in television underwriting and sponsorship: it was the first to premiere nationwide on the public broadcasting system, then air on selected commercial stations. With this imaginative approach, public broadcasting, sponsors, and the Academy, working together, reached a very large audience.

"The public importance of the Academy's work is a special incentive for busy scholars and other citizens to give time to its work. A bonus of no small value is the enhancement in knowledge and understanding of some of society's most perplexing and fascinating issues that inevitably comes with participation in the Academy's work."

Eleanor Holmes Norton
Professor of Law, Georgetown University Law Center

Published Debate

Issues in Science and Technology, **a quarterly publication introduced in 1984, is directed toward policy leaders and seeks to stimulate thoughtful debate. Articles by distinguished individuals on a broad spectrum of topics interweave science and technology with policy. Support from two universities, private foundations, and companies enabled the journal to enlarge its circulation to more than 17,000 subscribers in five years. With continuing support, the focus will be to increase this base through special promotions to academe, institutions, and members of scientific and technical societies. The aim is 30,000 subscribers in 1991.**

And the Academy must always be ready for spontaneous as well as planned opportunities for enlightenment and exchange between people and nations: to arrange informal, spur-of-the-moment meetings such as those between representatives from American industry and academe and the Soviet scientists and economists in the United States with Secretary Gorbachev for the 1987 Summit, between François Mitterand and Rajiv Gandhi, among other heads of state, and among groups assembled by the Academy. The Academy has long been a catalyst for these unofficial, highly productive international meetings, an extremely important role for it to continue playing.

For the general public, the Academy is planning and producing several projects that—through television, radio, and film—show people that science is exciting, timely, and important.

Projected for public television is **"Space Age,"** a film series and educational project to be produced in conjunction with the International Space Year of 1992. International in scope, the estimated 10 to 12 programs will take a definitive look at the achievements of space science and technology and will be the centerpiece of the many educational materials to be developed for use in elementary and secondary schools and postsecondary institutions.

For commercial radio, **"Why in the World,"** a series of 90-second spots is planned for "drive time" audiences. The spots will explore all aspects of science, technology, and health, examining both the news in science and the science behind the news.

In 1988, the Academy and WQED/Pittsburgh inaugurated a new project: airing in the United States the winning films of **Sci-Tech,** an international science, technology, and medicine film festival hosted by the Royal Society of Great Britain. Future award-winning films will be shown every two years in Washington and at the Beckman Center on the West Coast.

The W. K. Kellogg Foundation awarded $20 million in endowment funds to the National Academy of Sciences and the Institute of Medicine in May 1988 for the support of studies in agriculture, health, and education. Under the terms of the award, Kellogg provided $4 million in endowment funds in June 1988 and will provide up to $4 million in additional funds each year for a four-year period ending March 31, 1993. These latter funds must be matched on a one-to-one basis with endowment funds raised by the Academy and the Institute from other sources.

The Academy and the Institute have undertaken a capital campaign to raise the $16 million in matching funds needed to secure all available Kellogg dollars. Numerous opportunities exist within the campaign for donors wishing to create a permanent named fund. Donors may, for example, establish named endowment funds to support activities and studies in the eight major issue areas described in the preceding pages:

- Strengthening the Scientific Enterprise
- International Affairs
- Education
- Agriculture
- The Environment
- Social and Community Issues
- Health
- National Understanding

In addition, the Academy seeks endowment funds for the following areas:

■ Board on Biology—This major unit of the Research Council's Commission on Life Sciences needs endowment to address a broad range of critical issues in biology in a timely manner, often well before their benefits or risks are appreciated by conventional government and private sector funding sources. Such issues include: the opportunities offered by biotechnology for commercial and social goods; biodiversity, where traditional biology has the lead disciplinary role; and global environmental change, where biology has often been neglected.

■ Board on Chemical Sciences and Technology—This major unit of the Research Council's Commission on Physical Sciences, Mathematics, and Resources needs the flexibility of funding that endowment provides to: respond quickly to new developments in the fields of molecular science and engineering; provide consistent guidance over the long term on issues such as improving chemical education; and address timely issues, including the competitiveness of the chemical processing industries.

■ Institute for Strategic Transportation Studies (ISTP)—Endowment funds would be used to establish ISTP within the Research Council's Transportation Research Board. The institute would study strategic long-

range transportation problems and make policy recommendations that would be disseminated to the appropriate groups at the federal, state, and local levels. The transportation policy issues identified for study by ISTP would transcend the scope of any one federal government agency or individual transportation industry sector and might include such issues as: transportation infrastructure and inadequate airport capacity and its effect on the productivity and safety of our aviation system. The objective of ISTP would be to improve strategic transportation decision-making by providing policymakers with objective, credible facts, analyses, and recommendations.

Opportunities also exist under the campaign for donors to provide endowments for three of the Academy's facilities: the headquarters building in Washington, D.C.; the Woods Hole Study Center in Woods Hole, Massachusetts; and the Arnold and Mabel Beckman Center of the National Academies of Sciences and Engineering in Irvine, California.

Additionally, donors may contribute endowment to the Arts in the Academy Program, which brings fine music and art, often with a science-oriented theme, to the residents of the nation's capital.

Gifts can be made in a variety of forms, including cash, securities, and the establishment of life income and charitable lead trusts. Donors may prefer to make an extended commitment or pledge.

All gifts to the Academy and the Institute are tax-deductible.

Inquiries about the campaign and gifts to the Academy or Institute can be addressed to the:

Office of Development
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418.

Telephone inquiries should be directed to the office at:
(202) 334-2431.

SAMUEL O. THIER

"We have come close to chaos in health policy. We're developing incredible scientific potential—some of it translated without adequate evaluation. And at the same time, we have policies that create havoc in the practice of medicine and make the health professions potentially less attractive. The long-range impact of these policies needs to be thought about very carefully, because it is not a coordinated, thoughtful way of going forward. At IOM, we're trying to focus attention on the need for coordinated policies linking research and care."

Samuel O. Thier, M.D.
President, Institute of Medicine

Samuel Thier is a physician who can talk to government, industry, and academia about the nation's health problems. As an investigator, his studies of renal function advanced our understanding of inherited kidney disorders. As a department chairman, he developed innovative programs in undergraduate, graduate, and continuing medical education. And as a clinician/administrator, he personally provided care to and organized care for diverse populations of patients, including the indigent.

Dr. Thier has served as president of the Institute of Medicine since 1985. Before that he was professor and chairman of internal medicine at Yale. He also was chief of medical service at Yale-New Haven Hospital, where he initiated improvements in the training of physicians in clinical research and established consulting relationships for the School of Medicine with hospitals throughout the region. Dr. Thier attended Cornell University as an undergraduate, and received his M.D. from the State University of New York at Syracuse. His internship and residency were at the Massachusetts General Hospital, where in 1966 he was chief resident in medicine. Dr. Thier was a member of the medical faculty of Harvard and then of the University of Pennsylvania before moving to Yale in 1975. In 1981 he was named Sterling Professor, a university-wide chair at Yale reserved for scholars of exceptional accomplishment.

Dr. Thier has been president of the American Federation for Clinical Research, chairman of the American Board of Internal Medicine, and a member of the NIH Director's Advisory Committee. He has been invited to testify before congressional committees on a variety of issues on health-related research and medical care.

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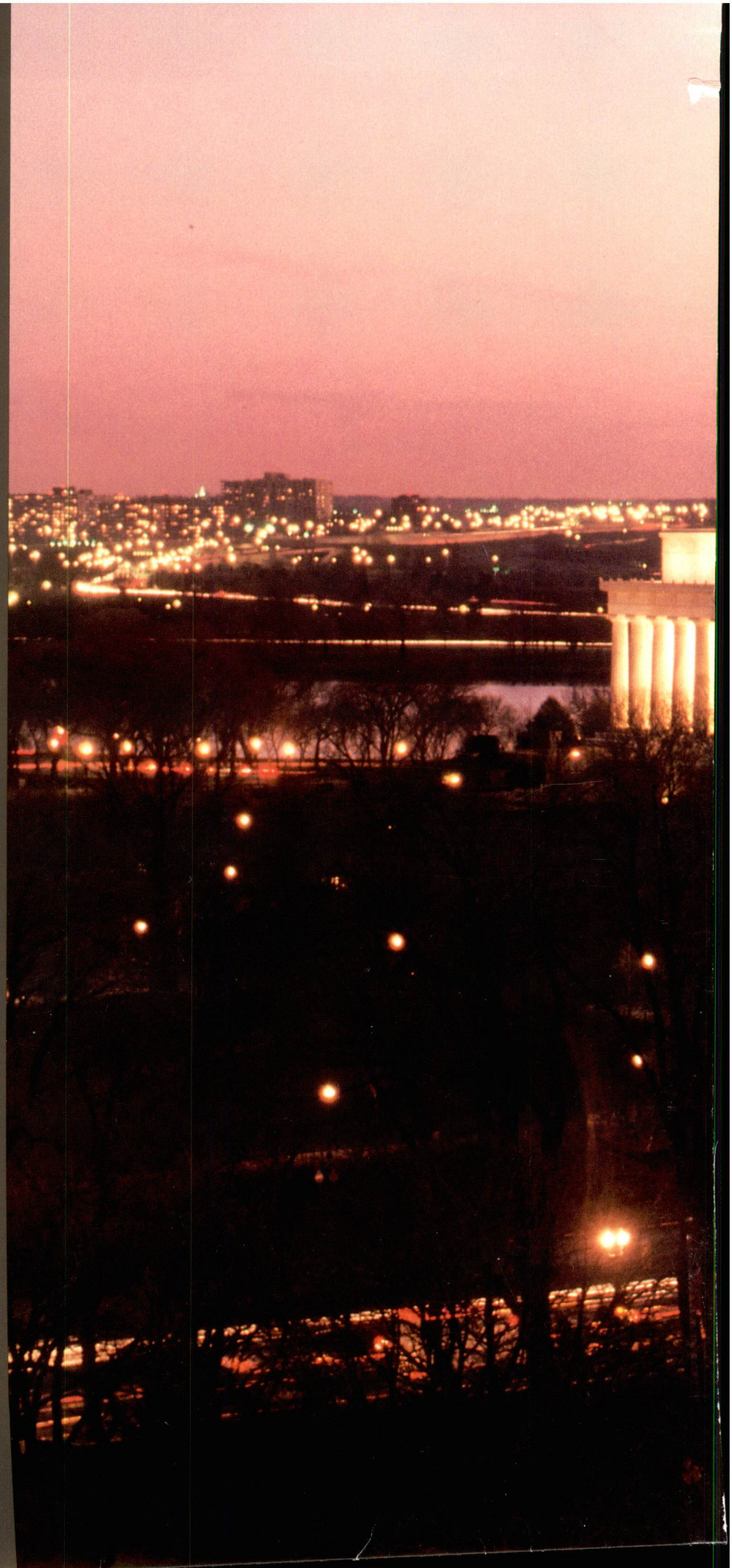
GRAPHIC DESIGN: Pamela Reznick

"The members of the Academy's study committees take their responsibilities very seriously, with the result that the discussion is deep, probing, and stimulating. Perhaps because of the intellectual rigor and care with which the Academy's committees approach their tasks, the resulting reports have significant impact. Indeed, the reports often serve as the foundation for government action or as the framework for subsequent public debate. It is my view that no other private institution in America has such profound and far-reaching impact on public-policy issues."

Richard A. Meserve, Esquire
Covington & Burling



COVER PHOTO: The National Academy of Sciences headquarters, the three-story neoclassical building in the right foreground, faces the Lincoln Memorial in Washington, D.C. It was named to the National Register of Historic Places in 1974.

REPRODUCED FROM THE COLLECTIONS
OF THE ARCHIVES OF THE
NATIONAL ACADEMY OF SCIENCES

NATIONAL ACADEMY OF SCIENCES AND ITS SISTER INSTITUTIONS

Brief Historical Outline by Period

Period	Historical Sketch	Highlights
1863-1915	The NAS was founded and organized in 1863 under a charter granted by the US Congress which established it as a private, self-organizing and self-perpetuating organization with the charge to provide the Federal Government with advice on scientific and technical matters. During its initial fifty-two years, NAS formed more than forty advisory committees and issued more than thirty formal reports containing such advice; it established thirteen trust funds whose income was used to support the work and publishing activities of scientists or to recognize the significant scientific achievements of individuals; and it grew in membership from the fifty nominations in the 1863 Act to 140 members, one honorary member, and forty foreign associates in 1915.	**1863** First report, on weights, measures and coinage ...**1884** Report that led to founding of USGS...**1885** Report recommending new Naval Observatory ...**1897** Report that led to founding of National Park Service and the national park system...**1880 and 1903** Reports on the condition and restoration of the Declaration of Independence... **1913-1914** Initial efforts to establish a permanent Academy home in Washington, D.C. ...**1915** The NAS Proceedings was founded...
1916-1918	This short period saw the founding of the National Research Council and marks the beginning of the modern Academy. The concerns of the Institution were mostly those of the Federal Government in time of war, and responding to the need the new Research Council established a wide variety of continuing	**1916** NRC created following President Wilson's acceptance of NAS offer, with George Ellery Hale as its first chairman...**May 1918** Wilson issued an executive order requesting the NAS to perpetuate the

1916-1918 (cont)	committees and special projects on topics ranging from chemical warfare, munitions and military medicine to the identification of submarines, the physics of optical observation, and the best type of balloon to use for aerial scouting. This work was new and intensive, and gave both the scientific community and the government a taste for a certain type of continuing interaction theretofore unknown.	NRC...**October 1918** Inter-Allied Conference on International Scientific Organizations adopted Hale's proposal to create an International Research Council (IRC)...
1919-1939	This period was, in essence, that in which much of the modern scientific community was created, particularly in the private sector. The Academy and the Research Council were heavily engaged in promoting scientific cooperation, providing and encouraging communications among the scientific, industrial and academic research communities, seeking the means to encourage scientific education and young scientists, and generally broadening the public's knowledge and understanding of scientific matters. The period also contained periods of conflict and its resolution in the relationships between the Academy and the Research Council, and between the Institution and the Federal Government. Funding was a major source of difficulty, as both the government and the Academy were hurt by the Depression, and for a time the Academy's international responsibilities were in jeopardy. By the end of the period, however, most of these conflicts and difficulties had been resolved.	**1919** NRC reorganized for peacetime ...Carnegie Corporation gave $5 million to NAS "for the purposes of the NRC"... Longest existing NRC entity, predecessor of TRB, established ...Rockefeller Foundation gave $50,000 and pledged $500,000 over 5 years, and the NRC Fellowship Program was launched...**1924** Dedication of NAS-NRC Building in Washington...**1931** IRC became the International Council of Scientific Unions (ICSU)... **1933-1939** Conflict over Science Advisory Board pitted NAS against NRC and Federal Government ...**1935-1936** F. R. Lillie first NAS President to be NRC Chairman...

1940-1950	The 1940's were a period of transition for the Academy. In the early years, it was heavily involved in support of the war effort, cooperating with the Office of Scientific Research and Development (OSRD), and becoming in essence its Committee on Medical Research. This experience led to post-war efforts by both the Academy and the government to institutionalize the advisory relationship that had been created. Various things were tried, but all failed, mostly because the Academy and the government could not agree on the level of control that the government would exercise. For this reason, the Academy initially opposed the establishment of the National Science Foundation; despite this, the Academy became a major recipient of NSF funds in the next decade.	**1940-41** Cooperating with OSRD/CMR, NRC created Committees on Military Medicine...NAS Committee on Atomic Fission reported that bomb was possible...**1946** D. W. Bronk became NRC Chairman...NRC accepted direction of the Atomic Bomb Casualty Commission ...**1947** NAS President Jewett warned of increasing government involvement in direction of science...**1950** NSF established by Federal Government ...D. W. Bronk elected NAS President, gave up NRC Chairmanship...
1951-1963	The achievements of the 1950's were the consolidation of thirty years of work by the Academy. The period was dominated by D. W. Bronk, NAS President and from 1954 NRC Chairman (the offices were never again separate), who encouraged a breadth of activity and a depth of involvement with the government never seen before. Many functions changed, however, as the government scientific apparatus grew and began to take over some of the things the Academy had done. The great fellowship programs were taken over by NSF...the military advisory boards became more powerful and the advice of the Academy less project-	**1951** NRC began advising NSF fellowship programs ...**1955** Committees on Biological Effects of Atomic Radiation appointed ...**1957-58/9** IGY in operation, leading to creation of NRC Committee on Polar Research, Space Science Board and Geophysics Research Board...**1957** Project Mohole began...Creation of President's Science Advisory Committee (PSAC) by President Eisenhower...**1962** NAS Council

1951-1963 (cont)	oriented...but the achievements of the International Geophysical Year, which the NAS initiated and for which it led the US effort, became a crowning achievement of 40 years of NRC history...as well as involving that spur to increased science-consciousness, Sputnik. The period ended with celebration of the Institution's Centennial.	formally joined offices of NAS President and NRC Chairman...NAS created the Committee on Science and Public Policy (COSPUP)... **1963** NAS celebrated its Centennial, with President Kennedy addressing the convocation...
1964-1973	This period was one of fundamental change for the Academy. It marks the end of the post-war period and the beginning of new relationships between the Academy and the Federal Government, as well as fundamental changes in how the Academy did business. The Academy began to perform an increasing number of policy studies in the 1960's, both on its own initiative and for the government, and this type of study became a chief characteristic of the following period. Internally, there were four major changes: the NAS President became resident; a program of peer review of reports was instituted; the first major reorganization of the Research Council was planned and implemented; and the National Academy of Engineering and the Institute of Medicine were founded. The Institution that emerged from this period was significantly different from the one that entered it, and no subsequent changes were as profound.	**1964** National Academy of Engineering founded...COSPUP began peer review of NRC reports; function taken over by Report Review Committee in 1970 ...**1966** F. Seitz became first resident NAS President...**1967** Most NRC staff consolidated in the Joseph Henry Building ...**1969** P. Handler elected to succeed F. Seitz, who resigned...**1970** Institute of Medicine founded ...**1971-73** NRC reorganized into four Assemblies and four Commissions ...Statement of Principles set relations of NAS and NAE in governance of NRC...
1974-1981	In the aftermath of the war in Vietnam, which had occasioned the abolishing of PSAC and	**1974** President's Food and Nutrition Study formed...

internal dissentions over classified studies, the Academy sought to find a new place in the science policy arena. The reorganization of the Research Council, completed in 1975, ended the involvement of the scientific societies in the Academy's policy activities and increased the role of Academy members. New concerns with energy and the environment brought calls for different kinds of advice and the need to use the expertise of individuals not part of the Academy's usual pool of experts. The Institution established formal means to ensure good balance in committee membership. The public face of the Institution was characteristically that of NAS President Philip Handler, architect of the NRC reorganization and active spokesman for the place of science in education and the public welfare.

Lombardo case established that NRC committees are not government advisory committees **...1975** Committee on Nuclear and Alternative Energy Systems established ...Radiation Effects Research Foundation took over ABCC programs **...1976** NAS Committee on Human Rights and NRC Committee on Scholarly Communications with People's Republic of China founded **...1979** First Science and Technology: Five Year Outlook issued on behalf of NSF...

1982- The modern period opened with the second major reorganization of the NRC, and a refocussing of the Institution's energies on building communications with the scientific research community, on achieving an increased ability to pursue independent or self-initiated projects, and on increasing public awareness of science, technology and the activities of the Institution. Activities include, in the first area, the Academy Industry Program and the Government-University-Industry Research Roundtable, among others; in the second area, the most significant and successful fund-raising efforts

1982 Second major reorganization of the NRC...**1984** NAS publication of Science and Creationism... Issues in Science and Technology began publication **...1985** NRC Board on Mathematical Sciences Education established...**1986** Strategic Highway Research Program began...Planet Earth film series broadcast...**1987** NRC offices moved from Pennsylvania

since the early years of the Research Council; and in the third, improved publishing and public relations efforts, including film series, news services, and augmented report announcement and presentation activities. By the later 1980's, the continuing shift in advisory emphasis from technical to policy topics resulted in the greater part of studies being of the latter sort; requests for advice were frequently being written into legislation by Congress; and the Institution was beginning to be concerned with managing the growth in the number and variety of its enterprises.

Avenue location to Whitehaven Street in Georgetown, and spread into several surrounding buildings...Report of Panel to Advise NSF on Basic Science and Technology Centers... Infinite Voyage film series began broadcasting...1988 Beckman Study Center in Irvine, California, dedicated...

REPRODUCED FROM THE COLLECTIONS
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Brief Historical Outline by Period

Period	Impacts of Reports/Activities
1863-1915	First government request for advisory services received in 1863 for report on weights, measures, and coinage...Navy requests reports on variety of technical questions, among them magnetic deviations in iron ships (1863), protecting bottoms of iron ships from corrosion (1864), and on continuance of Wind and Current Charts and Sailing Directions...NAS contributes to US policies and organization of its scientific bureaus through reports that lead to founding of United States Geological Survey and reorganization of weather service and signal corps (1884), the establishment of a new Naval Observatory (1885), and the founding of National Park Service and national park system (1897)...NAS reports on condition and restoration of Declaration of Independence in 1880 and 1903, and on controlling landslides during Panama Canal construction (1915-1917)
1916-1918	NRC organized to provide scientific research services for national preparedness and to mobilize nation's scientists in advisory activities...In 1917 US Council of National Defense asks NRC to serves as its Department of Research...Range of NRC national defense efforts includes work in submarine detection and defensive and offensive aspects of gas warfare...Research Information Committee and Research Information Service establish offices in allied countries to direct exchange of scientific, technical, and industrial information crucial to the war effort...NRC assists Signal Corp's organization of Science and Research Division (1917) and advises Patent Office on more effective operations...Committee on Psychology develops first large scale use of intelligence testing for the purposes of testing and classifying military recruits. The success of psychological testing elevates role of psychology and leads to development of large scale testing in school systems...NRC takes dominant role in creation of International Research Council (IRC) in 1918
1919-1939	NRC Fellowships established in 1919 to provide postdoctoral support in biological, natural, and medical sciences. This influential program is premiere source of American research training

1919-1939 (cont)

support for over thirty years...Highway Research Board established (1919) to conduct transportation studies. Is longest-lived NRC component, now directs studies as the Transportation Research Board...NAS Committee on Oceanography issues influential report (1929) that leads to establishment of Woods Hole Oceanographic Institution...IRC becomes International Council of Scientific Unions (ICSU) in 1931, and NRC directs US role in formation of international unions and participation in international scientific activities...From 1933 through the Science Advisory Board, Committee on Government Relations, and Government Relations and Science Advisory Committee NAS-NRC creates a new apparatus of advisory services to government. Technical services to armed forces (Army Air Corps, naval feasibility studies) provides basis for relationships that emerge during World War II...NRC founds the American Geophysical Union (1919)...NRC begins publication of Biological Abstracts and Psychological Abstracts...NRC brings science to general public by joining in creation of Science News Service (1920), by its role as scientific advisor to the directors of the 1933 World's Fair and by the activities of the Committees on Scientific Aids to Learning (1937-1939)...NRC grants to investigators through its committees on sex research and endocrinology result in discoveries of new hormones, vitamins, and diagnostic and treatment methods... With publication of multi-volume series Physics of the Earth (beginning in 1931) NRC makes substantial contribution to the earth sciences literature.

1940-1950

NAS-NRC preparedness for war predates US entry with creation of first military medical committees (1939-1940)...NRC advises the US Office of Scientific Research and Development (OSRD), its Committee on Medical Research (CMR) and National Defense Research Council (NDRC), the armed forces, and other agencies on a variety of war related studies conducted by all NRC technical divisions in all areas of concern...For CMR the NRC sponsors a research program in every area of military medicine, including synthesis of penicillin, aviation medicine, work in sanitary engineering, production of drugs and essential supplies, and providing new techniques and therapies for

1940-1950 (cont)

battlefield medicine...The NRC mobilizes US scientists for war work through the Roster of Scientific and Specialized Personnel and by establishing the Office of Scientific Personnel (1941)...NAS Committee on Atomic Fission reports on feasibility of an atomic bomb, leading to the Manhattan Project...War Metallurgy Committee directs work in minerals and metals...NRC provides advice on selection and training of pilots, on anti-submarine warfare, on fortification design, and on quartermaster problems...The Committee on Food Habits studies rationing...The Committee on Food and Nutrition is formed in 1940 (becomes Food and Nutrition Board in 1942) and published the first Recommended Dietary Allowances in 1941, a periodic publication that has had an impact on national nutritional policies from its inception...Through NRC reference committees scientific journals voluntarily restrict or suspend publication of articles deemed crucial to national defense, while ensuring authors credit for their discoveries when emergency subsides...First publication of Nutrient Requirement Series, authoritative reports on economically important domestic animals...A Presidential Directive requests the NRC to establish and assume operational responsibilities for the Atomic Bomb Casualty Commission...Pacific Science Board established (1946)...Committee on Undersea Warfare begins (1946)

1951-1963

The report of the Committees on Biological Effects of Atomic Radiation is published in 1956 and contributes to the national debate and policy-making on atomic radiation and the nuclear industry...NAS-NRC directs US participation in the International Geophysical Year (1957-1958), whose accomplishments include the launch of American satellites, the establishment of research bases in Antarctica, and upper atomosphere research...IGY initiatives and successes lead NAS-NRC to establish Committee on Atmospheric Sciences (1957), the Polar Research Board, the Space Science Board (1958), and the Geophysics Research Board (1959)...NAS and USSR Academy of Sciences sign scientific exchange agreement in 1959, providing for research visits to each country by the others' scientists, bilateral conferences, symposia, and research projects. Agreements with other countries are to follow...NAS-NRC conducts

1951-1963 (cont) summer studies for the Navy and for the Air Force; still-classified reports contributed to long-range planning and technological innovations...Air Force Studies Board predecessor established in 1962 to provide on-going advisory services to USAF... Committee on Science and Public Policy (COSPUP) established in 1961 (as Committee on Government Relations) to aid government in formation of science and technology policy and in application of policies to national problems. First COSPUP report Growth of World Population appears in 1963...In response to request from President Kennedy, the NAS forms the Committee on Natural Resources whose 1963 Natural Resources made significant contributions to national policy in regard to the conservation, development, and use of natural resources

1964-1973 The National Academy of Engineering (NAE) is founded under the NAS charter in 1964 to provide engineering advisory services to the nation and to provide a mechanism for honoring the contributions of distinguished engineers...COSPUP issues series of well-received reports surveying research fields and recommending government directions, including funding levels. Among these are Ground Based Astronomy: A Ten-Year Program (1964), the first chemistry survey Chemistry: Opportunities and Needs (1965) and The Behavioral and Social Sciences: Outlooks and Needs (1969)...First contract between the NAS and the Congress results in COSPUP reports for the House Committee on Science and Astronautics: Basic Research and National Needs (1965), Applied Science and Technological Progress (1967), and Technology: Processes of Assessment and Choice (1969). The COSPUP efforts were designed to identify and describe critical policy issues faced by government in its decisions to regulate, support, or otherwise foster research in the US, according to Rep. George Miller, Chairman, Committee on Science and Astronautics...SSB provides variety of advisory services to NASA including 1966 reports Space Research: Directions for the Future and Biology and the Exploration of Mars...Committee on Scholarly Communication with People's Republic of China formed with American Council of Learned Societies and the Social Science Research Council...The 1969 Drug Efficacy Study to the Commissioner of the Food and Drug Administration leads to sweeping FDA changes in the licensing and

1964-1973 (cont)

distribution of prescription medications... Contributions to environmental sciences and to national environmental policy include such studies as Impact of the Bay Area Rapid Transit System on the San Francisco Metropolitan Region (1970), Jamaica Bay and Kennedy Airport: A Multidisciplinary Environmental Study (1971) and the NAE Bay Area Transit (BART) Impact Program Advisory Committee...The Board on Medicine, formed in 1967, becomes the Institute of Medicine in December 1970. Under the IOM's charter its purpose is "the protection and advancement of the health of the public," including the conduct of study programs relating to the delivery of health care, medical education, and biomedical research and development...Motor Vehicle Emissions (1973) reports on technological feasibility of meeting emission standards

1974-1982

Science and Technology in Presidential Policy-making (1974) contributes to 1976 reestablishment of White House Office of Science and Technology... World Food and Nutrition Study responds to Presidential request for research recommendations for providing for present and future needs of world's poor...NAS creates Committee on Human Rights in 1976 to act on behalf of scientific colleagues throughout the world who are victims of repression...Eleven EPA Analytical Studies issued between 1973-1977 to review programs and priorities of the Environmental Protection Agency...Naval Studies Board created to advise Navy on space, aviation, and navigational activities...Energy in Transition: 1985-2010 (1980) studies US energy needs and appropriate role of nuclear and alternative energy systems...Outlook for Science and Technology: The Next Five Years appears in 1979. First of a series of significant reports to NSF identifying current and emerging national problems and opportunities for or constraints on scientific capabilities for addressing these problems...1980 Improving Aircraft Safety assesses FAA policies and procedures for certifying commercial aircraft airworthiness...

1982-1989

Science and Mathematics in the Schools, the report of a 1982 convocation, is distributed to each of nation's school districts...Concern with science and mathematics education on elementary and

1982-1989 (cont)

secondary levels leads to 1985 creation of the Mathematical Sciences Education Board, whose Everybody Counts (1989) has had broad impact and 1987 National Science Resources Center (joint with the Smithsonian Institution)...55: A Decade of Experience (1984) leads to exemption of rural interstate highways from the provision...NRC pursues its 1981 work on acid rain with Acid Deposition: Atmospheric Processes in Eastern North America (1983) and convenes joint tri-academy studies with Canada and Mexico...National Academies Op-Ed Service formed in 1983 to bring science editorials and opinion to country's newspapers; now reaches more than 350... COSEPUP (Committee on Science, Engineering and Public Policy) succeeds COSPUP in 1981...COSEPUP's research briefings for OSTP and selected federal agencies identify research areas within specific fields of science likely to return the highest scientific dividends (1982-1987) and generate exceptional interest within government and private sector...Recommendations of Risk Assessment in the Federal Government: Managing the Process (1983) are adopted by EPA and other agencies..."Issues in Science and Technology," a quarterly journal of opinion, begins in 1984...1984 formation of Government-University-Industry Research Roundtable (1984) provides forum for dialogue between scientists, engineers, administrators, and policy-makers on ways of improving the productivity of the nation's research enterprise...Injury in America (1985) influences national injury control program...Airliner Cabin Environment (1986) influences ban on smoking on domestic flights of less than two hours...Strategic Highway Research Program formed in NRC to accelerate research on highway maintenance..."Planet Earth" begins broadcasting in 1986. Produced by WQED, with NAS serving as scientific advisor, this Emmy-award winning series was followed by "The Infinite Voyage," now in its third season...IOM's Improving the Quality of Care in Nursing Homes (1986) has impact on federal legislation directed at addressing inadequacies of care in nursing homes...NASA requests NRC advice on space shuttle program following the Challenger disaster. Studies on solid rocket booster redesign and a criticality review and hazard analysis and audit of shuttle follow (1986-1988)...NRC and IOM address nation's concern with AIDS through various

1982-1989 (cont)

reports including Confronting AIDS: Directions for Public Health, Care, and Research (1986, Update in 1988) and AIDS, Sexual Behavior, and Intravenous Drug Use (1989); studies have helped mobilize Congress and the Executive Branch and to increase funding levels for AIDS research...NAS and NAE provide Department of Energy list of best qualified sites for Superconducting Super Collider (1987)...Long-term planning for space program addressed in 1988 Space Science in the Twenty-First Century: Imperatives for the Decades 1995-2015...The Academies and IOM contribute to federal budget planning through Federal Science and Technology Budget Priorities: New Perspectives & Procedures (1988) requested by Senate Budget Committee...Two IOM studies on the National Institutes of Health influence organizational structure, funding levels, and personnel recruitment and retention (1984, 1988)...Mapping and Sequencing the Human Genome (1988) provides blueprint for the proposed project...Major assessment on status of black Americans, A Common Destiny: Blacks and American Society published (1989)

NATIONAL ACADEMY OF SCIENCES

of the United States of America

Texas: 37 members

MEMBERSHIP LISTING

January 1990

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CLASSES

The Academy is divided into six Classes as follows:

I. **Physical & Mathematical Sciences (Sections 11, 12, 13, 14, 15, 16)**

II. **Biological Sciences (Sections 21, 22, 23, 24, 25, 26, 27)**

III. **Engineering & Applied Sciences (Sections 31, 32, 33)**

IV. **Medical Sciences (Sections 41, 42, 43)**

V. **Behavioral & Social Sciences (Sections 51, 52, 53, 54)**

VI. **Applied Biological & Agricultural Sciences (Sections 61, 62)**

SECTIONS

Each Class is further divided into Sections to which members are assigned at their own choice:

(11) **Mathematics**
(12) **Astronomy**
(13) **Physics**
(14) **Chemistry**
(15) **Geology**
(16) **Geophysics**
(21) **Biochemistry**
(22) **Cellular and Developmental Biology**
(23) **Physiology and Pharmacology**
(24) **Neurobiology**
(25) **Botany**
(26) **Genetics**
(27) **Population Biology, Evolution and Ecology**
(31) **Engineering**
(32) **Applied Mathematical Sciences**
(33) **Applied Physical Sciences**
(41) **Medical Genetics, Hematology and Oncology**
(42) **Medical Physiology and Metabolism**
(43) **Microbiology and Immunology**
(51) **Anthropology**
(52) **Psychology**
(53) **Social and Political Sciences**
(54) **Economic Sciences**
(61) **Applied Biological Sciences**
(62) **Agricultural Sciences**

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Ahrens, Edward H., Jr., Rockefeller U, New York, New York
Aki, Keiiti, U of Southern California, Los Angeles, California
Alberts, Bruce M., U of Calif, San Francisco, California
Alberty, Robert A., MIT, Cambridge, Massachusetts
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Amos, D. Bernard, Duke U Sch Med, Durham, North Carolina
Anders, Edward, U of Chicago, Chicago, Illinois
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Arnett, W. David, U of Arizona, Tucson, Arizona
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Arnold, William A., Oak Ridge Nat'l Lab, Oak Ridge, Tennessee
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Ashwell, G. Gilbert, NIH, Bethesda, Maryland
Atkinson, Richard C., U of Calif-San Diego, La Jolla, California
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Axelrod, Robert M., U of Michigan, Ann Arbor, Michigan
Axtell, John D., Purdue U, West Lafayette, Indiana
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Aydelotte, William O., U of Iowa, Iowa City, Iowa

Babcock, Horace W., Mt. Wilson/Las Campas Obsvs, Pasadena, California
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Baldeschwieler, John D., Cal Tech, Pasadena, California
Baldwin, Robert L., Stanford U-Sch of Med, Stanford, California
Ballou, Clinton E., U of Calif, Berkeley, California
Balluffi, Robert W., MIT, Cambridge, Massachusetts
Baltimore, David, Whitehead Inst, Cambridge, Massachusetts
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Barber, Stanley A., Purdue U, West Lafayette, Indiana
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Barschall, H. H., U of Wisconsin, Madison, Wisconsin
Bartholomew, George A., U of Calif, Los Angeles, California
Bartlett, Paul D., Harvard U, Cambridge, Massachusetts
Barton, Paul B. Jr., US Geological Survey, Reston, Virginia
Basolo, Fred, Northwestern U, Evanston, Illinois
Bass, Hyman, Columbia U, New York, New York
Bauman, Dale E., Cornell U, Ithaca, New York
Baumol, William J., Princeton U, Princeton, New Jersey
Baym, Gordon A., U of Illinois, Urbana, Illinois
Bean, Charles P., Rensselaer Polytech Inst, Troy, New York
Bearn, Alexander G., Rockefeller U, New York, New York
Beauchamp, Jesse L., Cal Tech, Pasadena, California
Beck, Stanley D., U of Wisconsin, Madison, Wisconsin
Becker, Gary S., U of Chicago, Chicago, Illinois
Beckwith, Jonathan R., Harvard Med Sch, Boston, Massachusetts
Beeson, Paul B., Redmond, Washington
Beevers, Harry, U of Calif, Santa Cruz, California
Beidler, Lloyd M., Florida State U, Tallahassee, Florida
Beinert, Helmut, Med Col of Wisconsin, Milwaukee, Wisconsin
Benacerraf, Baruj, Dana-Farber Cancer Inst, Boston, Massachusetts
Benditt, Earl P., U of Washington Sch of Med, Seattle, Washington
Benedek, George B., MIT, Cambridge, Massachusetts
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Benkovic, Stephen J., Penn State U, U Park, Pennsylvania

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Bennett, Michael V. L., Albert Einstein Col of Med, Bronx, New York
Benson, Andrew A., U of Calif-San Diego, La Jolla, California
Benson, Sidney W., U of Southern California, Los Angeles, California
Benzer, Seymour, Cal Tech, Pasadena, California
Berg, Howard C., Harvard U, Cambridge, Massachusetts
Berg, Paul, Stanford U Sch of Med, Stanford, California
Berggren, William A., Woods Hole Oceanogr Inst, Woods Hole, California
Bergman, Robert G., U of Calif, Berkeley, California
Bergson, Abram, Harvard U, Cambridge, Massachusetts
Berko, Stephan, Brandeis U, Waltham, Massachusetts
Berlin, O. Brent, U of Calif, Berkeley, Calkifornia
Berliner, Robert W., Yale U Sch of Med, New Haven, Connecticut
Bern, Howard A., U of Calif, Berkeley, California
Berne, Robert M., U of Virginia, Charlottesville, Virginia
Berner, Robert A., Yale U, New Haven, Connecticut
Bernstein, Ira B., Yale U, New Haven, Connecticut
Bernstein, Richard B., U of Calif, Los Angeles, California
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Berry, R. Stephen, U of Chicago, Chicago, Illinois
Bers, Lipman, Columbia U, New York, New York
Bersohn, Richard, Columbia U, New York, New York
Berson, Jerome A., Yale U, New Haven, Connecticut
Bethe, Hans A., Cornell U, Ithaca, New York
Beutler, Ernest, Scripps Clin Res Fdn, La Jolla, California
Beyer, Karl H., Jr., Penn State U Hershey Med Cntr, Hershey, Pennsylvania
Bickel, Peter J., U of Calif, Berkeley, California
Bigeleisen, Jacob, SUNY, Stony Brook, New York
Billings, Marland P., North Conway, New Hampshire *
Birch, A. Francis, Harvard U, Cambridge, Massachusetts *
Bird, R. Byron, U of Wisconsin, Madison, Wisconsin
Birkhoff, Garrett, Harvard U, Cambridge, Massachusetts
Bishop, J. Michael, U of Calif, San Francisco, California
Bizzi, Emilio, MIT, Cambridge, Massachusetts
Bjorken, James D., Fermi Natl Accel Lab, Batavia, Illinois
Bjorkman, Olle, Carnegie Inst Wash, Stanford, California
Blackwell, David H., U of Calif, Berkeley, California
Blalock, Hubert M., Jr., U of Washington, Hansville, Washington
Blau, Peter M., U of North Carolina, Chapel Hill, North Carolina
Bleakney, Walker, Santa Barbara, California *
Blobel, Gunter K., Rockefeller U, New York, New York
Bloch, Herman S., Skokie, Illinois
Bloch, Konrad E., Harvard U, Cambridge, Massachusetts
Bloembergen, Nicolaas, Harvard U, Cambridge, Massachusetts
Bloom, Barry R., Albert Einstein Col of Med, Bronx, New York
Bloom, Floyd E., Scripps Clin Res Fdn, La Jolla, California
Blout, Elkan R., Harvard U Med Sch, Boston, MA; Nat'l Acad of Scs, Washington, D.C.
Blumberg, Baruch S., Fox Chase Cancer Ctr, Philadelphia, Pennsylvania
Bodian, David, Johns Hopkins Med Sch, Baltimore, Maryland
Boehm, Felix H., Cal Tech, Pasadena, California
Boekelheide, V. C., U of Oregon, Eugene, Oregon
Bogorad, Lawrence, Harvard U, Cambridge, Massachusetts
Bogue, Allan G., U of Wisconsin, Madison, Wisconsin
Bonner, James F., Cal Tech, Pasadena, California
Bonner, J. T., Princeton U, Princeton, New Jersey
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* Emeritus Member

Bormann, Frederick H., Yale U, New Haven, Connecticut
Botstein, David, GENENTECH, S. San Francisco, California
Bott, Raoul, Harvard U, Cambridge, Massachusetts
Boudart, Michel, Stanford U, Stanford, California
Boulding, Kenneth E., U of Colorado, Boulder, Colorado
Bovey, Frank A., AT&T Bell Labs, Murray Hill, New Jersey
Bower, Gordon H., Stanford U, Stanford, California
Boyd, F. R., Jr., Carnegie Inst Wash, Washington, D.C.
Boyer, Herbert W., U of Calif, San Francisco, California
Boyer, P. D., U of Calif, Los Angeles, California
Boynton, Robert M., U of Calif-San Diego, La Jolla, California
Boyse, Edward A., U of Arizona Health Scs Ctr, Tucson, Arizona
Brace, W. F., MIT, Cambridge, Massachusetts
Bradbury, N. E., Los Alamos, New Mexico *
Brady, Roscoe O., NIH, Bethesda, Maryland
Braidwood, Robert J., La Porte, Indiana *
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Braunwald, Eugene, Harvard U Med Sch, Boston, Massachusetts
Bremner, John M., Iowa State U, Ames, Iowa
Breslow, Ronald, Columbia U, New York, New York
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Brewer, Richard G., IBM, San Jose, California
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Briggs, Winslow R., Carnegie Inst Wash, Stanford, California
Brill, Winston J., AGRACETUS, Middleton, Wisconsin
Brink, Frank, Jr., Doylestown, Pennsylvania
Brinkhous, Kenneth M., U of NC Sch of Med, Chapel Hill, North Carolina
Brinkman, W. F, AT&T Bell Labs, Murray Hill, New Jersey
Brinster, Ralph L., U of Penn, Philadelphia, Pennsylvania
Britten, Roy J., Cal Tech, Corona Del Mar, California
Brobeck, John R., Swarthmore, Pennsylvania
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Brooks, Norman H., Cal Tech, Pasadena, California
Browder, Felix E., Rutgers U, New Brunswick, New Jersey
Browder, William, Princeton U, Princeton, New Jersey
Brown, Donald D., Carnegie Inst Wash, Baltimore, Maryland
Brown, Gerald E., SUNY, Stony Brook, New York
Brown, Harold, Johns Hopkins Sch Adv Intnat'l Studies, Washington, D.C.
Brown, Herbert C., Purdue U, Lafayette, Indiana
Brown, Michael S., U of Texas Southwestern Med Ctr, Dallas, Texas
Brown, Roger W., Harvard U, Cambridge, Massachusetts
Brown, Walter L., AT&T Bell Labs, Murray Hill, New Jersey
Brown, William L., Pioneer Hibred Int'l, Johnston, Iowa
Brueckner, Keith A., U of Calif-San Diego, La Jolla, California
Bruice, Thomas C., U of Calif, Santa Barbara, California
Bryant, Marvin P., U of Illinois, Urbana, Illinois
Bryson, Arthur E., Jr., Stanford U, Stanford, California
Buchanan, John M., MIT, Cambridge, Massachusetts
Buchi, George H., MIT, Cambridge, Massachusetts
Buchsbaum, S. J., AT&T Bell Labs, Holmdel, New Jersey
Budiansky, Bernard, Harvard U, Cambridge, Massachusetts
Buikstra, Jane E., U of Chicago, Chicago, Illinois
Bukovac, Martin J., Michigan State U, East Lansing, Michigan
Bullock, Theodore H., U of Calif, Sch of Med, La Jolla, California

* Emeritus Member

Burbidge, E. Margaret, U of Calif-San Diego, La Jolla, California
Burchfiel, B. Clark, MIT, Cambridge, Massachusetts
Burke, Bernard F., MIT, Cambridge, Massachusetts
Burns, John J., Roche Inst. of Molec Bio, Nutley, New Jersey
Burris, R. H., U of Wisconsin, Madison, Wisconsin
Burstein, Elias, U of Penn, Philadelphia, Pennsylvania
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Byers, Horace R., Santa Barbara, California

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Cain, Stanley A., U of Calif, Santa Cruz, California *
Cairns, Theodore L., Chadds Ford, Pennsylvania
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Campbell, Donald T., Lehigh U, Bethlehem, Pennsylvania
Cantoni, Giulio L., NIMH, Bethesda, Maryland
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Carbon, John A., U of Calif, Santa Barbara, California
Cardona, Manuel, Max-Planck Inst, Federal Republic of Germany
Carrier, George F., Harvard U, Cambridge, Massachusetts
Carson, Hampton L., U of Hawaii Sch of Med, Honolulu, Hawaii
Carter, H. E., U of Arizona, Tucson, Arizona
Case, Kenneth M., Rockefeller U, New York, New York
Castle, W. B., Harvard U, Brookline, Massachusetts *
Catterall, William A., U of Washington, Seattle, Washington
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Chalmers, Bruce, Harvard U, Cambridge, Massachusetts *
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Chance, Britton, U of Penn Sch of Med, Philadelphia, Pennsylvania
Chandrasekhar, S., U of Chicago, Chicago, Illinois
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Chanock, Robert M., NIH, Bethesda, Maryland
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Chern, Shiing-Shen, U of Calif, Berkeley, California
Chernoff, Herman, Harvard U, Cambridge, Massachusetts
Chew, Geoffrey F., U of Calif, Berkeley, California
Chilton, Mary-Dell, CIBA-Geigy, Res Triangle Park, North Carolina
Cho, Alfred Yi, AT&T Bell Labs, Murray Hill, New Jersey
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Chomsky, A. Noam, MIT, Cambridge, Massachusetts
Choppin, Purnell W., HHMI, Bethesda, Maryland
Christy, Robert F., Cal Tech, Pasadena, California
Chu, Paul C-W., U of Houston, Houston, Texas
Church, Alonzo, U of Calif, Los Angeles, California
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Clayton, Roderick K., Ithaca, New York *
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Cohen, Seymour S., Marine Biol Lab, Woods Hole, Massachusetts
Cohen, Stanley, Vanderbilt U Sch of Med, Nashville, Tennessee
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Cohn, Mildred, U of Penn Sch of Med, Philadelphia, Pennsylvania
Cohn, Zanvil A., Rockefeller U, New York, New York
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Colgate, S. A., Los Alamos Nat'l Lab, Los Alamos, New Mexico
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Cronkite, Eugene P., Brookhaven Nat'l Lab, Upton, New York
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Davenport, Horace W., U of Michigan Med Sch, Ann Arbor, Michigan *
David, E. E., Jr., EED, Inc, Bedminster, New Jersey
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de Laguna, Frederica, Bryn Mawr Col, Bryn Mawr, Pennsylvania
DeLuca, H. F., U of Wisconsin, Madison, Wisconsin
Denison, Edward F., Brookings Inst, Washington, D.C.
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Dickinson, Robert E., Natl Ctr for Atmosph Res, Boulder, Colorado
Diener, Theodor O., USDA, Beltsville, Maryland
Dilcher, David L., Indiana U, Bloomington, Indiana
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Dynes, Robert C., AT&T Bell Labs, Murray Hill, New Jersey
Dynkin, Eugene B., Cornell U, Ithaca, New York
Dyson, Freeman J., The Inst for Adv Stdy, Princeton, New Jersey

Eagle, Harry, Albert Einstein Col of Med, Bronx, New York
Eastman, Dean E., IBM, Yorktown Heights, New York
Ebert, James D., Johns Hopkins U, Baltimore, Maryland; Nat'l Academy of Scs, Washington, DC
Edelman, Gerald M., Rockefeller U, New York, New York
Edelman, Isidore S., Columbia U-Col of Phys/Surgs, New York, New York
Edmondson, W. T., U of Washington, Seattle, Washington
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Ehrlich, Gert, U of Illinois, Urbana, Illinois
Ehrlich, Paul R., Stanford U, Stanford, California
Eilenberg, Samuel, Columbia U, New York, New York
Eisen, Herman N., MIT, Cambridge, Massachusetts
Eisenberg, David, U of Calif, Los Angeles, California
Eisner, Thomas, Cornell U, Ithaca, New York
Elias, Peter, MIT, Cambridge, Massachusetts
Eliel, Ernest L., U of North Carolina, Chapel Hill, North Carolina
Elsasser, Walter M., Johns Hopkins U, Baltimore, Maryland *
El-Sayed, Mostafa F., U of Calif, Los Angeles, California
Emery, K. O., Woods Hole Oceanogr Inst, Falmouth, Massachusetts *
Emmons, Howard W., Harvard U, Cambridge, Massachusetts
Engel, Albert E. J., U of Calif-San Diego, La Jolla, California *
Englesberg, Ellis, U of Calif, Santa Barbara, California
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Evans, Harold J., Oregon State U, Corvallis, Oregon
Evans, Howard E., Colorado State U, Fort Collins, Colorado
Evans, Ronald M., HHMI, The Salk Inst, San Diego, California

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Faber, Sandra M., U of Calif, Lick Obsv, Santa Cruz, California
Falicov, L. M., U of Calif, Berkeley, California
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Fano, Ugo, U of Chicago, Chicago, Illinois
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Federer, Herbert, North Scituate, Rhode Island *
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Feigenbaum, Mitchell J., Rockefeller U, New York, New York
Feit, Walter, Yale U, New Haven, Connecticut
Felsenfeld, Gary, NIH, Bethesda, Maryland
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Finch, Clement A., Seattle, Washington *
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First, Neal L., U of Wisconsin, Madison, Wisconsin
Fischbach, Gerald D., Washington U, Sch of Med, St. Louis, Missouri
Fischer, Edmond H., U of Washington, Seattle, Washington
Fitch, Val L., Princeton U, Princeton, New Jersey
Fitch, Walter M., U of Southern California, Los Angeles, California
Fixman, Marshall, Colorado State U, Fort Collins, Colorado
Flanagan, James L., AT&T Bell Labs, Murray Hill, New Jersey
Flannery, Kent V., U of Michigan, Ann Arbor, Michigan
Flexner, Louis B., U of Penn Sch of Med, Philadelphia, Pennsylvania
Fogel, Robert W., U of Chicago, Chicago, Illinois
Folkers, Karl A., U of Texas, Austin, Texas
Forster, Robert E., U of Penn Sch of Med, Philadelphia, Pennsylvania
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Fox, Maurice S., MIT, Cambridge, Massachusetts
Fraenkel-Conrat, Heinz, U of Calif, Berkeley, California
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Frauenfelder, Hans, U of Illinois, Urbana, Illinois
Fredrickson, Donald S., Bethesda, Maryland
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French, C. Stacy, Los Altos Hills, California
Fridovich, Irwin, Duke U Sch of Med, Durham, North Carolina
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Friedkin, Morris Enton, U of Calif-San Diego, La Jolla, California
Friedlander, Gerhart, Brookhaven Nat'l Lab, Upton, New York
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Furth, Harold P., Princeton U, Princeton, New Jersey

* Emeritus Member

Gajdusek, D. Carleton, NIH, Bethesda, Maryland
Galambos, Robert, La Jolla, California
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Garabedian, Paul R., New York U, New York, New York
Garcia, John A., U of Calif, Los Angeles, California *
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Garen, Alan, Yale U, New Haven, Connecticut
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Garner, Wendell R., Yale U, New Haven, Connecticut
Gartler, Stanley M., U of Washington, Seattle, Washington
Garwin, Richard L., IBM, Yorktown Heights, New York
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Geballe, T. H., Stanford U, Stanford, California
Geertz, Clifford J., Inst for Adv Study, Princeton, New Jersey
Gehring, Frederick W., U of Michigan, Ann Arbor, Michigan
Geiduschek, E. Peter, U of Calif-San Diego, La Jolla, California
Gellert, Martin F., NIH, Bethesda, Maryland
Gell-Mann, Murray, Cal Tech, Pasadena, California
Giacconi, Riccardo, Space Teles Sci Inst, Baltimore, Maryland
Giaever, Ivar, Rensselear Polytech Inst, Troy, New York
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Gibbs, Martin, Brandeis U, Waltham, Massachusetts
Giblett, Eloise R., Puget Sound Blood Ct, Seattle, Washington
Gibson, Eleanor J., Cornell U, Ithaca, New York
Gibson, Quentin H., Cornell U, Ithaca, New York
Giebisch, Gerhard H., Yale U Sch of Med, New Haven, Connecticut
Gilbert, J. Freeman, U of Calif-San Diego, La Jolla, California
Gilbert, Walter, Harvard U, Cambridge, Massachusetts
Giles, Norman H., U of Georgia, Athens, Georgia
Gilman, Alfred G., U of Texas Southwestern Med Ctr, Dallas, Texas
Gilruth, Robert R., Kilmarnock, Virginia
Ginsberg, Harold S., Columbia U-Col of Phys/Surgs, New York, New York
Ginzton, E. L., Varian Associates, Palo Alto, California
Glaser, Donald A., U of Calif, Berkeley, California
Glashow, Sheldon L., Harvard U, Brookline, Massachusetts
Glass, H. Bentley, East Setauket, New York
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Glimm, James G., SUNY, Stony Brook, New York
Goddard, William A. III, Cal Tech, Pasadena, California
Goebel, Walther F., Rockefeller U, Greenwich, Connecticut
Gold, T., Cornell U, Ithaca, New York
Goldberg, Edward D., U of Calif-San Diego, La Jolla, California
Goldberger, Arthur S., U of Wisconsin, Madison, Wisconsin
Goldberger, M. L., The Inst for Adv Study, Princeton, New Jersey
Goldhaber, Gerson, U of Calif, Berkeley, California
Goldhaber, Gertrude S., Brookhaven Nat'l Lab, Upton, New York
Goldhaber, Maurice, Brookhaven Nat'l Lab, Upton, New York
Goldreich, Peter M., Cal Tech, Pasadena, California
Goldstein, Avram, Stanford U, Palo Alto, California
Goldstein, Joseph L., U of Texas Southwestern Med Ctr, Dallas, Texas
Goldstine, Herman H., Amer Phil Society, Philadelphia, Pennsylvania
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Good, Robert A., U of So Florida, St. Petersburg, Florida

* Emeritus Member

Goodenough, Ward H., U of Penn, Philadelphia, Pennsylvania
Goodman, Leo A., U of Calif, Berkeley, California
Goodman, Louis S., U of Utah Col of Med, Salt Lake City, Utah
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Goody, Richard M., Harvard U, Cambridge, Massachusetts
Gordon, James P., AT&T Bell Labs, Murray Hill, New Jersey
Gordon, Roy G., Harvard U, Cambridge, Massachusetts
Gordon, W. E., Rice U, Houston, Texas; Nat'l Academy of Scs, Washington, D.C.
Gorenstein, Daniel, Rutgers U, New Brunswick, New Jersey
Gotschlich, Emil C., Rockefeller U, New York, New York
Gottschalk, Carl W., U of NC Sch Med, Chapel Hill, North Carolina
Gould, Roy W., Cal Tech, Pasadena, California
Gould, Stephen Jay, Harvard U, Cambridge, Massachusetts
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Graham, Ronald L., AT&T Bell Labs, Murray Hill, New Jersey
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Green, David M., U of Florida, Gainesville, Florida
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Greenewalt, Crawford H., E I Dupont de Nemours & Co, Wilmington, Delaware *
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Gross, Ludwik, Veterans Admin, Bronx, New York
Grubbs, Robert H., Cal Tech, Pasadena, California
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Guillemin, Roger, Whittier Inst, La Jolla, California
Guillemin, Victor W., MIT, Cambridge, Massachusetts
Gunn, James E., Princeton U, Princeton, New Jersey
Gunsalus, Irwin C., U of Illinois, Urbana, Illinois
Guth, Alan H., MIT, Cambridge, Massachusetts
Gutowsky, H. S., U of Illinois, Urbana, Illinois

Haas, Mary R., U of Calif, Berkeley, California
Hackerman, Norman, Robt A. Welch Fdn, Houston, Texas
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Hall, John L., U of Colorado, Boulder, Colorado
Hall, Robert N., General Electric, Schenectady, New York
Hallauer, Arnel R., Iowa State U, Ames, Iowa
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Halpern, Jack, U of Chicago, Chicago, Illinois
Halver, John E., U of Washington, Seattle, Washington

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Hamburger, Viktor, Washington U, St. Louis, Missouri
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Hauser, Robert Mason, U of Wisconsin, Madison, Wisconsin
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Hay, Elizabeth D., Harvard U Med Sch, Boston, Massachusetts
Heeschen, D. S., Nat'l Radio Astron Lab, Charlottesville, Virginia
Hegsted, D. Mark, Harvard U Med Sch, Southborough, Massachusetts
Heidelberger, Michael, New York U Sch of Med, New York, New York
Heiser, Charles B., Jr., Indiana U, Bloomington, Indiana
Held, Richard M., MIT, Cambridge, Massachusetts
Helinski, Donald R., U of Calif-San Diego, La Jolla, California
Helliwell, Robert A., Stanford U, Stanford, California
Hellwarth, Robert W., U of So California, Los Angeles, California
Henle, Gertrude, Newtown Square, Pennsylvania *
Henley, Ernest M., U of Washington, Seattle, Washington
Heppel, Leon A., Cornell U, Ithaca, New York
Herb, R. G., Nat'l Electrostat, Middleton, Wisconsin
Herbig, George H., U of Hawaii, Honolulu, Hawaii
Herring, W. Conyers, Stanford U, Stanford, California
Herschbach, Dudley R., Harvard U, Cambridge, Massachusetts
Hershey, A. D., Syosset, New York *
Herskowitz, Ira, U of Calif, San Francisco, California
Hertz, Roy, George Washington U, Bethesda, Maryland
Herzenberg, Leonard A., Stanford U Sch of Med, Stanford, California
Hess, George P., Cornell U, Ithaca, New York
Hewlett, William R., Hewlett-Packard Inc, Palo Alto, California
Hilgard, E. R., Stanford U, Stanford, California
Hill, Robert L., Duke U Sch of Med, Durham, North Carolina
Hill, Terrell L., Santa Cruz, California
Hille, Bertil, U of Washington Sch of Med, Seattle, Washington
Hilleman, Maurice R., Merck Sharp & Dohme Res Labs, West Point, Pennsylvania
Hirschfelder, J. O., U of Wis, Madison,; U of Calif, Santa Barbara, California
Hirschman, Albert O., Inst for Adv Study, Princeton, New Jersey
Hirsh, Ira J., Washington U, St. Louis, Missouri *
Hirst, George K., Morgan Hill, California *

* Emeritus Member

Hitchings, George H., Burroughs Wellcome, Durham, North Carolina
Hoagland, Mahlon, Worcester Fndn Exper Bio, Thetford, Vermont
Hoard, J. L., Cornell U, Ithaca, New York *
Hochberg, Julian, Columbia U, New York, New York
Hochschild, Gerhard P., U of Calif, Berkeley, California
Hochstrasser, Robin M., U of Penn, Philadelphia, Pennsylvania
Hockett, Charles F., Ithaca, New York *
Hoeffding, Wassily, U of NC, Chapel Hill, North Carolina
Hoenigswald, Henry M., U of Penn, Philadelphia, Pennsylvania
Hoffman, Alan J., IBM, Yorktown Heights, New York
Hoffman, Joseph F., Yale U Sch of Med, New Haven, Connecticut
Hoffmann, Roald, Cornell U, Ithaca, New York
Hofmann, Klaus H., U Pittsburgh Sch of Med, Pittsburgh, Pennsylvania
Hofstadter, Robert, Stanford U, Stanford, California
Hogness, David S., Stanford U Sch of Med, Stanford, California
Hohenberg, Pierre C., AT&T Bell Labs, Murray Hill, New Jersey
Hole, Frank A., Yale U, New Haven, Connecticut
Holland, H. D., Harvard U, Cambridge, Massachusetts
Holley, Robert W., Salk Inst Biol Study, San Diego, California
Holm, Richard H., Harvard U, Cambridge, Massachusetts
Holman, Ralph T., U of Minnesota, Austin, Minnesota
Holonyak, Nick, Jr., U of Illinois, Urbana, Illinois
Holtfreter, Johannes, U of Rochester, Rochester, New York *
Hood, Leroy, Cal Tech, Pasadena, California
Hopfield, John J., Cal Tech, Pasadena, California
Horecker, B. L., Cornell U Med Col, New York, New York
Hornig, Donald F., Harvard U, Boston, Massachusetts
Horowitz, Norman H., Cal Tech, Pasadena, California
Horsfall, James G., Conn Agri Exper Sta, New Haven, Connecticut
Horstmann, Dorothy M., Yale U Sch of Med, New Haven, Connecticut
Hotchkiss, Rollin D., SUNY, Albany, New York
Hottel, H. C., MIT, Cambridge, Massachusetts
Housner, George W., Cal Tech, Pasadena, California
Houthakker, Hendrik S., Harvard U, Cambridge, Massachusetts
Howard, Louis N., Florida State U, Tallahassee, Florida
Howell, F. Clark, U of Calif, Berkeley, California
Howells, W. W., Harvard U, Cambridge, Massachusetts
Hubel, David H., Harvard U Med Sch, Boston, Massachusetts
Huebner, Robert J., Rockville, Maryland *
Huffaker, Carl B., Lafayette, California
Huggins, Charles B., U of Chicago, Chicago, Illinois
Hughes, Vernon W., Yale U, New Haven, Connecticut
Huizenga, John R., U of Rochester, Rochester, New York
Hulm, John K., Pittsburgh, Pennsylvania
Hulse, Frederick S., Pebble Beach, California
Hunten, Donald M., U of Arizona, Tucson, Arizona
Hurvich, Leo M., U of Penn, Philadelphia, Pennsylvania
Hurwicz, Leonid, U of Minnesota, Minneapolis, Minnesota
Hurwitz, Jerard, Mem Sln-Kettering Cancer Cntr, New York, New York
Hutchinson, G. Evelyn, Yale U, New Haven, Connecticut
Hutchison, Clyde A., Jr., U of Chicago, Chicago, Illinois

Iben, Icko, Jr., Penn State U, University Park, Pennsylvania
Ibers, James A., Northwestern U, Evanston, Illinois
Imbrie, John, Brown U, Providence, Rhode Island
Inghram, Mark G., U of Chicago, Chicago, Illinois
Inkeles, Alex, Stanford U, Stanford, California
Ippen, Erich P, MIT, Cambridge, Massachusetts

* Emeritus Member

Isard, Walter, Drexell Hill, Pennsylvania
Isselbacher, Kurt J., Mass General Hosp, Boston, Massachusetts
Itano, Harvey A., U of Calif-San Diego, La Jolla, California

Jackson, Marion L., U of Wisconsin, Madison, Wisconsin
Jacobson, Leon O., U of Chicago Sch of Med, Chicago, Illinois
Jacobson, Nathan, Yale U, New Haven, Connecticut
Jagendorf, Andre T., Cornell U, Ithaca, New York
James, Harold L., US Geological Survey, Port Townsend, Washington
Jameson, Dorothea, U of Penn, Philadelphia, Pennsylvania
Javan, Ali, MIT, Cambridge, Massachusetts
Jeffries, Carson D., U of Calif, Berkeley, California
Jencks, William P., Brandeis U, Waltham, Massachusetts
Jennings, Jesse D., U of Oregon, Eugene, Oregon
Jensen, Elwood V., U of Chicago, Chicago, Illinois
John, Fritz, New York U, New York, New York *
Johnson, Clarence L., Lockheed Aircraft Co, Burbank, California
Johnson, William S., Stanford U, Stanford, California
Johnston, Harold S., U of Calif, Berkeley, California
Joklik, W. K., Duke U Sch of Med, Durham, North Carolina
Jonas, Jiri, U of Illinois, Urbana, Illinois
Jones, Mary Ellen, U of NC Sch Med, Chapel Hill, North Carolina
Jones, Robert T., Stanford, California
Jorgenson, Dale W., Harvard U, Cambridge, Massachusetts
Julesz, Bela, Rutgers U, New Brunswick, New Jersey

Kaback, H. Ronald, HHMI, U of Calif. Los Angeles, California
Kabat, Elvin A., Columbia U, Col of Phys/Surgs, New York, New York
Kadanoff, Leo P., U of Chicago, Chicago, Illinois
Kafatos, F. Constantine, Harvard U, Cambridge, Massachusetts
Kaiser, A. Dale, Stanford U-School of Med, Stanford, California
Kalckar, Herman M., Boston U, Boston, Massachusetts
Kamen, Martin D., Montecito, California *
Kan, Yuet Wai, U of Calif, San Francisco, California
Kandel, Eric R., Columbia U, Col of Phys/Surgs, New York, New York
Kantrowitz, Arthur R., Dartmouth Col, Hanover, New Hampshire
Kaplan, Joseph, Los Angeles, California
Kaplansky, Irving, Math Sci Res Inst, Berkeley, California
Kappler, John W., HHMI, Denver, Colorado
Karle, Isabella L., U.S. Naval Res Lab, Washington, D.C.
Karle, Jerome, U.S. Naval Res Lab, Washington, D.C.
Karlin, Samuel, Stanford U, Stanford, California
Karp, Richard M., U of Calif, Berkeley, California
Karplus, Martin, Harvard U, Cambridge, Massachusetts
Kasha, Michael, Florida State U, Tallahassee, Florida
Kates, Robert W., Brown U, Providence, Rhode Island
Katz, Joseph J., Argonne Nat'l Lab, Argonne, Illinois
Kaufman, Seymour, NIH, Bethesda, Maryland
Kaula, William M., U of Calif, Los Angeles, California
Kauzmann, Walter J., Princeton U, Princeton, New Jersey
Keller, Joseph B., Stanford U, Stanford, California
Kellermann, K. I., Nat'l Radio Astron Lab, Charlottesville, Virginia
Kelley, Harold H., U of Calif, Los Angeles, California
Kelman, Arthur, North Carolina State U, Raleigh, North Carolina
Kennedy, Donald, Stanford U, Stanford, California
Kennedy, Eugene P., Harvard U Med Sch, Boston, Massachusetts
Kerst, Donald W., U of Wisconsin, Madison, Wisconsin
Kesten, Harry, Cornell U, Ithaca, New York

* Emeritus Member

Kety, Seymour S., NIMH, Bethesda, Maryland
Keyfitz, Nathan, IIASA, Laxenburg, Austria
Khorana, H. Gobind, MIT, Cambridge, Massachusetts
Kieffer, Susan W., US Geological Survey, Flagstaff, Arizona
Kilbourne, Edwin D., Mt Sinai Sch of Med-CUNY, New York, New York
King, Ivan R., U of Calif, Berkeley, California
Kipnis, David M., Washington U, Sch of Med, St. Louis, Missouri
Kirk, T. Kent, U.S. Forest Products Lab, Madison, Wisconsin
Kirschner, Marc W., U of Calif Med Sch, San Francisco, California
Kittel, Charles, U of Calif, Berkeley, California
Klebanoff, Seymour J., U of Washington Sch of Med, Seattle, Washington
Kleene, Stephen C., U of Wisconsin, Madison, Wisconsin
Klein, Lawrence R., U of Penn, Philadelphia, Pennsylvania
Klein, Martin J., Yale U, New Haven, Connecticut
Klemperer, William, Harvard U, Cambridge, Massachusetts
Kleppner, Daniel, MIT, Cambridge, Massachusetts
Klotz, Irving M., Northwestern U, Evanston, Illinois
Knight, Walter D., U of Calif, Berkeley, California
Knipling, E. F., USDA, Beltsville, Maryland *
Knobil, Ernst, U of Tex Health Sci Ctr, Houston, Texas
Knopoff, Leon, U of Calif, Los Angeles, California
Knudson, Alfred G. Jr., Fox Chase Cancer Ctr, Philadephia, Pennsylvania
Knuth, Donald E., Stanford U, Stanford, California
Kochi, Jay K., U of Houston, Houston, Texas
Koelle, George B., U of Penn Sch Med, Philadelphia, Pennsylvania
Kohn, Joseph J., Princeton U, Princeton, New Jersey
Kohn, Walter, U of Calif, Santa Barbara, California
Kolthoff, I. M., U of Minnesota, Minneapolis, Minnesota *
Konishi, Masakazu, Cal Tech, Pasadena, California
Koprowski, Hilary, Wistar Inst, Philadelphia, Pennsylvania
Kornberg, Arthur, Stanford U Sch of Med, Stanford, California
Kornfeld, Stuart A., Washington U Sch of Med, St. Louis, Missouri
Koshland, Daniel E., Jr., U of Calif, Berkeley, California
Koshland, Marian E., U of Calif, Berkeley, California
Kostant, Bertram, MIT, Cambridge, Massachusetts
Kraft, Robert P., U of Calif, Santa Cruz, California
Kramer, Paul J., Duke U, Durham, North Carolina
Krampitz, Lester O., Case Western Reserve U, Cleveland, Ohio
Krause, Richard M., NIH, Bethesda, Maryland
Kraushaar, William L., U of Wisconsin, Madison, Wisconsin
Krauskopf, Konrad B., Stanford U, Stanford, California
Kraut, Joseph, U of Calif, San Diego, California
Kravitz, Edward A., Harvard Med Sch, Boston, Massachusetts
Krebs, Edwin G., HHMI, U of Washington Sch of Med, Seattle, Washington
Kroll, Norman M., U of Calif-San Diego, La Jolla, California
Krugman, Saul, New York U Med Ctr, New York, New York
Kruskal, Martin D., Princeton U, Princeton, New Jersey
Kuhn, Thomas S., MIT, Cambridge, Massachusetts
Kusch, P., U of Texas-Dallas, Richardson, Texas

Lacey, John I., Wright State U Sch of Med, Yellow Springs, Ohio
Lachenbruch, Arthur H., US Geological Survey, Menlo Park, California
Lacy, Paul E., Washington U Sch of Med, St. Louis, Missouri
Lamb, Willis E., Jr., U of Arizona, Tucson, Arizona
Land, Edwin H., Rowland Inst for Sc, Inc., Cambridge, Massachusetts
Landauer, Rolf W., IBM, Yorktown Heights, New York,
Landes, David S., Harvard U, Cambridge, Massachusetts
Lane, M. Daniel, Johns Hopkins U-Medical Insts., Baltimore, Maryland

* Emeritus Member

Lang, Anton, Michigan State U, East Lansing, Michigan
Lang, Serge, Yale U, New Haven, Connecticut
Langer, James S., U of Calif, Santa Barbara, California
Lardy, Henry A., U of Wisconsin, Madison, Wisconsin
Larrabee, Martin G., Johns Hopkins U, Baltimore, Maryland
Lauterbur, Paul C., U of Illinois, Urbana, Illinois
Lawrence, H. Sherwood, New York U Med Ctr, New York, New York
Lax, Benjamin, MIT, Cambridge, Massachusetts
Lax, Melvin, City College of CUNY, New York, New York
Lax, Peter D., New York U, New York, New York
Leaf, Alexander, Mass General Hosp, Boston, Massachusetts
Lebowitz, Joel L., Rutgers U, New Brunswick, New Jersey
Leder, Philip, HHMI, Harvard U Med School, Boston, Massachusetts
Lederberg, Joshua, Rockefeller U, New York, New York
Lederman, Leon M., Fermi Nat'l Accelerator Lab, Batavia, Illinois
Lee, Tsung-Dao, Columbia U, New York, New York
Lee, Yuan T., Lawrence Berkeley Lab, Berkeley, California
Lefkowitz, Robert J., HHMI, Duke U, Durham, North Carolina
Lehman, I. Robert, Stanford U Sch of Med, Stanford, California
Lehmann, Erich L., U of Calif, Berkeley, California
Leighton, Robert B., Cal Tech, Pasadena, California
Lennarz, William J., SUNY, Stony Brook, New York
Leonard, Nelson J., U of Illinois, Urbana, Illinois
Leontief, Wassily, New York U, New York, New York
Leopold, Estella B., U of Washington, Seattle, Washington
Leopold, Luna B., U of Calif, Berkeley, California
Lerman, Leonard S., MIT, Cambridge, Massachusetts
Lerner, Aaron B., Yale U Sch of Med, New Haven, Connecticut
Letsinger, Robert L., Northwestern U, Evanston, Illinois
Levi-Montalcini, Rita, Inst of Neurobio, Rome, Italy
Levine, Rachmiel, City of Hope Med Ctr, Duarte, California
Levings, C. S. III, NC State U, Raleigh, North Carolina
Levinthal, Cyrus, Columbia U, New York, New York
Levy, Donald H., U of Chicago, Chicago, Illinois
Lewis, Edward B., Cal Tech, Pasadena, California
Liberman, Alvin M., Haskins Labs, New Haven, Connecticut
Licklider, J. C. R., MIT, Arlington, Massachusetts
Lieb, Elliott H., Princeton U, Princeton, New Jersey
Lieberman, Seymour, St. Luke's-Roosevelt Inst, New York, New York
Liepmann, Hans W., Cal Tech, Pasadena, California
Likens, Gene E., New York Bot Garden, Millbrook, New York
Lilly, Frank, Albert Einstein Col of Med, Bronx, New York
Lin, Chia-Chiao, MIT, Cambridge, Massachusetts
Lindsley, Dan L., Jr., U of Calif-San Diego, La Jolla, California
Lindsley, Donald B., U of Calif, Los Angeles, California
Lindzey, Gardner, Ctr for Adv Stdy in Behav. Scs., Stanford, California
Lindzen, Richard S., Newton, Massachusetts
Lineberger, W. Carl, U of Colorado, Boulder, Colorado
Lippard, Stephen J., MIT, Cambridge, Massachusetts
Lipscomb, William N., Harvard U, Cambridge, Massachusetts
Lipset, S. M., Stanford U, Stanford, California
Littlefield, John W., Johns Hopkins U Sch of Med, Baltimore, Maryland
Llinas, R. R, New York U Sch of Med, New York, New York
Lodish, Harvey F., MIT, Cambridge, Massachusetts
London, Irving M., Harvard-MIT, Cambridge, Massachusetts
Long, Franklin A., U of Calif, Irvine, California
Lorand, Laszlo, Northwestern U, Evanston, Illinois
Lorente de No, R., Tucson, Arizona *

* Emeritus Member

Lorenz, Edward N., MIT, Cambridge, Massachusetts *
Lounsbury, Floyd G., Yale U, New Haven, Connecticut
Lovering, Thomas S., Santa Barbara, California *
Low, Francis E., MIT, Cambridge, Massachusetts
Low, Frank J., U of Arizona, Tucson, Arizona
Lowenstam, Heinz A., Cal Tech, Pasadena, California
Lowry, Oliver H., Washington U Sch of Med, St. Louis, Missouri
Lucas, Robert E., Jr., U of Chicago, Chicago, Illinois
Luce, R. Duncan, U of Calif, Irvine, California
Luck, David J. L., Rockefeller U, New York, New York
Luria, S. E., MIT, Cambridge, Massachusetts
Luttinger, J. M., Columbia U, New York, New York
Luyten, Willem J., U of Minnesota, Minneapolis, Minnesota
Lynds, Roger, Kitt Peak Nat'l Obsv, Tuscon, Arizona

MacDonald, Gordon J. F., MITRE Corporation, McLean, Virginia
Macdonald, J. Ross, U of North Carolina, Chapel Hill, North Carolina
Mackey, George W., Harvard U, Cambridge, Massachusetts
Mac Lane, Saunders, U of Chicago, Chicago, Illinois
MacNeish, Richard S., Andover Fdn for Arch Res, Andover, Massachusetts
Magasanik, Boris, MIT, Cambridge, Massachusetts
Magoun, H. W., Santa Monica, California *
Maiman, Theodore H., Santa Barbara, California
Majerus, Phil, Washington U Sch of Med, St. Louis, Missouri
Malkus, Willem V. R., MIT, Cambridge, Massachusetts
Malone, Thomas F., St. Joseph's Col, West Hartford, Connecticut
Maniatis, Thomas P., Harvard U, Cambridge, Massachusetts
Mann, Robert W., MIT, Cambridge, Massachusetts
Marble, Frank E., Cal Tech, Pasadena, California
March, James G., Stanford U, Stanford, California
Marchesi, Vincent T., Yale U Sch of Med, New Haven, Connecticut
Marcus, R. A., Cal Tech, Pasadena, California
Margoliash, Emanuel, Northwestern U, Evanston, Illinois
Margrave, John L., Rice U, Houston, Texas
Margulis, Lynn, U of Mass, Amherst, Massachusetts
Mark, H. F., Polytech U, Brooklyn, New York
Markert, Clement L., NC State U, Raleigh, North Carolina
Marks, Paul A., Mem Sloan-Kett Can Ctr, New York, New York
Marler, Peter R., Rockefeller U, Millbrook, New York
Marrack, Philippa, HHMI, Denver, Colorado
Marshak, Robert E., Blacksburg, Virginia
Martin, Paul, Harvard U, Cambridge, Massachusetts
Mather, John N., Princeton U, Princeton, New Jersey
Mathews, Max V., Stanford U, Stanford, California
Matthews, Brian W., U of Oregon, Eugene, Oregon
Mayall, N. U., Tucson, Arizona *
Mayr, Ernst, Harvard U, Cambridge, Massachusetts
Mazia, Daniel, Stanford U, Pacific Grove, California
Mazur, Barry C., Harvard U, Cambridge, Massachusetts
McCann, S. M., U of Texas Southwestern Med Center, Dallas, Texas
McCarthy, John, Stanford U, Stanford, California
McCarty, Maclyn, Rockefeller U, New York, New York
McClintock, Barbara, Cold Sprng Harbor Lab, Cold Spring Harbor, New York
McClure, Donald S., Princeton U, Princeton, New Jersey
McConnell, Harden M., Stanford U, Stanford, California
McCray, Richard, Columbia U, New York, New York
McDaniel, Boyce D., Cornell U, Ithaca, New York
McDevitt, Hugh O'N., Stanford U Sch of Med, Stanford, California

* Emeritus Member

McDonald, Frank B., NASA, Greenbelt, Maryland
McElroy, W. D., U of Calif-San Diego, La Jolla, California
McFadden, Daniel L., MIT, Cambridge, Massachusetts
McGaugh, James L., U of Calif, Irvine, California
McKay, Kenneth G., AT&T Bell Labs, New York, New York
McKean, Henry P., New York U, New York, New York
McKenzie, Lionel W., U of Rochester, Rochester, New York
McKusick, Victor A., Johns Hopkins U Sch of Med, Baltimore, Maryland
McLafferty, Fred W., Cornell U, Ithaca, New York
McMillan, Edwin M., Lawrence Berkeley Lab, Berkeley, California
Mead, Carver A., Cal Tech, Pasadena, California
Meehl, Paul E., U of Minnesota, Minneapolis, Minnesota
Meinwald, Jerrold, Cornell U, Ithaca, New York
Meister, Alton, Cornell U Med Col, New York, New York
Menken, Jane A., U of Penn, Philadelphia, Pennsylvania
Merrifield, R. Bruce, Rockefeller U, New York, New York
Merton, Robert K., New York, New York
Mertz, Edwin T., West Lafayette, Indiana
Meselson, M. S., Harvard U, Cambridge, Massachusetts
Metcalf, Robert L., U of Illinois, Urbana, Illinois
Meyer, Karl, Columbia U, Col of Phys/Surg, New York, New York *
Meyer, Peter, U of Chicago, Chicago, Illinois
Michener, Charles D., U of Kansas, Lawrence, Kansas
Michl, Josef, U of Texas, Austin, Texas
Mihalas, Dimitri, U of Illinois, Urbana, Illinois
Miles, John W., U of Calif-San Diego, La Jolla, California
Miller, George A., Princeton U, Princeton, New Jersey
Miller, James A., U of Wisconsin, Madison, Wisconsin
Miller, Neal E., Yale U, New Haven, Connecticut
Miller, Oscar L., Jr., U of Virginia, Charlottesville, Virginia
Miller, Stanley L., U of Calif-San Diego, La Jolla, California
Miller, William H., U of Calif, Berkeley, California
Milnor, John W., SUNY, Stony Brook, New York
Minsky, Marvin Lee, MIT, Cambridge, Massachusetts
Mintz, Beatrice, Fox Chase Cancer Ctr, Philadelphia, Pennsylvania
Mishkin, Mortimer, NIMH, Bethesda, Maryland
Mislow, Kurt M., Princeton U, Princeton, New Jersey
Modigliani, Franco, MIT, Belmont, Massachusetts
Moll, John L., Hewlett-Packard Labs, Palo Alto, California
Montgomery, Deane, Chapel Hill, North Carolina
Mooney, Harold A., Stanford U, Stanford, California
Moore, C. Bradley, U of Calif, Berkeley, California
Moore, Francis D., Harvard U Med Sch, Boston, Massachusetts
Moore, John A. U of Calif, Riverside, California
Morales, Manuel F., San Francisco, California
Morgan, James Newton, U of Michigan, Ann Arbor, Michigan
Morgan, W. Jason, Princeton U, Princeton, New Jersey
Morgan, W. W., Yerkes Obsv, Williams Bay, Wisconsin
Morrison, Philip, MIT, Cambridge, Massachusetts
Moscona, Aron A., U of Chicago, Chicago, Illinois
Moser, Jurgen K., Swiss Fed Inst Tech, Zurich, Switzerland
Moss, Bernard, NIH, Bethesda, Maryland
Mosteller, Frederick, Harvard U, Cambridge, Massachusetts
Mostow, G. D., Yale U, New Haven, Connecticut
Motulsky, Arno G., U of Washington Sch of Med, Seattle, Washington
Mountcastle, Vernon B., Johns Hopkins U Sch of Med, Baltimore, Maryland
Muller-Eberhard, Hans J., Bernhard Nocht Inst, Hamburg, Germany
Mullins, William W., Carnegie Mellon U, Pittsburgh, Pennsylvania

* Emeritus Member

Mumford, David B., Harvard U, Cambridge, Massachusetts
Munch, Guido, Max-Planck Inst, Federal Republic of Germany
Munk, Walter H., U of Calif-San Diego, La Jolla, California
Munro, H. N., Tufts U, Boston, Massachusetts
Musgrave, Richard A., U of Calif, Santa Cruz, California
Myers, Jack, U of Texas, Austin, Texas

Nachmias, Jacob, U of Penn, Philadelphia, Pennsylvania
Nambu, Yoichiro, U of Chicago, Chicago, Illinois
Namias, Jerome, U of Calif-San Diego, La Jolla, California
Nathans, Daniel, Johns Hopkins U, Baltimore, Maryland
Nathenson, Stanley G., Albert Einstein Col of Med, Bronx, New York
Nauta, Walle J. Harinx, Cambridge, Massachusetts
Needleman, Philip, Monsanto, St. Louis, Missouri
Neel, James V. G., U of Michigan Med Sch, Ann Arbor, Michigan
Neff, William D., Indiana U, Bloomington, Indiana
Neisser, Ulric, Emory U, Atlanta, Georgia
Nelson, Oliver E. Jr., U of Wisconsin, Madison, Wisconsin
Nerlove, Marc, U of Penn, Philadelphia, Pennsylvania
Ness, Norman F., Landenberg, Pennsylvania
Neufeld, Elizabeth F., U of Calif Sch of Med, Los Angeles, California
Neugebauer, Gerry, Cal Tech, Pasadena, California
Neugebauer, Otto E., The Inst for Adv Stdy, Princeton, New Jersey
Neurath, Hans, U of Washington, Seattle, Washington
Newcomb, Eldon H., U of Wisconsin, Madison, Wisconsin
Newell, Allen, Carnegie Mellon U, Pittsburgh, Pennsylvania
Newell, Norman D., Amer Museum Nat Hist, New York, New York
Newman, Melvin S., Ohio State U, Columbus, Ohio
Ney, Edward P., U of Minnesota, Minneapolis, Minnesota
Nier, Alfred O. C., U of Minnesota, Minneapolis, Minnesota
Nierenberg, William A., Scripps Inst of Oceanogr, La Jolla, California
Nirenberg, Louis, New York U, New York, New York
Nirenberg, Marshall W., NIH, Bethesda, Maryland
Nisonoff, Alfred, Brandeis U, Waltham, Massachusetts
Nolan, Thomas B., Washington, D.C. *
Nomura, Masayasu, U of Calif, Irvine, California
Nottebohm, Fernando, Rockefeller U, New York, New York
Nowell, Peter C., U of Penn Sch of Med, Philadelphia, Pennsylvania
Noyce, Robert N., SEMATECH, Austin, Texas
Noyes, Richard M., U of Oregon, Eugene, Oregon

O'Brien, Brian, Woodstock, Connecticut
Ochoa, Severo, U Autonoma, Madrid, Spain
Odum, Eugene P., U of Georgia, Athens, Georgia
Ogren, William L., U of Illinois, Urbana, Illinois
Ohno, Susumu, City Of Hope Med Ctr, Duarte, California
Olah, George A., U of Southern California, Los Angeles, California
Old, Lloyd J., Mem Sloan-Kett Cntr, New York, New York
Oliver, B. M., Hewlett-Packard Co, Palo Alto, California
Oliver, Douglas, U of Hawaii, Honolulu, Hawaii
Oliver, Jack E., Cornell U, Ithaca, New York
Olson, Everett C., U of Calif, Los Angeles, California
Oncley, J. L., U of Michigan, Ann Arbor, Michigan
Orians, Gordon H., U of Washington, Seattle, Washington
Ornstein, Donald S., Stanford U, Stanford, California
Osborn, Mary Jane, U of Connecticut Health Ctr, Farmington, Connecticut
Osgood, Charles E., U of Illinois, Urbana, Illinois *
Osheroff, Douglas D., Stanford U, Stanford, California

* Emeritus Member

Osterbrock, Donald E., U of Calif Lick Obsv, Santa Cruz, California
Ostriker, Jeremiah P., Princeton U, Princeton, New Jersey
Overhauser, Albert W., Purdue U, West Lafayette, Indiana
Owen, Ray D., Cal Tech, Pasadena, California

Page, Irvine H., Hyannis Port, Massachusetts
Paine, Robert T., U of Washington, Seattle, Washington
Pais, Abraham, Rockefeller U, New York, New York *
Pake, George E., Inst for Res on Learn, Palo Alto, California
Palade, George E., Yale U Sch of Med, New Haven, Connecticut
Palay, Sanford L., Concord, Massachusetts
Palmiter, Richard D., U of Washington Sch of Med, Seattle, Washington
Panish, Morton B., AT&T Bell Labs, Murray Hill, New Jersey
Panofsky, W. K. H., Stanford U, Stanford, California
Pappenheimer, A. M., Jr., Harvard U, Cambridge, Massachusetts
Pappenheimer, John R., Harvard U, Bedford, Massachusetts
Paquette, Leo A., Ohio State U, Columbus, Ohio
Pardee, Arthur B., Dana Farber Canc Inst, Boston, Massachusetts
Pardue, Mary-Lou, MIT, Cambridge, Massachusetts
Park, Charles R., Vanderbilt U Sch of Med, Nashville, Tennessee
Parker, Eugene N., U of Chicago, Chicago, Illinois
Parr, Robert G., U of NC, Chapel Hill, North Carolina
Parshall, George W., E I Dupont De Nem Co, Wilmington, Delaware
Partee, Barbara H., U of Massachusetts, Amherst, Massachusetts
Pastan, Ira, NIH, Bethesda, Maryland
Patel, C. Kumar N., AT&T Bell Labs, Murray Hill, New Jersey
Patrick, Ruth, Acad Natural Sci, Philadelphia, Pennsylvania
Patterson, Clair C., Cal Tech, Pasadena, California
Paul, William E., NIH, Bethesda, Maryland
Pauling, Linus, Big Sur, California
Pearson, Ralph G., U of Calif, Santa Barbara, California
Pederson, Donald O., U of Calif, Berkeley, California
Pedlosky, Joseph, WHOI, Woods Hole, Massachusetts
Pekeris, Chaim L., Weizmann Inst of Sci, Rehovot, Israel
Peloquin, S. J., U of Wisconsin, Madison, Wisconsin
Penman, Sheldon, MIT, Cambridge, Massachusetts
Penzias, Arno A., AT&T Bell Labs, Murray Hill, New Jersey
Perkins, David D., Stanford U, Stanford, California
Perl, Martin L., Stanford U, Stanford, California
Perlman, I., Lawrence Berkeley Lab, Berkeley, California
Perry, Robert P., Fox Chase Cancer Ctr, Philadelphia, Pennsylvania
Pettengill, Gordon, MIT, Cambridge, Massachusetts
Pettijohn, F. J., Johns Hopkins U, Baltimore, Maryland
Pfaffmann, Carl, Rockefeller U, New York, New York
Phelps, Edmund S., Columbia U, New York, New York
Phillips, J. C., AT&T Bell Labs, Murray Hill, New Jersey
Phillips, Norman A., Merrimack, New Hampshire
Phillips, William D., Mallinckrodt Inc, St. Louis, Missouri
Phinney, Bernard O., U of Calif, Los Angeles, California
Pickering, W. H., Pickering Res Corp, Pasadena, California
Pierce, J. R., Stanford U, Stanford, California
Pike, Kenneth L., Summer Inst of Ling, Dallas, Texas
Pines, Alexander, U of Calif, Berkeley, California
Pines, David, U of Illinois, Urbana, Illinois
Piore, E. R., New York, New York
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Purcell, Robert H., NIH, Bethesda, Maryland
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Putnam, Frank W., Indiana U, Bloomington, Indiana

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Quine, Willard V., Harvard U, Cambridge, Massachusetts *

Rabinowitz, Jesse C., U of Calif, Berkeley, California
Racker, Efraim, Cornell U, Ithaca, New York
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Rahn, Hermann, State U of New York, Buffalo, New York
Rakic, Pasko, Yale U Sch of Med, New Haven, Connecticut
Rall, J. Edward, NIH, Bethesda, Maryland
Ramo, Simon, TRW Inc, Redondo Beach, California
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Ranney, Helen M., VA Med Ctr, San Diego, California
Rasmussen, Norman C., MIT, Cambridge, Massachusetts
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Raven, Peter H., Missouri Bot Gardens, St. Louis, Missouri; Nat'l Academy of Scs, Washington, D.C.
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Rose, Irwin, Fox Chase Cancer Ctr, Philadelphia, Pennsylvania
Rose, Jerzy E., U of Wisconsin Sch of Med, Madison, Wisconsin
Roseman, Saul, Johns Hopkins U, Baltimore, Maryland
Rosen, Ora M., Mem Sloan-Kett Cancer Ctr, New York, New York
Rosenberg, Leon E., Yale U Sch of Med, New Haven, Connecticut
Rosenblatt, Murray, U of Calif-San Diego, La Jolla, California
Rosenblith, Walter A., MIT, Cambridge, Massachusetts
Rosenbluth, M. N., U of Calif-San Diego, La Jolla, California
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Ross, Ian M., AT&T Bell Labs, Holmdel, New Jersey
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Russell, Liane B., Oak Ridge Nat'l Lab, Oak Ridge, Tennessee
Russell, William L., Oak Ridge Nat'l Lab, Oak Ridge, Tennessee
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Selander, Robert K., Penn State U, University Park, Pennsylvania
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Sheehan, John C., MIT, Cambridge, Massachusetts
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Shepp, Lawrence A., AT&T Bell Labs, Murray Hill, New Jersey
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Spoehr, Alexander, Honolulu, Hawaii *
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Sprague, James M., U of Penn Sch of Med, Philadelphia, Pennsylvania
Srb, Adrian M., Cornell U, Ithaca, New York *
Stadtman, E. R., NIH, Bethesda, Maryland
Stadtman, Thressa C., NIH, Bethesda, Maryland
Stahl, Franklin W., U of Oregon, Eugene, Oregon
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Sykes, Lynn R., Columbia U, New York, New York

Tabor, Herbert, NIH, Bethesda, Maryland
Talalay, Paul, Johns Hopkins U Sch of Med, Baltimore, Maryland
Talmage, David W., U of Colorado Med Ctr, Denver, Colorado
Tamm, Igor, Rockefeller U, New York, New York
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Tien, Ping King, AT&T Bell Labs, Holmdel, New Jersey
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Vagelos, P. Roy, Merck & Co, Inc, Rahway, New Jersey
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Valentine, William N., U of Calif, Los Angeles, California
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van Holde, K. E., Oregon State U, Corvallis, Oregon
van Tamelen, Eugene E., Stanford U, Stanford, California
Varmus, Harold, U of Calif, San Francisco, California
Varner, J. E., Washington U, St. Louis, Missouri
Vaughan, Martha, NIH, Bethesda, Maryland
Velick, Sidney F., U of Utah, Salt Lake City, Utah
Verba, Sidney, Harvard U, Cambridge, Massachusetts
Verhoogen, John, U of Calif, Berkeley, California *
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Vogt, Peter K., U of Southern Calif Sch of Med, Los Angeles, California
von Hippel, Peter H., U of Oregon, Eugene, Oregon

Wadleigh, Cecil H., Lanham, Maryland
Waelsch, Salome G., Albert Einstein Col of Med, Bronx, New York
Waggoner, Paul E., Conn Agri Exper Sta, New Haven, Connecticut
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Wald, George, Harvard U, Cambridge, Massachusetts *
Waldmann, Thomas A., NIH, Bethesda, Maryland
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Walker, Robert M., Washington U, St. Louis, Missouri
Wall, Frederick T., U of Calif-San Diego, La Jolla, California
Wallace, Anthony F. C., U of Penn, Philadelphia, Pennsylvania
Wallace, Bruce, Virginia Polytech Inst & State U, Blacksburg, Virginia
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Wasserburg, G. J., Cal Tech, Pasadena, California
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Watson, James D., Cold Spring Harbr Lab, Long Island, New York
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Weber, Gregorio, U of Illinois, Urbana, Illinois
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Weymann, Ray J., Mt Wilson & Las Campanas Obsvs, Pasadena, California
Wheeler, John A., Princeton U, Princeton, New Jersey
Whinnery, John R., U of Calif, Berkeley, California
Whipple, Fred L., Smithsonian Inst, Cambridge, Massachusetts
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White, Gilbert F., U of Colorado, Boulder, Colorado
White, Harrison C., Columbia U, New York, New York
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Wilson, Jean D., U of Texas Southwestern Med Ctr, Dallas, Texas
Wilson, Kenneth G., Cornell U, Ithaca, New York
Wilson, Olin C., Hale Obsv, Pasadena, California *
Wilson, Robert R., Cornell U, Ithaca, New York
Wilson, R. W., AT&T Bell Labs, Holmdel, New Jersey

* Emeritus Member

Winograd, Shmuel, IBM, Yorktown Heights, New York
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Witkop, Bernhard, NIH, Bethesda, Maryland
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Woese, Carl R., U of Illinois, Urbana, Illinois
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Wurtz, Robert H., Nat'l Eye Inst, Bethesda, Maryland
Wyckoff, Ralph W. G., U of Arizona, Tucson, Arizona *
Wyman, Jeffries, Paris, France
Wyngaarden, James B., NIH, Bethesda, Maryland

Yalow, Rosalyn S., Veterans Admin Med Ctr, Bronx, New York
Yang, Chen Ning, State U of New York, Stony Brook, New York
Yanofsky, Charles, Stanford U, Stanford, California
Yoder, Hatten S., Jr., Carnegie Inst Wash, Washington, D.C.

Zamecnik, Paul C., Worcester Fndn Exper Bio, Shrewsbury, Massachusetts
Zare, Richard N., Stanford U, Stanford, California
Zen, E-an, US Geological Survey, Reston, Virginia
Zener, Clarence M., Carnegie Mellon U, Pittsburgh, Pennsylvania
Zentmyer, George A., U of Calif, Riverside, California
Zewail, Ahmed H., Cal Tech, Pasedena, California
Zilversmit, Donald B., Cornell U, Ithaca, New York
Zimm, Bruno H., U of Calif-San Diego, La Jolla, California
Zimmerman, Howard E., U of Wisconsin, Madison, Wisconsin
Zinder, Norton D., Rockefeller U, New York, New York
Zinn, Walter H., Clearwater, Florida *
Zumino, Bruno, U of Calif, Berkeley, California
Zwanzig, Robert W., NIH, College Park, Maryland
Zygmund, Antoni, U of Chicago, Chicago, Illinois

Number of Members January 1990: 1,552
Number of Members Emeriti January 1990: 78

* Emeritus Member

FOREIGN ASSOCIATES

Abdus Salam, Imp Col, London, England, U.K.; Int'l Cen for Theo Phys, Trieste, Italy
Abragam, Anatole, Paris, France
Aigrain, Pierre R., Paris, France
Alfven, Hannes, U of Calif-San Diego, La Jolla, California
Allegre, Claude J., Inst de Physique du Globe, Paris, France
Ambartsumian, V., Burakan Astronom Obsv, Erevan, Armenia, U.S.S.R.
Arber, Werner, Biozentrum der U Basel, Basel, Switzerland
Arnold, Vladimir I., Steklov Mathematical Inst, Moscow, U.S.S.R.
Atiyah, Michael F., U of Oxford, Oxford, England, U.K.
Auerbach, Charlotte, Inst of Animal Genetics, Edinburgh, Scotland, U.K.
Axford, W. I., Max-Planck-Inst fur Aeronomie, FRG

Bartlett, Neil, U of Calif, Berkeley, California
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Brenner, Sydney, MRC Molec Genetics Unit, Cambridge, England, U.K.
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Broadbent, Donald E., U of Oxford, Oxford, England, U.K.
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Cartan, Henri P., Paris, France
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Catcheside, D. G., Leabrook, South Austrialia
Cavalli-Sforza, L. L., Stanford U Sch of Med, Stanford, California
Chambon, Pierre H., Inst de Chimie Biologique, Paris, France
Changeux, Jean-Pierre, Inst Pasteur, Paris, France
Charpak, Georges, CERN, Geneve, Switzerland
Cherenkov, Pavel A., The Academy of Scs of the U.S.S.R., Moscow, U.S.S.R.
Clark, J. Desmond, U of California, Berkeley, California
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Crick, Francis, Salk Inst for Bio Studies, San Diego, California

Dahrendorf, Ralf, St. Antony's Col, Oxford, England, U.K.
Dausset, Jean, Col De France, Paris, France

de Duve, Christian, Int'l Inst. of Cell & Molec Path., Brussels, Belgium;
The Rockefeller U, New York, New York
de Gennes, Pierre-Gilles, Ecole Super de Phys et Chimie Indust, Paris, France
Dubinin, N. P., The Academy of Scs of the U.S.S.R., Moscow, U.S.S.R.
Dunitz, Jack D., Swiss Fed Inst of Tech, Zurich, Switzerland
Duysens, Louis N.M., State U, Leiden, The Netherlands

Eccles, Sir John C., Contra, Switzerland
Eigen, Manfred, Max-Planck-Inst fur Biophy Chem, Gottingen, FRG
Eisenstadt, Shmuel Noah, Hebrew U, Jerusalem, Israel
Erdos, Paul, Hungarian Academy of Scs, Realtanoda, Hungary
Esaki, Leo, IBM, Yorktown Heights, New York
Eschenmoser, Albert J., Swiss Fed Inst Tech, Zurich, Switzerland

Farkas, Tibor, Hungarian Academy of Scs, Szeged, Hungary
Feng, De-Pei, Academia Sinica, Shanghai, Peoples Republic of China
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Frey-Wyssling, A. F., Inst for Allegem Bot, Zurich, Switzerland
Fukui, Kenichi, Kyoto U, Kyoto, Japan

Gansser, A., Massagno, Switzerland
Garcia-Bellido, Antonio, U Autonom de Madrid, Madrid, Spain
Gautheret, Roger, Bourg la Reine, France
Gear, James H. S., Nat'l Inst. for Virol & S Afr Inst for Med Res,
Johannesburg, Republic of South Africa
Gehring, Walter J., U of Basel, Basel, Switzerland
Geiss, Johannes, U of Berne, Berne, Switzerland
Gelfand, I. M., Moscow State U, Moscow, U.S.S.R.
Ginzburg, Vitaly L., Academy of Scs of the U.S.S.R., Moscow, U.S.S.R.
Glen, Robert, Victoria, British Columbia, Canada
Gowans, Sir James L., Oxford, England, U.K.
Granit, Ragnar, Stockholm, Sweden
Gromov, Mickael, Inst des Hautes Etud Scientif, Bures-sur-Yvette, France
Grunberg-Manago, M., Inst de Bio Physico-Chim, Paris, France
Gurdon, John Bertrand, U of Cambridge, Cambridge, England, U.K.

Hahn, Frank H., U of Cambridge, Cambridge, England, U.K.
Hanafusa, Hidesaburo, Rockefeller U, New York, New York
Harper, John L., U Col of North Wales, Bangor, Gwynedd, Wales, U.K.
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Harrison, J. M., Sci Inst of Northwest Territories, Ottawa, Ontario, Canada
Hawthorne, W. R., Churchill Col, Cambridge, England, U.K.
Hayaishi, Osamu, Osaka Biosci Inst, Osaka, Japan
Hayashi, Choshiro, Koyoto U, Kyoto , Japan
Herzberg, Gerhard, Nat'l Res Coun of Canada, Ottawa, Ontario, Canada
Heslop-Harrison, J., Welsh Plant Breed Station, Leominster, England, U.K.
Hicks, Sir John R., U of Oxford, All Souls Col, Oxford, England, U.K.
Hill, Robin, U of Cambridge, Cambridge, England, U.K.
Hinde, Robert A., St John's Col, Cambridge, England, U.K.
Hirzebruch, F., Max-Planck-Inst fur Mathematik, FRG
Hodgkin, Sir Alan, U Cambridge, Cambridge, England, U.K.
Hodgkin, Dorothy, Chem Crystallog Lab, Oxford, England, U.K.
Hokfelt, Tomas, Karolinska Inst, Stockholm, Sweden
't Hooft, G., Inst for Theoret Physics, Utrecht, The Netherlands

Hormander, Lars, U of Lund, Lund, Sweden
Hoyle, Sir Fred, Bournemouth, England, U.K.
Hsu, Kenneth J., Swiss Fed Inst of Tech, Zurich, Switzerland
Huisgen, Rolf, U of Munich, Munich, Federal Republic of Germany
Huxley, Sir Andrew, Trinity Col, Cambridge, England, U.K.
Huxley, Hugh E., Brandeis U, Waltham, Massachusetts

Inose, Hiroshi, U of Tokyo, Tokyo, Japan
Ishizaka, Kimishige, Johns Hopkins U Sch of Med, Baltimore, Maryland
Iversen, L. L., Merck Sharp & Dohme Res Labs, Essex, England, U.K.

Jacob, Francois, Inst Pasteur, Paris, France
Jerne, Niels Kaj, Castillon-du-Gard, France
Joliot, Pierre A., Inst de Bio Physico-Chim, Paris, France
Jost, Alfred D., Col de France, Paris, France
Jost, Res, Zurich, Switzerland

Kaiser, Wolfgang, Tech U Munchen, Munich, Federal Republic of Germany
Katchalski-Katzir, Ephraim, The Weizmann Inst of Science, Rehovot, Israel
Katz, Sir Bernard, U Col of London, England, U.K.
Keilis-Borok, V. I., Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.
Kendrew, Sir John, The Guildhall, Cambridge, England, U.K.
Khush, Gurdev S., Internat'l Rice Research Inst, Manila, Philippines
Kimura, Motoo, Nat'l Inst of Genetics, Misima, Japan
Klein, George, Karolinska Inst, Stockholm, Sweden
Klug, Aaron, MRC Lab of Molec Bio, Cambridge, England, U.K.
Knowles, Jeremy R., Harvard U, Cambridge, Massachusetts
Kodaira, Kunihiko, Tokyo, Japan
Kornberg, Sir Hans L., Christ's Col, Cambridge, England, U.K.
Kosterlitz, Hans W., U of Aberdeen, Scotland, U.K.
Krein, Mark G., Academy of Scs of the U.S.S.R., Odessa, U.S.S.R.
Kubo, Ryogo, Keio U, Yokohama, Japan
Kushiro, Ikuo, U of Tokyo, Tokyo, Japan

Lal, Devendra, Scripps Inst of Oceanogr, U of Calif, La Jolla, California
Leakey, Mary D., Nat'l Museum of Kenya, Nairobi, Kenya
LeDouarin, Nicole, Inst D'Embryo du CNRS Col De France, Nogent-sur-Marne, France
Lehn, Jean-Marie P., Col de France, Paris; U Louis Pasteur, Strasbourg, France
Leray, Jean, Col de France, Paris, France
Levi-Strauss, Claude, Col De France, Paris, France
Lord Lewis, of Newnham (Jack Lewis), Cambridge U, Cambridge, England, U.K.
Lighthill, Sir M. James, U Col London, London, England, U.K.
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Longuet-Higgins, H. C., U of Sussex, Brighton, England, U.K.
Longuet-Higgins, Michael S., U of Cambridge, Cambridge, England, U.K.
Luft, Rolf, Karolinska Hospital, Stockholm, Sweden
Lwoff, Andre, Inst Pasteur, Paris, France
Lyon, Mary F., MRC Radiobio Unit, Oxon, England, U.K.

Malinvaud, Edmond, Paris, France
Mandelbrot, Benoit B., IBM, Yorktown Heights, New York
Margalef, Ramon, U of Barcelona, Barcelona, Spain
McKenzie, Dan P., Bullard Labs, Cambridge, England, U.K.
McLaren, Digby J., Royal Society of Canada, Ottawa, Ontario, Canada
McMichael, Sir John, London, England, U.K.
Meade, James E., Little Shelford, Cambridge, England, U.K.
Melchers, Georg F., Max-Planck Inst fur Bio, Tubingen, FRG
Metcalf, Donald, The Royal Melbourne Hospital, Victoria, Australia
Miledi, Ricardo, U of Calif, Irvine, California

Miller, Jacques F. A. P., The Royal Melbourne Hospital, Victoria, Australia
Milner, Brenda, Montreal Neuro Inst, Montreal, Quebec, Canada
Milstein, Cesar, MRC Lab of Molec Bio, Cambridge, England, U.K.
Mitchell, Peter D., The Glynn Res Fdn Ltd., Cornwall, England, U.K.
Monin, Andrei S., Acad of Sci of the U.S.S.R., Moscow, U.S.S.R.
Mossbauer, Rudolf L., Tech U Munchen, Garching, FRG
Mott, Sir Nevill, U of Cambridge, Cambridge, England, U.K.
Mottelson, Ben R., Nordisk Inst for Teoretisk Atomfysik, Copenhagen, Denmark
Muller, K. Alex, IBM Zurich Research Lab, Ruschlikon, Switzerland
Mutt, Viktor, Karolinska Inst, Stockholm, Sweden

Nagata, Takesi, Nat'l Inst of Polar Res, Tokyo, Japan
Needham, Joseph, Cambridge, England, U.K.
Ne'eman, Yuval, Tel Aviv U, Ramat Aviv, Israel
Neher, Erwin, Max-Planck-Inst for Biophys Chem, Gottingen, FRG
Nicolet, Marcel, Brussels, Belgium
Nishizuka, Yasutomi, Kobe U Sch of Med, Kobe, Japan
Nossal, Sir Gustav J. V., U of Melbourne, Victoria, Australia

Occhialini, Giuseppe, U of Milan, Milan, Italy
Oort, Jan H., Sterrewacht-Huygens Lab, Leiden, The Netherlands

Paczynski, Bohdan, Princeton U, Princeton, New Jersey
Peebles, Phillip J., Princeton U, Princeton, New Jersey
Peierls, Sir Rudolf, Nuclear Physics Lab, Oxford, England, U.K.
Peimbert, Manuel, U Nacional Autonoma de Mexico, Mexico
Penney, W. G. B., Wantage, Oxfordshire, England, U.K.
Perutz, Max F., U Postgraduate Med Sch, Cambridge, England, U.K.
Phillips, Sir David, The Rex Richards Building, Oxford, England, U.K.
Polanyi, John C., U of Toronto, Toronto, Canada
Pontecorvo, G. P. A., London, England, U.K.
Pople, John A., Carnegie Mellon U, Pittsburgh, Pennsylvania
Popper, Sir Karl, London Sch of Economics, London, England, U.K.
Porter, Sir George, The Royal Society, London, England, U.K.
Prelog, V., Eigenossische Tech Hochschule, Zurich, Switzerland
Price, Raymond A., Queens U, Kingston, Onatario, Canada
Prigogine, I., U of Brussels, Brussels, Belgium

Rabin, Michael O., Hebrew U, Jerusalem, Israel; Harvard U, Cambridge, Massachusetts
Ramalingaswami, V., Indian Coun of Med Res, Ansari Nagar, New Delhi, India
Ramsay, John G., Geo Inst, Zurich, Switzerland
Rees, Martin J., Inst of Astron, Cambridge, England, U.K.
Reichard, Peter A., Karolinska Inst, Stockholm, Sweden
Reichardt, Werner E., Max-Planck-Inst for Bio Cybrnetics, Tubingen, FRG
Reichel-Dolmatoff, G., U of Calif, Los Angeles, California
Reichstein, Tadeus, Inst fur Organ Chem, Basel, Switzerland
Reig, Osvaldo A., U de Buenos Aires, Argentina
Rensch, Bernhard, Zoo Inst der Westfalischen Wilhelms-U, FRG
Riley, Sir Ralph, Stapleford, Cambridge, England, U.K.
Ringwood, A. E., The Australian Nat'l U, Canberra, Australia
Robertson, Alan, Inst of Animal Gen, Edinburgh, Scotland, U.K.
Robertson, Sir Rutherford N., Binalong, Australia
Rohrer, Heinrich, IBM, Zurich, Switzerland
Rosenblueth, Emilio, Ciudad U, Mexico
Rubbia, Carlo, Harvard U, Cambridge, Massachusetts; CERN, Geneva, Switzerland

Sagdeev, Roald Z., Academy of Scs of the U.S.S.R, Moscow, U.S.S.R
Samuelsson, Bengt, Karolinska Inst, Stockholm, Sweden

Sanger, Frederick, Cambridge, England, U.K.
Schatz, Gottfried, U of Basel, Basel, Switzerland
Schell, Jozef S., Max-Planck-Inst fur Zuchtungsforschung, Egelspfad, FRG
Schmidt, Maarten, Cal Tech, Pasadena, California
Seaton, Michael John, U Col of London, London, England, U.K.
Sela, Michael, Weizmann Inst of Sc, Rehovot, Israel
Serre, Jean-Pierre, Col de France, Paris, France
Shafarevich, Igor R., Academy of Scs of the U.S.S.R., Moscow, U.S.S.R.
Siegbahn, Kai, Inst of Physics, Uppsala, Sweden
Skou, Jens C., U of Aarhus, Aarhus, Denmark
Slatyer, Ralph O., Australian Nat'l U, Canberra, Australia
Smith, John M., U of Sussex, Falmer, Brighton, England, U.K.
Sokolov, Eugene N., Moscow State U, Moscow, U.S.S.R.
Southwood, Sir Richard, U of Oxford, Oxford, England, U.K.
Starlinger, Peter, U of Cologne, Cologne, FRG
Sugimura, Takashi, Nat'l Cancer Ctr, Tokyo, Japan
Swaminathan, M. S., Madras, India
Szentagothai, Janos, Semmelweis U Med Sch, Budapest, Hungary

Takhtajan, Armen L., Komarov Bot Inst, Leningrad, U.S.S.R.
Tan, Jia-Zhen, Fudan U, Shanghai, People's Republic of China
Thirring, Walter E., The Inst for Theoret Physics, Vienna, Austria
Tinbergen, J., The Hagne, The Netherlands
Tobias, Phillip V., U of Witwatersrand Med Sch, Johannesburg, Rep of So Africa
Todd, Lord of Trumpington, (A. R. Todd), Christ's Col, Cambridge, England, U.K.
Tomita, Tsuneo, Keio U Sch of Med, Tokyo, Japan
Tonegawa, Susumu, MIT, Cambridge, Massachusetts
Trumpy, D. Rudolf, Kuesnacht, Switzerland
Tulving, Endel, U of Toronto, Toronto, Canada
Tversky, Amos, Stanford U, Stanford, California

Ussing, Hans H., Copenhagen U, Copenhagen, Denmark
Uyeda, Seiya, U of Tokyo, Tokyo, Japan
van de Hulst, Hendrik C., Huygens Lab, Leiden, The Netherlands
Vane, Sir John R., St. Bartholomew's Hospital Med Col, London, England, U.K.
Van Hove, Leon, CERN, Geneva, Switzerland
Van Montagu, Marc, Labo Voor Genetika, Gent, Belgium
von Wettstein, Diter, Carlsberg Lab, Copenhagen Valby, Denmark

Waldenstrom, Jan G., General Hospital, Malmo, Sweden
Waterhouse, Douglas F., C.S.I.R.O., Canberra, Australia
Weibel, Ewald R., U of Berne, Berne, Switzerland
Weil, Andre, The Inst for Adv Study, Princeton, New Jersey
Weissman, Charles, U Zurich, Zurich, Switzerland
Wigglesworth, Sir Vincent, U of Cambridge, Cambridge, England, U.K.
Wilkes, Maurice V., Olivetti Res Limited, Cambridge, England, U.K.
Wilkinson, Sir Geoffrey, Imp Col of Sc & Tech, London, England, U.K.
Wilson, J. Tuzo, Toronto, Ontario, Canada
Wyllie, Peter J., Cal Tech, Pasadena, California

Yen, D. E., The Australian Nat'l U, Canberra, Australia

Zhou Guangzhao, Chinese Academy of Scs, Beijing, People's Republic of China

Number of Foreign Associates January 1990: 258

PUBLIC WELFARE MEDALISTS

Baumgartner, Leona, Chilmark, Massachusetts

Carey, William D., Carnegie Corporation of New York, Washington, D.C.
Corson, Dale, Cornell University, Ithaca, New York

Daddario, Emilio Q., Washington, D.C.
Doolittle, James H., Carmel, California

Gardner, John W., Carmel, California
Green, Cecil H., Dallas, Texas

Henderson, Donald A., Johns Hopkins U, Baltimore, Maryland
Hesburgh, The Reverend Theodore M. C S C, Retired, Notre Dame, Indiana

Packard, David, Hewlett-Packard Co., Palo Alto, California

Rees, Mina S., New York, New York
Rogers, Paul Grant, Washington, D.C.

Sawyer, John E., Woods Hole, Massachusetts
Shannon, James A., Portland, Oregon
Sullivan, Walter S., New York Times, New York, New York

Train, Russell E., World Wildlife Fund, Washington, D.C.

Number of Public Welfare Medalists January 1990: 16

11-Mathematics-69 Members

Ahlfors, Lars V.
Artin, Michael
Bass, Hyman
Bers, Lipman
Birkhoff, Garrett
Borel, Armand
Bott, Raoul
Browder, Felix E.
Browder, William
Calabi, Eugenio
Calderon, Alberto P.
Chern, Shiing-shen
Church, Alonzo
Cohen, Paul J.
Eilenberg, Samuel
Fefferman, Charles
Feit, Walter
Freedman, Michael H.
Furstenberg, Hille H.
Gehring, F. W.
Gleason, Andrew M.
Glimm, James
Gorenstein, Daniel
Graham, Ronald L.
Griffiths, Phillip A.
Guillemin, Victor W.
Hochschild, Gerhard P.
Jacobson, Nathan
Kaplansky, Irving
Kleene, Stephen C.
Kohn, Joseph J.
Kostant, Bertram
Lang, Serge
Lax, Peter D.
Lieb, Elliott
Mackey, George W.
Mac Lane, Saunders
Mather, John N.
Mazur, Barry C.
McKean, Henry P.
Milnor, John W.
Montgomery, Deane
Moser, Jurgen
Mostow, G. D.
Mumford, David B.
Nirenberg, Louis
Ornstein, Donald S.
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Rota, Gian-Carlo
Schiffer, M. M.
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Serrin, James B.
Shannon, Claude E.
Singer, I. M.
Smale, Stephen
Solovay, Robert
Stein, Charles M.
Stein, Elias M.
Steinberg, Robert
Sternberg, Shlomo
Sullivan, Dennis P.
Swan, Richard G.
Tate, John T.
Thompson, J. G.
Thurston, William P.
Uhlenbeck, Karen K.
Whitehead, George W.
Zygmund, Antoni

Members Emeriti

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Federer, Herbert
Spencer, D. C.

Foreign Associates

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Atiyah, Michael F.
Cartan, Henri
Cox, Sir David R.
Erdos, Paul
Gelfand, I. M.
Gromov, Mikhael
Hirzebruch, F.
Hormander, Lars
Kodaira, Kunihiko
Krein, Mark G.
Leray, Jean
Serre, Jean-Pierre
Shafarevich, Igor R.
Weil, Andre

12-Astronomy-59 Members

Aller, Lawrence H.
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Baker, James G.
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Burke, Bernard F.
Chandrasekhar, S.
Clark, George W.
Code, Arthur D.
Cohen, Marshall H.
Davis, Raymond, Jr.
de Vaucouleurs, Gerard

Drake, Frank D.
Faber, Sandra Moore
Field, George B.
Friedman, Herbert
Giacconi, Riccardo
Greenstein, Jesse L.
Gunn, James E.
Heeschen, D. S.
Herbig, George H.
Iben, Icko, Jr.
Kellermann, K. I.
King, Ivan R.
Kraft, Robert P.
Kraushaar, William L.
Leighton, R. B.
Low, Frank J.
Luyten, Willem J.
Lynds, Roger
McCray, Richard A.
Mihalas, Dimitri
Morgan, W. W.
Muench, Guido
Neugebauer, Gerry
Neugebauer, Otto E.
Osterbrock, Donald E.
Ostriker, Jeremiah P.
Parker, Eugene N.
Penzias, Arno A.
Preston, George W.
Roberts, Morton S.
Rubin, Vera C.
Salpeter, E. E.
Schwarzschild, Martin
Shapiro, Irwin I.
Shu, Frank H.
Spinrad, Hyron
Spitzer, Lyman, Jr.
Taylor, Joseph H., Jr.
Thaddeus, Patrick
Thorne, Kip S.
Toomre, Alar
Tousey, Richard
Weymann, Ray J.
Whipple, Fred L.
Whitford, A. E.
Wilson, R. W.

Members Emeriti

Mayall, N. U.
Wilson, Olin C.

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Ambartsumian, V.
Bolton, John G.
Hayashi, Chushiro
Hoyle, Sir Fred
Oort, Jan
Paczynski, Bohdan
Peebles, Phillip J.
Peimbert, Manuel
Rees, Martin J.
Schmidt, Maarten
Seaton, Michael John
van de Hulst, Hendrik C.

13-Physics-145 Members

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Adair, Robert K.
Adler, Stephen L.
Agnew, Harold M.
Ahlers, Guenter
Bacher, Robert F.
Bainbridge, Kenneth T.
Bardeen, John
Barschall, H. H.
Baym, Gordon A.
Benedek, George B.
Berg, Howard C.
Berko, Stephan
Bethe, H. A.
Bjorken, James D.
Bloembergen, Nicolaas
Boehm, Felix
Brewer, Richard G.
Brown, Gerald E.
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Callan, Curtis, G., Jr.
Chamberlain, Owen
Chew, Geoffrey F.
Christy, Robert F.
Cohen, Marvin L.
Coleman, Sidney
Colgate, S. A.
Commins, Eugene D.
Cooper, Leon N.
Courant, Ernest D.
Creutz, E.
Crewe, Albert V.
Cronin, James W.
Dashen, Roger
Dehmelt, Hans
Deutsch, Martin
Dicke, Robert H.
Drell, Sidney D.
Dyson, Freeman J.
Fano, Ugo
Feher, George
Feshbach, Herman
Fitch, Val L.
Fowler, William A.
Frauenfelder, Hans
Garwin, Richard L.
Gell-Mann, Murray
Glaser, Donald A.

Glashow, Sheldon Lee
Glauber, Roy J.
Goldberger, M. L.
Goldhaber, Gerson
Goldhaber, Gertrude S.
Goldhaber, Maurice
Greisen, Kenneth I.
Gross, David J.
Guth, Alan H.
Hahn, E. L.
Hall, John L.
Halperin, Bertrand I.
Henley, Ernest M.
Herb, R. G.
Herring, W. Conyers
Hofstadter, R.
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Hopfield, John J.
Hughes, Vernon W.
Inghram, Mark G.
Javan, Ali
Jeffries, Carson D.
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Kerst, Donald W.
Kittel, C.
Klein, Martin J.
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Kohn, Walter
Kroll, Norman M.
Kusch, P.
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McMillan, Edwin M.
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Reppy, John D.
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Richter, Burton
Ruderman, Malvin A.
Sachs, Robert G.
Samios, Nicholas P.
Sandweiss, Jack
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Zumino, Bruno

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Van Hove, Leon
Zhou, Guangzhao

14-Chemistry-171 Members

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Todd, Lord, of Trumpington
Wilkinson, Sir Geoffrey

15-Geology-39 Members

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16-Geophysics-65 Members

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Uyeda, Seiya
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21-Biochemistry-148 Members

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Smith, Hamilton O.
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Foreign Associates

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Reichard, Peter A.
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Schatz, Gottfried
Sela, Michael

22-Cellular and Developmental Biology-64 Members

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Bonner, James F.
Bonner, J. T.
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Britten, Roy J.
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Davidson, Norman
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Dulbecco, Renato

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Wigglesworth, Sir Vincent

23-Physiology and Pharmacology-29 Members

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McCann, S. M.
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24-Neurobiology-51 Members

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Lindauer, Martin
Miledi, Ricardo
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Reichardt, Werner
Tomita, Tsuneo

25-Botany-36 Members

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Burris, R. H.
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Gibbs, Martin
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Kramer, Paul J.
Lang, Anton
Mooney, Harold A.
Myers, Jack
Newcomb, Eldon H.
Phinney, Bernard O.
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Van Montagu, Marc
von Wettstein, Diter

26-Genetics-60 Members

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27-Population Biology, Evolution and Ecology-41 Members

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Southwood, Sir Richard

31-Engineering-77 Members

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Bogue, Allan G.
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White, Harrison C.
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54-Economic Sciences-
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20 Members

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McGaugh, James L.
McMillan, Edwin M.
Mead, Carver A.
Miles, John W.
Miller, Stanley L.
Miller, William H.
Moll, John L.
Mooney, Harold A.
Moore, C. Bradley
Moore, John A.
Morales, Manuel F.
Munk, Walter H.
Musgrave, Richard Abel
Namias, Jerome
Neufeld, Elizabeth F.
Neugebauer, Gerry
Nierenberg, William A.
Nomura, Masayasu
Ohno, Susumu
Olah, George A.
Oliver, B. M.
Olson, Everett C.
Ornstein, Donald S.
Osheroff, Douglas D.
Osterbrock, Donald E.
Owen, Ray D.
Pake, George E.
Panofsky, W. K. H.
Patterson, Clair C.
Pauling, Linus
Pearson, Ralph G.
Pederson, Donald O.
Perkins, David D.
Perl, Martin L.
Perlman, I.
Phinney, Bernard O.
Pickering, W. H.
Pierce, J. R.
Pines, Alexander
Pitzer, K. S.
Postman, Leo J.
Prausnitz, John M.
Preston, George W.
Price, P. Buford, Jr.
Puckett, Allen E.
Quate, C. F.
Rabinowitz, Jesse C.
Ramo, Simon
Ranney, Helen M.

Raymond, Arthur E.
Reines, Frederick
Reiss, Howard
Rentzepis, Peter M.
Revelle, Roger
Reynolds, John H.
Richards, Paul L.
Richter, Burton
Rick, Charles M.
Roberts, Eugene
Roberts, John D.
Rosenblatt, Murray
Rosenbluth, M. N.
Rosenzweig, Mark R.
Ross, John
Rowland, F. Sherwood
Rubin, Gerald M.
Rubin, Harry
Rudnick, Isadore
Rutter, William J.
Sargent, Thomas J.
Sawyer, Charles H.
Schachman, Howard K.
Schawlow, Arthur L.
Schiffer, M. M.
Schimke, Robert T.
Schmid, Rudi
Schoener, Thomas W.
Schrieffer, J. Robert
Schwartz, Melvin
Schwinger, Julian
Seaborg, Glenn T.
Seegmiller, J. Edwin
Shank, Charles V.
Shapley, Lloyd S.
Sharp, Robert P.
Shepard, Roger N.
Shirley, David A.
Shu, Frank H.
Shull, Harrison
Sibley, Charles G.
Siegman, Anthony E.
Silver, Leon Theodore
Simon, Melvin I.
Singer, S. J.
Sinsheimer, Robert Louis
Skinner, G. William
Smale, Stephen
Smith, Emil L.
Smith, Ray F.
Solovay, Robert
Somero, George N.
Somorjai, G. A.
Sperry, Roger W.
Spinrad, Hyron
Spiro, Melford E.
Stebbins, G. Ledyard
Stein, Charles M.
Steinberg, Daniel
Steinberg, Robert
Stent, Gunther S.
Stiglitz, Joseph
Stoeckenius, Walther
Stone, Edward C.
Streitwieser, Andrew, Jr.
Stryer, Lubert
Stumpf, P. K.
Suess, Hans E.
Suhl, Harry
Suppes, Patrick
Taube, Henry
Taylor, Hugh P., Jr.
Teller, Edward
Thimann, Kenneth V.
Thomas, Gareth
Thompson, Richard F.
Thorne, Kip S.
Tilton, George R.
Tinoco, Ignacio, Jr.
Tobler, Waldo R.
Townes, Charles H.
Trilling, George H.
Trost, Barry M.
Valentine, James W.
Valentine, William N.
van Tamelen, Eugene E.
Varmus, Harold E.
Verhoogen, John
Villard, Oswald G., Jr.
Vogt, Peter K.
Wall, Frederick T.
Washburn, Sherwood L.
Wasserburg, G. J.
Watson, Kenneth M.
Weissman, Irving L.
Weymann, Ray J.
Whinnery, John R.
White, Donald E.
Whitford, A. E.
Williams, Robley C.
Wilson, Olin C.
Wooldridge, Dean E.
Yanofsky, Charles
Zare, Richard N.
Zentmyer, George A.
Zewail, Ahmed H
Zimm, Bruno H.
Zumino, Bruno

Colorado-19 Members

Barrett, C. S.
Boulding, Kenneth E.
Cech, Thomas R.
Cristol, Stanley J.
Dickinson, Robert E.
Evans, Howard E.

Fixman, Marshall
Hall, John L.
Hamilton, Warren B.
Kappler, John W.
Lineberger, W. Carl
Marrack, Philippa
McCray, Richard A.
Prescott, David Marshall
Puck, Theodore T.
Spencer, D. C.
Talmage, David W.
White, Gilbert F.
Wood, William B.

Connecticut-58 Members

Adair, Robert K.
Adelberg, Edward A.
Berliner, Robert W.
Berner, Robert A.
Bernstein, Ira B.
Berson, Jerome A.
Bormann, Frederick H.
Coe, Michael D.
Cohen, Melvin J.
Conklin, Harold C.
Crothers, Donald M.
Dahl, Robert A.
Danishefsky, Samuel J.
Farquhar, Marilyn Gist
Feit, Walter
Fruton, Joseph S.
Garen, Alan
Garner, Wendell R.
Giebisch, Gerhard
Goebel, Walther F.
Hoffman, Joseph F.
Hole, Frank
Horsfall, James G.
Horstmann, Dorothy M.
Hughes, Vernon W.
Hutchinson, G. Evelyn
Jacobson, Nathan
Klein, Martin J.
Lang, Serge
Lerner, Aaron B.
Liberman, Alvin M.
Lounsbury, Floyd G.
Malone, Thomas F.
Marchesi, Vincent T.
Miller, Neal E.
Mostow, G. D.
O'Brien, Brian
Osborn, M. J.
Palade, George E.
Pospisil, Leopold J.
Rakic, Pasko
Richards, Frederic M.
Rodgers, John
Rosenberg, Leon E.
Rouse, Irving
Ruddle, Francis H.
Sandweiss, Jack
Scarf, Herbert E.
Shulman, Robert G.
Steitz, Joan A.
Stevens, Charles F.
Sturtevant, Julian M.
Tobin, James
Turekian, Karl K.
Waggoner, Paul E.
Wasserman, Harry H.
Weissman, Sherman M.
Wiberg, Kenneth B.

Delaware-5 Members

Graham, Frances K.
Greenewalt, Crawford H.
Ness, Norman F.
Parshall, George W.
Simmons, H. E.

Dist. of Columbia-23 Members

Abelson, Philip H.
Adams, Robert McCormick
Boyd, F. R., Jr.
Brown, Harold
Costa, Erminio
Denison, Edward F.
Friedman, Herbert
Griffin, James B.
Haskins, Caryl P.
Karle, Isabella L.
Karle, Jerome
Nolan, Thomas B.
Press, Frank
Ripley, S. Dillon
Rubin, Vera C.
Sabin, Albert B.
Singer, Maxine F.
Stever, H. Guyford
Stewart, T. D.
Tousey, Richard
Wedel, Waldo R.
Wetherill, George W.
Yoder, Hatten S., Jr.

Florida-12 Members

Beidler, Lloyd M.
Conn, Jerome W.
Davis, George K.

Deere, Don U.
Good, Robert A.
Green, David M.
Howard, Louis N.
Kasha, Michael
Rossini, Frederick D.
Taylor, J. Herbert
Teitelbaum, Philip
Zinn, Walter H.

Georgia-5 Members

Anderson, Wyatt W.
Burton, Glenn W.
Giles, Norman H.
Neisser, Ulric
Odum, Eugene P.

Hawaii-6 Members

Baker, Paul T.
Carson, Hampton L.
Herbig, George H.
Oliver, Douglas
Smith, Albert C.
Spoehr, Alexander

Idaho-1 Member

Sarett, Lewis H.

Illinois-82 Members

Anders, Edward
Bardeen, John
Basolo, Fred
Baym, Gordon A.
Becker, Gary S.
Berry, R. Stephen
Bjorken, James D.
Bloch, Herman S.
Bryant, Marvin P.
Buikstra, Jane E.
Calderon, Alberto P.
Chandrasekhar, S.
Closs, Gerhard L.
Coleman, James S.
Crewe, Albert V.
Cronin, James W.
Curtin, David Y.
Doob, J. L.
Drickamer, Harry G.
Ehrlich, Gert
Fano, Ugo
Fogel, Robert W.
Frauenfelder, Hans
Fried, Josef
Fultz, Dave
Gomer, Robert
Gunsalus, Irwin C.
Gutowsky, H. S.
Halpern, Jack
Hauser, Philip M.
Holonyak, Nick, Jr.
Huggins, Charles
Hutchison, Clyde A.
Ibers, James A.
Jacobson, Leon O.
Jensen, Elwood V.
Jonas, Jiri
Kadanoff, Leo P.
Katz, Joseph J.
Klotz, Irving M.
Lauterbur, Paul C.
Lederman, Leon M.
Leonard, Nelson J.
Letsinger, Robert L.
Levy, Donald H.
Lorand, Laszlo
Lucas, Robert E., Jr.
Mac Lane, Saunders
Margoliash, Emanuel
Metcalf, Robert L.
Meyer, Peter
Mihalas, Dimitri
Moscona, Aron A.
Nambu, Yoichiro
Ogren, William L.
Osgood, Charles E.
Parker, Eugene N.
Pines, David
Prosser, C. Ladd
Raup, David M.
Rice, Stuart A.
Roizman, Bernard
Rowley, Janet D.
Sachs, Robert G.
Salisbury, G. W.
Schiffer, John P.
Schramm, David N.
Schultz, Theodore W.
Simpson, John A.
Slichter, Charles P.
Smith, Joseph V.
Sprague, G. F.
Steiner, Donald F.
Stigler, George J.
Swan, Richard G.
Swift, Hewson
Turkevich, Anthony L.
Underwood, Benton J.
Weber, Gregorio
Woese, Carl R.
Wolfe, Ralph S.

Zygmund, Antoni

Indiana-17 Members

Axtell, John D.
Barber, Stanley A.
Braidwood, Robert J.
Brown, Herbert C.
Craig, George Brownlee, Jr.
Davidson, Ernest R.
Dilcher, Davil L.
Heiser, Charles B., Jr.
Mertz, Edwin T.
Neff, William D.
Overhauser, Albert W.
Preer, John R., Jr.
Putnam, Frank W.
Rhoades, M. M.
Rossmann, Michael G.
San Pietro, Anthony
Umbarger, H. Edwin

Iowa-5 Members

Aydelotte, William O.
Bremner, John M.
Brown, William L.
Hallauer, Arnel R.
Van Allen, James A.

Kansas-1 Member

Michener, Charles D.

Kentucky-1 Member

Shepherd, Robert J.

Louisiana-2 Members

Harlan, Jack R.
Schally, Andrew V.

Maine-2 Members

Russell, Elizabeth S.
Snell, George D.

Maryland-68 Members

Anfinsen, C. B.
Ashwell, G. Gilbert
Aurbach, Gerald D.
Axelrod, Julius
Bodian, David
Brady, Roscoe O.
Brown, Donald D.
Cahn, John W.
Cantoni, Giulio L.
Chanock, Robert M.
Choppin, Purnell W.
Davies, David R.
Dawid, Igor B.
Diener, Theodor O.
Ebert, James D.
Elsasser, Walter M.
Felsenfeld, Gary
Fredrickson, Donald S.
Gajdusek, D. Carleton
Gall, Joseph G.
Gallo, Robert C.
Gellert, Martin
Giacconi, Riccardo
Griffin, James B.
Hagins, W. A.
Hansen, Morris H.
Harrington, William F.
Hertz, Roy
Huebner, Robert J.
Kaufman, Seymour
Kety, Seymour S.
Knipling, Edward F.
Krause, Richard
Lane, M. Daniel
Larrabee, Martin G.
Littlefield, John W.
McDonald, Frank
McKusick, Victor A.
Mishkin, Mortimer
Moss, Bernard
Mountcastle, Vernon B.
Nathans, Daniel
Nirenberg, Marshall W.
Pastan, Ira
Paul, William E.
Pettijohn, F. J.
Potter, Michael
Purcell, Robert H.
Rall, J. Edward
Reese, Thomas
Roseman, Saul
Smith, Hamilton O.
Snyder, Solomon H.
Sokoloff, Louis
Spradling, Allan C.
Stadtman, E. R.
Stadtman, Thressa C.
Stetten, DeWitt, Jr.
Tabor, Herbert
Talalay, Paul
Temkin, Owsei
Vaughan, Martha

Wadleigh, Cecil H.
Waldmann, Thomas
Witkop, Bernhard
Wolman, M. Gordon
Wurtz, Robert H.
Wyngaarden, James B.
Zwanzig, Robert

Massachusetts-243 Members

Abeles, Robert H.
Ahlfors, Lars V.
Alberty, Robert A.
Artin, Michael
Austen, K. Frank
Bainbridge, Kenneth T.
Baker, James G.
Balluffi, Robert W.
Baltimore, David
Bartlett, Paul D.
Beckwith, Jonathan
Benacerraf, Baruj
Benedek, George B.
Benedict, Manson
Berg, Howard C.
Berggren, William A.
Bergson, Abram
Berko, Stephan
Birch, A. Francis
Birkhoff, Garrett
Bizzi, Emilio
Bloch, Konrad E.
Bloembergen, Nicolaas
Blout, Elkan R.
Bogorad, Lawrence
Bott, Raoul
Brace, W. F.
Branscomb, Lewis M.
Branton, Daniel
Braunwald, Eugene
Brooks, Harvey
Brown, Roger
Buchanan, John M.
Buchi, George H.
Budiansky, Bernard
Burchfiel, B. Clark
Burke, Bernard F.
Cameron, A. G. W.
Carrier, George F.
Castle, W. B.
Chalmers, Bruce
Chang, Kwang-chih
Chernoff, Herman
Chomsky, Noam
Clark, George W.
Cohen, Morris
Cohen, Seymour S.
Coleman, Sidney
Corey, E. J.
Cormack, A. M.
Davis, Bernard D.
Dethier, Vincent G.
Deutsch, Karl W.
Deutsch, Martin
Diamond, Peter Arthur
Doering, William
Doty, Paul
Dowling, John E.
Dresselhaus, Mildred S.
Edgerton, Harold E.
Edsall, John T.
Eisen, Herman N.
Elias, Peter
Emery, K. O.
Emmons, Howard W.
Erikson, R. L.
Estes, William K.
Evans, David A.
Fano, Robert M.
Feshbach, Herman
Field, George B.
Fields, Bernard N.
Fink, Gerald R.
Fox, Maurice S.
Furshpan, Edwin J.
Gibbs, Martin
Gilbert, Walter
Glashow, Sheldon Lee
Glauber, Roy J.
Gleason, Andrew M.
Goody, Richard M.
Gordon, Roy
Gould, Stephen Jay
Graybiel, Ann M.
Green, Howard
Griliches, Zvi
Gross, Jerome
Grunwald, Ernest
Guillemin, Victor W.
Guth, Alan H.
Haensel, Vladimir
Halle, Morris
Halperin, Bertrand I.
Hart, Stanley R.
Haus, Hermann A.
Hay, Elizabeth D.
Hegsted, D. M.
Held, Richard M.
Herschbach, Dudley
Holland, H. D.
Holm, Richard H.
Hornig, Donald F.
Hotchkiss, Rollin D.
Hottel, H. C.
Houthakker, Hendrik S.
Howells, W. W.
Hubel, David H.

Ippen, Erich P.
Isselbacher, Kurt J.
Javan, Ali
Jencks, William P.
Jorgenson, Dale W.
Kafatos, Fotis C.
Kalckar, Herman M.
Karplus, Martin
Kennedy, Eugene P.
Khorana, H. Gobind
Klemperer, William
Kleppner, Daniel
Kostant, Bertram
Kravitz, Edward A.
Kuhn, Thomas S.
Land, Edwin H.
Landes, David S.
Lax, Benjamin
Leaf, Alexander
Leder, Philip
Lerman, Leonard S.
Licklider, J. C. R.
Lin, Chia-Chiao
Lindzen, Richard S.
Lippard, Stephen J.
Lipscomb, William N.
Lodish, Harvey F.
London, Irving M.
Lorenz, Edward N.
Low, Francis E.
Luria, S. E.
Mackey, George W.
MacNeish, Richard S.
Magasanik, Boris
Malkus, Willem V. R.
Maniatis, Thomas
Mann, Robert W.
Margulis, Lynn
Martin, Paul
Mayr, Ernst
Mazur, Barry C.
McFadden, Daniel L.
Meselson, M. S.
Minsky, Marvin L.
Modigliani, Franco
Moore, Francis D.
Morrison, Philip
Mosteller, Frederick
Mumford, David B.
Munro, H. N.
Nauta, Walle J. Harinx
Nisonoff, Alfred
Orowan, Egon
Page, Irvine H.
Palay, Sanford L.
Pappenheimer, A. M., Jr.
Pappenheimer, John R.
Pardee, Arthur B.
Pardue, Mary-Lou
Partee, Barbara H.
Pedlosky, Joseph
Penman, Sheldon
Pettengill, Gordon
Pound, Robert V.
Ptashne, Mark
Purcell, E. M.
Quine, Willard V.
Ramsey, Norman F.
Rasmussen, Norman C.
Redfield, Alfred G.
Rice, James R.
Rich, Alexander
Richardson, Charles C.
Robbins, Phillips W.
Roedder, Edwin W.
Rollins, Reed C.
Rosenblith, Walter A.
Rossi, Bruno B.
Rota, Gian-Carlo
Sager, Ruth
Samuelson, Paul A.
Sanders, Howard L.
Schelling, Thomas Crombie
Schmitt, Francis O.
Schultes, Richard Evans
Scrimshaw, Nevin
Segal, I. E.
Shannon, Claude E.
Shapiro, Ascher H.
Shapiro, Irwin I.
Sharp, Phillip A.
Sharpless, K. Barry
Sheehan, John C.
Shemin, David
Shull, Clifford G.
Sidman, Richard L.
Singer, I. M.
Skinner, B. F.
Smith, Cyril Stanley
Solow, Robert M.
Sternberg, Shlomo
Stommel, Henry M.
Stratton, J. A.
Strominger, Jack Leonard
Tate, John T.
Taylor, C. Richard
Thaddeus, Patrick
Thompson, James B., Jr.
Ting, Samuel C.C.
Tinkham, M.
Toomre, Alar
Torrey, John G.
Turnbull, David
Vallee, Bert L.
Verba, Sidney
Vogt, Evon Zartman, Jr.
Wald, George
Walsh, Christopher T.

Wang, James C.
Waugh, J. S.
Weinberg, Robert A.
Weisskopf, Victor F.
Weller, Thomas
Westheimer, Frank H.
Whipple, Fred L.
Whitehead, George W.
Whitesides, George M.
Whiting, John W. M.
Wiesner, Jerome B.
Willey, Gordon R.
Williams, Carroll M.
Wilson, E. Bright
Wilson, Edward O.
Wogan, Gerald N.
Wunsch, Carl
Zamecnik, Paul C.

Michigan-20 Members

Alexander, Richard D.
Axelrod, Robert
Bukovac, Martin J.
Coon, M. J.
Crane, H. Richard
Cuatrecasas, Pedro M.
Davenport, Horace W.
Donahue, Thomas M.
Dye, James L.
Flannery, Kent V.
Freedman, Ronald
Garn, Stanley M.
Gehring, F. W.
Inghram, Mark G.
Lang, Anton
Morgan, James N.
Neel, James V.
Oncley, J. L.
Tolbert, N. Edward
Wagner, Warren H., Jr.

Minnesota-14 Members

Borchert, John R.
Crawford, Bryce, Jr.
Davis, Margaret Bryan
Gassman, Paul G.
Holman, Ralph T.
Hurwicz, Leonid
Kolthoff, I. M.
Luyten, Willem J.
Meehl, Paul E.
Ney, Edward P.
Nier, Alfred O. C.
Serrin, James B.
Sims, Christopher A.
Wright, H. E., Jr.

Missouri-25 Members

Daughaday, William H.
Davis, Hallowell
Davis, James Othello
Fischbach, Gerald D.
Frieden, Carl
Hamburger, Viktor
Hirsh, Ira J.
Kipnis, David M.
Kornfeld, Stuart A.
Lacy, Paul E.
Lowry, Oliver H.
Majerus, Phil
Needleman, Philip
Phillips, William D.
Purves, Dale
Raven, Peter H.
Schneiderman, Howard A.
Sears, Ernest R.
Shreffler, Donald C.
Sly, William S.
Unanue, Emil R.
Varner, J. E.
Walker, Robert M.
Watson, Patty Jo
Weissman, S. I.

Montana-2 Members

Fawcett, Don W.
Pittendrigh, Colin S.

Nebraska-2 Members

Brakke, Myron K.
Daly, J. M.

Nevada-1 Member

Went, F. W.

New Hampshire-7 Members

Andrews, Henry N.
Billings, Marland P.
Darlington, Sidney
Kantrowitz, Arthur
Phillips, Norman A.
Solomon, Richard L.
Stockmayer, W. H.

New Jersey-90 Members

Abrahams, Elihu
Adler, Stephen L.
Anderson, Philip W.
Bahcall, John N.
Baker, W. O.
Baumol, William J.
Bonner, J. T.
Borel, Armand
Bovey, Frank
Brinkman, W. F
Browder, Felix E.
Browder, William
Brown, Walter L.
Buchsbaum, S. J.
Burns, John J.
Callan, Curtis G.
Cho, Alfred Y.
Coale, Ansley J.
Cohen, Morrel H.
Conney, Allan H.
David, E. E., Jr.
Dicke, Robert H.
Dynes, Robert C.
Dyson, Freeman J.
Fefferman, Charles
Fitch, Val L.
Flanagan, James L.
Furth, Harold P.
Geertz, Clifford
Goldberger, M. L.
Gordon, James P.
Gorenstein, Daniel
Graham, Ronald L.
Gross, David Jonathan
Gunn, James E.
Hagstrum, Homer D.
Hirschman, Albert O.
Hohenberg, Pierre C.
Julesz, Bela
Kaback, H. Ronald
Kauzmann, Walter
Kohn, Joseph J.
Kruskal, Martin
Lebowitz, Joel L.
Lieb, Elliott
Mather, John N.
McClure, Donald S.
Miller, George A.
Milnor, John W.
Mislow, Kurt
Morgan, W. Jason
Neugebauer, Otto E.
Ostriker, Jeremiah P.
Panish, Morton B.
Patel, C. Kumar N.
Penzias, Arno A.
Phillips, J. C.
Radner, Roy
Robbins, Herbert
Ross, Ian M.
Schwarzschild, Martin
Shatkin, Aaron J.
Shepp, Lawrence A.
Sinfelt, John H.
Slepian, David
Smyth, Charles P.
Spitzer, Lyman, Jr.
Stein, Elias M.
Stillinger, Frank Henry
Tarjan, Robert E.
Taylor, Joseph H., Jr.
Thompson, Ken
Thurston, William P.
Tien, Ping King
Treiman, Sam
Tsui, Daniel Chee
Tukey, John W.
Udenfriend, Sidney
Vagelos, P. Roy
Weissbach, Herbert
Wever, E. G.
Wheeler, John A.
Wightman, Arthur S.
Wigner, Eugene P.
Wilkinson, David T.
Wilson, R. W.
Witkin, Evelyn M.
Witten, Edward
Wolpert, Julian

New Mexico-4 Members

Bradbury, N. E.
Clogston, Albert M.
Colgate, S. A.
Eggan, Fred

New York-187 Members

Ahrens, Edward H., Jr.
Axel, Richard
Bachrach, Howard L.
Banks, Harlan P.
Bass, Hyman
Bauman, Dale E.
Bean, Charles P.
Bearn, Alexander
Bennett, Michael V. L.
Bers, Lipman
Bersohn, Richard
Bethe, H. A.
Bigeleisen, Jacob
Blobel, Gunter
Bloom, Barry R.

Breslow, Ronald
Brink, Frank
Broecker, Wallace S.
Brooks, Chandler McC.
Brown, Gerald E.
Cantor, Charles R.
Case, Kenneth M.
Chargaff, Erwin
Chase, Merrill W.
Clayton, Roderick K.
Cohn, Zanvil A.
Cole, Julian D.
Courant, Ernest D.
Cronkite, Eugene P.
Darnell, James E., Jr.
Dole, Vincent P.
Dynkin, Eugene B.
Eagle, Harry
Eastman, Dean E.
Edelman, Gerald M.
Edelman, Isidore S.
Eilenberg, Samuel
Eisner, Thomas
Feigenbaum, Mitchell J.
Fenno, Richard F., Jr.
Friedlander, Gerhart
Garabedian, Paul R.
Garwin, Richard L.
Gates, Marshall
Giaever, Ivar
Gibson, Eleanor Jack
Gibson, Quentin H.
Ginsberg, Harold S.
Glass, H. Bentley
Glimm, James
Gold, T.
Goldhaber, Gertrude S.
Goldhaber, Maurice
Gomory, Ralph E.
Gotschlich, Emil C.
Greengard, Paul
Greisen, Kenneth I.
Griffin, Donald R.
Gross, Ludwik
Hall, Robert N.
Harker, David
Harris, Cyril M.
Hauptman, Herbert A.
Heidelberger, Michael
Heppel, Leon A.
Hershey, A. D.
Hess, George P.
Hoard, J. L.
Hochberg, Julian
Hockett, Charles F.
Hoffman, Alan J.
Hoffmann, Roald
Holtfreter, Johannes
Horecker, B. L.
Huizenga, John R.
Hurwitz, Jerard
Isard, Walter
Jagendorf, Andre T.
John, Fritz
Kabat, Elvin A.
Kandel, Eric R.
Kesten, Harry
Kilbourne, Edwin D.
Krugman, Saul
Landauer, Rolf W.
Lawrence, H. Sherwood
Lax, Melvin
Lax, Peter D.
Lederberg, Joshua
Lee, Tsung-Dao
Lennarz, William J.
Leontief, Wassily
Levinthal, Cyrus
Lieberman, Seymour
Likens, Gene E.
Lilly, Frank
Llinas, R.
Luck, David J. L.
Luttinger, J. M.
Mark, H. F.
Marks, Paul A.
Marler, Peter
McCarty, Maclyn
McClintock, Barbara
McDaniel, Boyce D.
McCray, Richard A.
McKay, Kenneth G.
McKean, Henry P.
McKenzie, Lionel W.
McLafferty, Fred W.
Meinwald, Jerrold
Meister, Alton
Merrifield, Bruce
Merton, Robert K.
Meyer, Karl
Nathenson, Stanley G.
Newell, Norman D.
Nirenberg, Louis
Nottebohm, Fernando
Old, Lloyd J.
Oliver, Jack E.
Pais, Abraham
Pfaffmann, Carl
Phelps, Edmund S.
Piore, E. R.
Purpura, Dominick P.
Racker, Efraim
Rahn, Hermann
Ratliff, Floyd
Ratner, Sarah
Reppy, John D.
Richardson, Robert C.
Riker, William H.

Roeder, Robert G.
Roelofs, Wendell L.
Rosen, Ora M.
Ruderman, Malvin A.
Sabatini, David D.
Salpeter, E. E.
Samios, Nicholas P.
Sato, Gordon H.
Schachter, Stanley
Scharff, Matthew D.
Scharrer, Berta V.
Scheraga, H. A.
Schwartz, Jacob T.
Seitz, Frederick
Serber, Robert
Setlow, Richard B.
Shapiro, Harry L.
Sherman, Fred
Shirane, Gen
Siekevitz, Philip
Sokal, Robert R.
Sorokin, Peter P.
Sperling, George
Spitzer, Frank L.
Srb, Adrian M.
Stoker, J. J.
Stork, Gilbert
Suits, C. G.
Sullivan, Dennis P.
Sykes, Lynn R.
Tamm, Igor
Thomas, David H.
Thomas, Lewis
Tilly, Charles
Trager, William
Turcotte, Donald L.
Turro, Nicholas J.
Waelsch, Salome G.
Wasserman, Robert H.
Watson, J. D.
Wells, John W.
White, Harrison
Widom, Benjamin
Wiesel, Torsten N.
Wigler, Michael H.
Williams, Robin M., Jr.
Wilson, Kenneth G.
Wilson, Robert R.
Winograd, Shmuel
Wolf, Alfred P.
Wu, C. S.
Yalow, Rosalyn S.
Yang, Chen Ning
Zilversmit, Donald B.
Zinder, Norton D.

North Carolina-33 Members

Amos, Bernard
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Cockerham, C. Clark
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Diamond, Irving T.
Eliel, Ernest L.
Fridovich, Irwin
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Griffiths, Phillip A.
Hill, Robert L.
Hitchings, George H.
Hoeffding, Wassily
Joklik, W. K.
Jones, Mary Ellen
Kramer, Paul J.
Lefkowitz, Robert J.
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Montgomery, Deane
Parr, Robert G.
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Schmidt-Nielsen, Knut
Simons, Elwyn L.
Smithies, Oliver
Terborgh, John W.
Thomas, L. H.
Weber, Ernst

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Robbins, Frederick C.
Wood, Harland G.

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van Holde, K. E.

von Hippel, Peter H.

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Burstein, Elias
Cairns, T. L.
Calabi, Eugenio
Campbell, Donald T.
Chance, Britton
Cohn, Mildred
Davis, Raymond J.
de Laguna, Frederica
Duffin, R. J.
Flexner, Louis B.
Forster, Robert E.
Goldstine, Herman H.
Goodenough, Ward H.
Griffiths, Robert B.
Harris, Zellig S.
Henle, Gertrude
Hilleman, Maurice R.
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Hoenigswald, Henry M.
Hofmann, Klaus
Hulm, John K.
Hurvich, Leo M.
Iben, Icko, Jr.
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Klein, Lawrence R.
Knudson, Alfred G.
Koelle, George B.
Koprowski, Hilary
Menken, Jane A.
Mintz, Beatrice
Mullins, William W.
Nachmias, Jacob
Nerlove, Marc
Newell, Allen
Nowell, Peter C.
Patrick, Ruth
Perry, Robert P.
Porter, Keith
Preston, Samuel H.
Rescorla, Robert A.
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Rose, Irwin
Sanders, William T.
Scolnick, Edward M.
Scott, Dana S.
Selander, Robert K.
Simon, Herbert A.
Skell, Philip S.
Sprague, James M.
Stellar, Eliot
Sternberg, Saul
Sutherland, Ivan
Wallace, Anthony F. C.
Wallach, Hans
Watkins, George D.
Weinhouse, Sidney
Wolfenstein, Lincoln
Zener, Clarence

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Cooper, Leon N.
Federer, Herbert
Imbrie, John
Kates, Robert W.
Riggs, Lorrin A.

Tennessee-9 Members

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Cohen, Stanley
Darby, William J.
Liddle, Grant W.
Park, Charles R.
Russell, Liane Brauch
Russell, William L.
Tarbell, D. Stanley
Weinberg, Alvin M.

Texas-37 Members

Adkisson, Perry L.
Arntzen, Charles
Bard, Allen J.
Berry, Brian J. L.
Brown, Michael S.
Chamberlain, Joseph W.
Chu, Paul C. W.
Cotton, F. Albert
de Vaucouleurs, Gerard
Dewar, Michael J. S.
Estabrook, Ronald W.
Folkers, Karl
Gilman, Alfred G.
Goldstein, Joseph L.
Gordon, W. E.
Grant, Verne E.
Hackerman, Norman
Knobil, Ernst
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Kusch, P.
Margrave, John L.

McCann, S. M.
Michl, Josef
Myers, Jack
Noyce, Robert
Pike, Kenneth L.
Reed, Lester J.
Sclater, John G.
Snell, Esmond E.
Starr, Richard C.
Summers, Max D.
Uhlenbeck, Karen K.
Uhr, Jonathan W.
Unger, Roger H.
Weinberg, Steven
Wendorf, Fred
Wilson, Jean D.

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Goodman, Louis S.
Roth, John R.
Velick, Sidney F.
Walling, Cheves

Vermont-1 Member

Hoagland, Mahlon

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Berne, Robert M.
Gilruth, Robert R.
Hammond, George S.
Heeschen, D. S.
Kellermann, K. I.
MacDonald, Gordon J. F.
Marshak, Robert E.
Miller, Oscar L., Jr.
Roberts, Morton S.
Wallace, Bruce
Zen, E-an

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Benditt, Earl P.
Blalock, Hubert M., Jr.
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Davie, Earl W.
Dehmelt, Hans
Dunne, Thomas
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Finch, Clement A.
Fischer, Edmond H.
Gartler, Stanley M.
Giblett, Eloise R.
Halver, John E.
Hannay, N. Bruce
Hartwell, Leland H.
Henley, Ernest M.
Hille, Bertil
James, Harold L.
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Krebs, Edwin G.
Leopold, Estella B.
Motulsky, Arno G.
Neurath, Hans
Orians, Gordon H.
Paine, Robert T.
Palmiter, Richard D.
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Rhines, Peter B.
Ryan, Clarence A., Jr.
Schairer, George S.
Thomas, E. Donnall
Todaro, George Joseph
Waters, Aaron C.
Weintraub, Harold

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Barschall, H. H.
Beck, Stanley D.
Beinert, Helmut
Bird, R. Byron
Bogue, Allan G.
Brill, Winston J.
Burris, R. H.
Cleland, W. Wallace
Code, Arthur D.
Cohen, Philip P.
Crow, James F.
Dahl, Lawrence F.
DeLuca, H. F.
Ferry, John D.
First, Neal L.
Goldberger, Arthur S.
Hasler, Arthur D.
Hauser, Robert Mason
Herb, R. G.
Hirschfelder, Joseph O.
Jackson, Marion L.
Kelman, Arthur
Kerst, Donald W.
Kirk, T. Kent
Kleene, Stephen C.
Kraushaar, William L.
Lardy, Henry A.
Miller, James A.
Morgan, W. W.
Nelson, Oliver E., Jr.

Newcomb, Eldon H.
Peloquin, S. J.
Potter, Van R.
Ris, Hans
Rose, Jerzy E.
Sequeira, Luis
Sewell, William H.
Skoog, Folke
Tanner, Champ B.
Temin, Howard M.
Woolsey, Clinton N.
Zimmerman, Howard E.

Members Abroad

Austria-1 Member

Keyfitz, Nathan

Canada-2 Members

Cook, Stephen A.
Doermann, August H.

Costa Rica-1 Member

West-Eberhard, Mary Jane

FRG-2 Members

Cardona, Manuel
Mueller-Eberhard, Hans J.

France-1 Member

Wyman, Jeffries

Israel-3 Members

Aumann, Robert J.
Furstenberg, Hillel
Pekeris, Chaim L.

Italy-2 Members

Levi-Montalcini, Rita
Wick, Gian-Carlo

Mexico-1 Member

Borlaug, Norman E.

New Zealand-1 Member

Green, R. C.

Spain-2 Members

Muench, Guido
Ochoa, Severo

Switzerland-3 Members

Moser, Jurgen
Steinberger, J.
Telegdi, Valentine L.

United Kingdom-5 Members

Quillen, Daniel G.
Stark, George R.
Tanford, Charles
Thompson, J. G.
Weiskrantz, Lawrence

GEOGRAPHICAL LISTING OF FOREIGN ASSOCIATES

Argentina-1 Foreign Associate

Reig, Osvaldo A.

Australia-12 Foreign Associates

Bolton, John G.
Catcheside, D. G.
Fenner, Frank
Frankel, Sir Otto H.
Metcalf, Donald
Miller, Jacques F. A. P.
Nossal, Sir Gustav J. V.
Ringwood, A. E.
Robertson, Sir Rutherford
Slatyer, Ralph O.
Waterhouse, Douglas F.
Yen, D. E.

Austria-2 Foreign Associates

Birnstiel, Max L.
Thirring, Walter E.

Belgium-4 Foreign Associates

de Duve, Christian
Nicolet, Marcel
Prigogine, I.
Van Montagu, Marc

Canada-9 Foreign Associates

Glen, Robert
Harrison, J. M.
Herzberg, Gerhard
McLaren, Digby J.
Milner, Brenda
Polanyi, John C.
Price, Raymond
Tulving, Endel
Wilson, J. Tuzo

China-3 Foreign Associates

Feng, De-Pei
Tan, Jia-Zhen
Zhou, Guangzhao

Colombia-1 Foreign Associate

Reichel-Dolmatoff, Gerard

Denmark-5 Foreign Associates

Bohr, Aage
Mottelson, Ben R.
Skou, Jens C.
Ussing, Hans H.
von Wettstein, Diter

FRG-16 Foreign Associates

Axford, W. I.
Beermann, Wolfgang
Binnig, Gerd Karl
Bunning, Erwin
Eigen, Manfred
Hirzebruch, F.
Huisgen, Rolf
Kaiser, Wolfgang
Lindauer, Martin
Melchers, Georg Friedrich
Moessbauer, Rudolf L.
Neher, Erwin
Reichardt, Werner
Rensch, Bernhard
Schell, Jozef Stefaan
Starlinger, Peter

France-24 Foreign Associates

Abragam, Anatole
Aigrain, Pierre R.
Allegre, Claude J.
Blamont, Jacques Emile
Cartan, Henri
Chambon, Pierre
Changeux, Jean-Pierre
Dausset, Jean
de Gennes, Pierre-Gilles
Fraisse, Paul
Gautheret, Roger
Grunberg-Manago, Marianne
Jacob, Francois
Jerne, Niels Kaj
Joliot, Pierre A.
Jost, Alfred
Le Douarin, Nicole M.
Lehn, Jean-Marie P.
Leray, Jean

Levi-Strauss, Claude
Lwoff, Andre
Malinvaud, Edmond
Serre, Jean-Pierre

Guatemala-1 Foreign Associate

Bressani, Ricardo

Hungary-3 Foreign Associates

Erdos, Paul
Farkas, Tibor
Szentagothai, Janos

India-2 Foreign Associates

Ramalingaswami, Vulimiri
Swaminathan, M. S.

Israel-5 Foreign Associates

Eisenstadt, Shmuel Noah
Katchalski-Katzir, Ephraim
Ne'eman, Yuval
Rabin, Michael O.
Sela, Michael

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Abdus Salam
Amaldi, Edoardo
Cabibbo, Nicola
Occhialini, Giuseppe

Japan-13 Foreign Associates

Fukui, Kenichi
Hayaishi, Osamu
Hayashi, Chushiro
Inose, Hiroshi
Kimura, Motoo
Kodaira, Kunihiko
Kubo, Ryogo
Kushiro, Ikuo
Nagata, Takesi
Nishizuka, Yasutomi
Sugimura, Takashi
Tomita, Tsuneo
Uyeda, Seiya

Kenya-1 Foreign Associate

Leakey, Mary D.

Mexico-3 Foreign Associates

Bernal, Ignacio
Peimbert, Manuel
Rosenblueth, Emilio

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Casimir, H. B. G.
Duysens, Louis N. M.
't Hooft, G.
Oort, Jan
Tinbergen, J.
van de Hulst, Hendrik C.

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Philippines-1 Foreign Associate

Khush, Gurdev S.

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Tobias, Phillip V.

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Garcia-Bellido, A.
Margalef, Ramon

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Bergstrom, Sune
Frankenhaeuser, Marianne
Granit, Ragnar
Hokfelt, Tomas
Hormander, Lars
Klein, George
Luft, Rolf
Mutt, Viktor
Reichard, Peter A.
Samuelsson, Bengt
Siegbahn, Kai
Waldenstrom, Jan G.

Switzerland-22 Foreign Associates

Arber, Werner
Boserup, Ester
Charpak, Georges
Dunitz, Jack D.
Eccles, Sir John
Eschenmoser, Albert J.
Frey-Wyssling, A.
Gansser, A.
Gehring, Walter J.
Geiss, Johannes
Hsu, Kenneth J.
Jost, Res
Muller, K. Alex
Prelog, V.
Ramsay, John G.
Reichstein, Tadeus
Rohrer, Heinrich
Schatz, Gottfried
Truempy, D. Rudolf
Van Hove, Leon
Weibel, Ewald R.
Weissmann, Charles

United Kingdom-62 Foreign Associates

Atiyah, Michael F.
Auerbach, Charlotte
Bates, Sir David
Bell, Ronald P.
Bodmer, Sir Walter
Brass, W.
Brenner, Sydney
Broadbent, Donald E.
Burgen, Sir Arnold S. V.
Clark, J. G. D.
Cornforth, Sir John
Cottrell, Sir Alan
Cox, Sir David R.
Dahrendorf, Ralf
Frank, Sir Charles
Gowans, Sir James
Gurdon, John Bertrand
Hahn, Frank H.
Harper, John L.
Heslop-Harrison, J.
Hill, Robin
Hinde, Robert A.
Hodgkin, Sir Alan
Hodgkin, Dorothy
Hoyle, Sir Fred
Huxley, Sir Andrew F.
Iversen, L. L.
Katz, Sir Bernard
Kendrew, Sir John
Klug, Aaron
Kornberg, Sir Hans
Kosterlitz, Hans W.
Lord Lewis of Newnham
Lighthill, Sir M. James
Longuet-Higgins, H. C.
Longuet-Higgins, Michael S.
Lyon, Mary F.
McKenzie, Dan P.
McMichael, Sir John
Meade, James
Milstein, Cesar
Mitchell, Peter
Mott, Sir Nevill
Needham, Joseph
Peierls, Sir Rudolf
Penney, W. G.
Perutz, Max F.
Phillips, Sir David
Pontecorvo, G.
Popper, Sir Karl
Porter, Sir George
Rees, Martin J.
Riley, Sir Ralph
Sanger, Frederick
Seaton, Michael John
Smith, John Maynard
Southwood, Sir Richard
Lord Todd of Trumpington
Vane, Sir John R.
Wigglesworth, Sir Vincent
Wilkes, Maurice V.
Wilkinson, Sir Geoffrey

U.S.S.R.-15 Foreign Associates

Ambartsumian, V.
Arnold, Vladimir I.
Bogolubov, Nikolai N.
Cherenkov, Pavel A.
Dubinin, N. P.
Gelfand, I. M.
Ginzburg, Vitaly L.
Keilis-Borok, V. I.
Krein, Mark G.
Monin, Andrei S.
Sagdeev, Roald Z.
Sakharov, Andrei
Shafarevich, Igor R.
Sokolov, Eugene N.
Takhtajan, Armen

USA-28 Foreign Associates

Alfven, Hannes
Bartlett, Neil
Barton, D. H. R.

Cavalli-Sforza, L. L.
Clark, J. Desmond
Cousteau, Jacques-Yves
Cowan, W. Maxwell
Crick, Francis
Esaki, Leo
Fisher, Michael E.
Hanafusa, Hidesaburo
Harris, Harry
Hawthorne, William R.
Huxley, Hugh E.
Ishizaka, Kimishige
Knowles, Jeremy
Lal, Devendra
Mandelbrot, Benoit B.
Miledi, Ricardo
Paczynski, Bohdan
Peebles, Philip J.
Pople, John A.
Rubbia, Carlo
Schmidt, Maarten
Tonegawa, Susumu
Tversky, Amos
Weil, Andre
Wyllie, Peter J.

Many will be in audience

NAS MEMBERS AND THE NOBEL PRIZE AWARDS

PHYSICS

1936	Carl D. Anderson
1952	E. M. Purcell
1955	P. Kusch and Willis E. Lamb, Jr.
1956	John Bardeen and William Shockley
1957	Chen Ning Yang and Tsung-Dao Lee
1959	Owen Chamberlain and Emilio Segré
1960	Donald A. Glaser
1961	Robert Hofstadter
1963	Eugene Wigner
1964	Charles H. Townes
1965	Julian Schwinger
1967	H. A. Bethe
1969	Murray Gell-Mann
1972	J. Robert Schriefer, Leon N Cooper and John Bardeen
1973	Ivar Giaever
1976	Burton Richter and Samuel C. C. Ting
1977	Philip W. Anderson
1978	R. W. Wilson and Arno A. Penzias
1979	Steven Weinberg and Sheldon Lee Glashow
1980	James W. Cronin and Val L. Fitch
1981	Nicolaas Bloembergen
1982	Kenneth G. Wilson
1983	S. Chandrasekhar and William S. Fowler
1988	Leon M. Lederman
1989	Norman F. Ramsey and Hans G. Dehmelt

CHEMISTRY

1951	Edwin M. McMillian and Glenn T. Seaborg
1954	Linus Pauling
1961	Melvin Calvin
1972	C. B. Anfinsen
1976	William N. Lipscomb
1979	Herbert C. Brown
1980	Paul Berg and Walter Gilbert
1981	Roald Hoffmann
1983	Henry Taube
1984	Bruce Merrifield
1985	Herbert Hauptman and Jerome Karle
1986	Yuan T. Lee and Dudley Herschbach
1987	Donald J. Cram
1989	Thomas R. Cech

PHYSIOLOGY OR MEDICINE

1954	Frederick C. Robbins and Thomas Weller
1958	George Beadle and Joshua Lederberg
1959	Arthur Kornberg and Severo Ochoa
1964	Konrad E. Bloch
1966	Charles Huggins
1967	George Wald
1968	Robert W. Holley, H. Gobind Khorana and Marshall Warren Nirenberg
1969	A. D. Hershey and S. E. Luria
1970	Julius Axelrod
1972	Gerald M. Edelman
1974	George E. Palade
1975	David Baltimore, Howard W. Temin and Renato Dulbecco
1976	Baruch S. Blumberg and D. Carleton Gajdusek
1977	Roger Guillemin, Andrew V. Schally and Rosalyn S. Yalow
1978	Daniel Nathans and Hamilton O. Smith
1979	A. M. Comack
1980	Baruj Benacerraf and George Snell
1981	David H. Hubel, Roger W. Sperry and Torsten Wiesel
1983	Barbara McClintock
1985	Michael S. Brown and Joseph L. Goldstein
1986	Stanley Cohen and Rita Levi-Montalcini
1989	J. Michael Bishop

ECONOMICS

1970	Paul A. Samuelson
1972	Kenneth J. Arrow
1973	Wassily Leontief
1976	Milton Friedman
1978	Herbert A. Simon
1979	Theodore W. Schultz
1980	Lawrence Klein
1981	James Tobin
1982	George J. Stigler
1983	Gerard Debreu
1985	Franco Modigliani
1987	Robert M. Solow

PEACE

1963	Linus Pauling
1970	Norman Borlaug