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CHRISTOPHER CERF

VICTOR NAVASKY

The Experts Speak

The Definitive Compendium of Authoritative Misinformation

RESEARCH DIRECTOR: CHRISTOPHER POWER

A JOINT PROJECT OF THE NATION MAGAZINE
AND THE INSTITUTE OF EXPERTOLOGY

PANTHEON BOOKS, NEW YORK

Inventions: The Triumph of Technology

"Everything that can be invented has been invented."[1]

—*Charles H. Duell*
(Commissioner of U.S. Office of Patents),
urging President William McKinley to abolish his office, 1899

The Electric Light

"[W]hen the Paris Exhibition closes electric light will close with it and no more will be heard of it."[2]

—*Erasmus Wilson*
(professor at Oxford University), 1878

"[Edison's ideas are] good enough for our transatlantic friends . . . but unworthy of the attention of practical or scientific men."[3]

—*Report of a committee set up by the British Parliament to look into Edison's work on the incandescent lamp, c. 1878*

"How can he [Thomas Alva Edison] call it a wonderful success when everyone acquainted with the subject will recognize it as a conspicuous failure?"[4]

—*Henry Morton*
(Professor of Physics and President of the Stevens Institute of Technology),
commenting on Edison's electric light bulb, December 28, 1879

speech could be replaced

ıvention a fake, and attributed

."[6]

, to see if he was not
ter we left the room that

"[I am] not satisfied . . . that under any rate of postage that could be adopted, its revenues could be made equal to its expenditures."[8]

—*U.S. Postmaster General,*
rejecting an offer by Samuel Morse to
sell the rights to his telegraph to the U.S. government
for $100,000,
c. 1845

"I do not look upon any system of wireless telegraphy as a serious competitor with our cables. Some years ago I said the same thing and nothing has since occurred to alter my views."[9]

—*Sir John Wolfe-Barry*
(Chief Executive of Western Telegraph Company),
annual stockholders' meeting,
1907

The Telephone

"Well-informed people know it is impossible to transmit the voice over wires and that were it possible to do so, the thing would be of no practical value."[10]

—*Editorial in the Boston* Post,
commenting on the arrest for fraud of
Joshua Coopersmith (who had been
attempting to raise funds for work on a telephone),
1865

"Only a toy."[11]

—*Gardiner Greene Hubbard*
(Boston lawyer),
assessing the telephone invented by his
prospective son-in-law, Alexander Graham Bell,
and urging him to devote his time
to other pursuits,
1876

t to use one of them?"[12]

ton and Philadelphia,

later, offered to sell it to the
was not interested.

l Society),

phone apparatus that the

gnature that it would be
atic before many years.
atements, the misguided
company."[15]

"The radio craze . . . will die out in time."[16]

—*Thomas Alva Edison*
(American scientist and inventor),
1922

"I am reported to be 'pessimistic' about broadcasting. . . . [T]he truth is that I have anticipated its complete disappearance—confident that the unfortunate people, who must now subdue themselves to 'listening-in,' will soon find a better pastime for their leisure."[17]

—*H. G. Wells*
(British writer and historian),
The Way the World Is Going,
1928

PICTURES ON THE WIRELESS: THE "TELEVISION BUBBLE"

"For God's sake go down to reception and get rid of a lunatic who's down there. He says he's got a machine for seeing by wireless! Watch him—he may have a razor on him."[18]

—*Editor of the* Daily Express, *London*,
refusing to see John Logie Baird
(the inventor of television),
1925

"While theoretically and technically television may be feasible, commercially and financially I consider it an impossibility, a development of which we need waste little time dreaming."[19]

—*Lee DeForest*
(American radio pioneer and
inventor of the audion tube),
quoted in The New York Times,
1926

"Television won't matter in your lifetime or mine."[20]

—*Rex Lambert*,
Editorial in The Listener,
1936

Reaches for
: Cosmos:
ketry and
Exploration

Propulsion in a Vacuum?

Professor of Physics at Clark College in Worcester, he had developed in the course of conducting solid- y the Smithsonian Institution. Among the suggestions ared to launch one of his creations from a site on his uld be used to power vehicles at altitudes above the

"That Professor Goddard with his 'chair' at Clark College and the countenancing of the Smithsonian Institution does not know the relation of action and reaction, and the need to have something better than a vacuum against which to react—to say that would be absurd. Of course, he only seems to lack the knowledge ladled out daily in high schools."[1]

—New York Times *editorial,*
1921

"[T]oo far-fetched to be considered."[2]

—*Editors of* Scientific American,
letter to Professor Robert Goddard (dismissing his idea for a rocket-accelerated airplane bomb), 1940

"[T]he Air Corps . . . does not, at this time, feel justified in obligating . . . funds for basic jet propulsion research and experimentation."[3]

—*Brigadier General George H. Brett*
(Chief of Material of U.S. Army Air Corps), letter to Professor Robert Goddard (rejecting his rocket research proposals), 1941

✍ In the meantime, the German military forces were paying close attention to Goddard's writings. The V-1 and V-2 rockets that rained down on Britain during World War II were directly inspired, German scientists later acknowledged, by Goddard's work.

The Myth of Space Travel

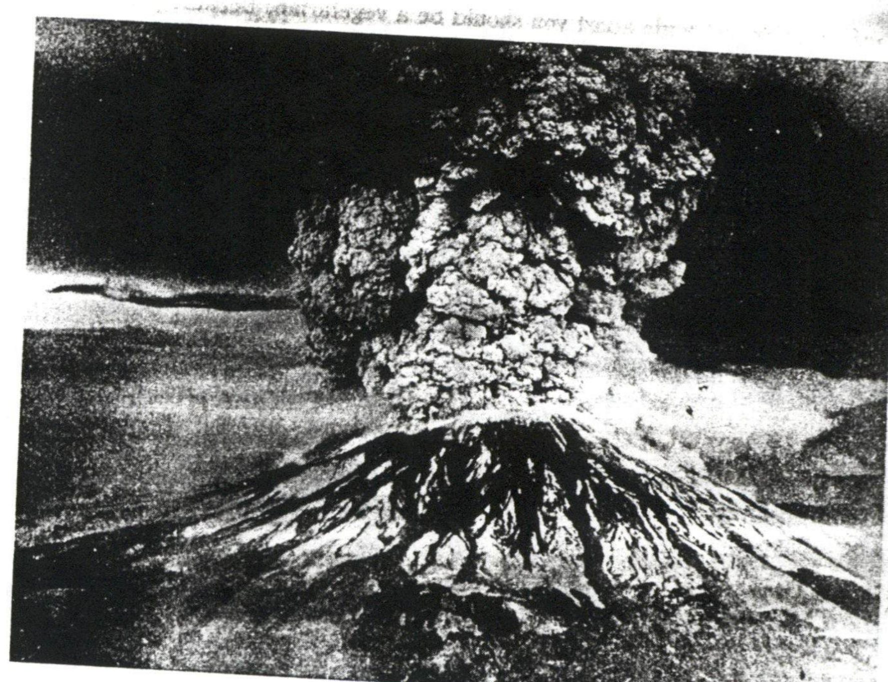
"The whole procedure [of shooting rockets into space] . . . presents difficulties of so fundamental a nature, that we are forced to dismiss the notion as essentially impracticable, in spite of the author's insistent appeal to put aside prejudice and to recollect the supposed impossibility of heavier-than-air flight before it was actually accomplished."[4]

—*Richard van der Riet Wooley*
(British astronomer), reviewing P. E. Cleator's
Rockets in Space, Nature, *March 14, 1936*

Part II: Old Harry Gives 'Em Hell

"No one knows more about this mountain [Mount St. Helens] than Harry. And it don't dare blow up on him. This goddamned mountain won't blow."[38]

—*Harry Truman*
(83-year-old owner of a lodge near Washington State's Mount St. Helens), commenting on predictions that the long-dormant volcano was about to erupt, 1980



A few days later, Mount St. Helens erupted, killing, among others, Harry Truman and his sixteen cats.

X-RAYS

"X-rays are a hoax."[39]

—*Lord Kelvin*
(British physicist and former President of the British Royal Society), ca. 1900

(Smith/Blessey)
Draft Three
October 13, 1989
TECH

PRESIDENTIAL REMARKS: SCIENCE & TECHNOLOGY
THE EAST ROOM
WEDNESDAY, OCTOBER 18, 1989

Let me welcome you to the White House. And on behalf of each American, thank you for your magnificent efforts on behalf of this Nation and the world.

It is indeed an honor to address this singularly diverse and distinguished group of Americans. And to present America's highest honor in the areas of science and technology: The National Medal of Science and the National Medal of Technology.

Three decades ago the National Medal of Science was created by Congress. Its purpose was to recognize individuals for their "outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences."

Then, nine years ago, the National Medal of Technology was established. Its purpose was to "recognize scientists and engineers for projects that improve the well-being of the United States through the development or application of technology."

Over the past several decades, these contributions and projects have helped make America a richer, better place. New types of grain and fertilizers have spurred greater crop yields. Diagnostic technology has helped combat disease. Progress in biology and biotechnology has begun unmasking the secrets of heredity. And the work goes on -- through pioneers, like you.

For ours is a pioneering heritage -- from Eli Whitney to Lee De Forest to the Salk vaccine for polio. And this year's 27 recipients of the Science and Technology medals embody the best and brightest of that heritage -- Americans inspired by the belief that the trailblazers of today will be the heroes of tomorrow.

Think of Professor Richard Bernstein, whose work in molecular beams has helped shape modern chemistry. Or Professor Emeritus Katherine Esau, enriching the study of the botanical sciences. Or Jay Forrester and Robert Everett, helping technologies and computers enhance America's defense.

Since the 1940s, for instance, Robert Sharp has overcome physical and logistical barriers to illumine our knowledge of planetary surfaces. He's climbed glaciers, and felt permafrost -- dared mountains and ravines. Like each of you, he has shown that progress often comes neither quickly nor cheaply. It demands devotion and sacrifice. It knows adversity and pain. And like each of you, he knows that dreams realized make possible even bigger dreams.

Today, we celebrate those dreams -- dreams that you are making possible. And I only wish I had time to mention each recipient. For all of your dreams will keep America competitive. Dreams that will raise our standard of living -- and, moreover, our quality of life. They are dreams that presage a new Golden Age of information, understanding, and technology. Dreams that show how creativity comes from the human heart and mind.

In closing, then, let me first salute your achievements and your commitment. Many of you have been teachers. Some have served in government. All have shown that America has no natural resource more precious than her intellectual resources.

Next, let me promise you: Our Administration will do its part. We know that scientific knowledge must be renewed and expanded. And so we will continue the American tradition of strong, broad-based support for research and development in all areas of science and technology.

Our approach will be balanced, and fair: It includes both "large science and technology projects" as well as "small science principal investigator" funding.

In "large science and technology," look at the opportunities ahead: The Superconducting Super Collider and the Human Genome initiatives. Or Space Station Freedom, which will lead us toward the stars. And the "small science" potential is no less dazzling: We want to double the National Science Foundation budget over the next five years. And give our youth a special incentive to excel in science, mathematics, and engineering through our new program of National Science Scholars.

Ladies and gentlemen, these new initiatives -- this investment -- can help science and technology help America triumph in the future. Uplifting this generation. And inspiring generations to come. For you are America's true pioneers. Dreaming the dreams that enhance our energy and health, medicine and productivity, national security and education. The dreams that your remarkable deeds are helping to come true.

Again, my heart-felt congratulations on behalf of each and every citizen. And now it is my great pleasure to introduce my Advisor for Science and Technology, Allan Bromley, and my Secretary of Commerce, Bob Mosbacher, who will present you with America's highest technological and scientific achievement. But, you know, I like my end of the bargain. I get to shake your hands.

Thank you very much, God bless you, and God bless America.

# # # #

Richard B. Bernstein
Professor of Chemistry
Department of Chemistry & Biochemistry
University of California
Los Angeles, California

Citation: For his development and use of the technique of molecular beams, which has played a significant role in shaping the field of modern chemical dynamics.

Summary of Achievements

Richard Bernstein pioneered the field of molecular beam scattering in chemistry. His work has transformed the field of experimental gas-phase chemical kinetics from a largely phenomenological subject (involving measurements of rate constants vs. temperature) to a molecular-level science.

Among his most significant achievements was the development in 1965 of the technique for producing beams of oriented molecules, which led to the first measurements of the dependence of chemical reactivity upon the reagents' mutual orientation. The very measurability itself of the steric factor was unexpected and represents a conceptual advance in chemistry.

He was the first to observe atom-atom diffraction scattering (using a velocity-selected lithium beam) and to work out the applicable quantal and semiclassical scattering theory in 1960. Out of this came his prediction in 1961 of the glory undulations in the velocity dependence of the total cross section and in 1962 the relation between the glories (and rainbows), the interactive potential energy well, and the bound states of the system.

He introduced the technique of velocity analysis for the study of inelastic and reactive molecular scattering. His 1965 experiments on velocity analysis of products of reaction employing a velocity-selected reagent led to the first measurements of the detailed differential reactive cross sections of chemical reactions, culminating in 1971 with the first measurements of the collision energy dependence of same.

In 1966 he developed the phenomenology of resonances in atom-atom and atom-molecule scattering, which led to the so-called resonance theory of thermolecular reactions with Charles Curtiss in 1968. In 1970, he and Robert LeRoy devised the near-dissociation limiting approximation for diatomics and introduced the now standard extrapolation method for dissociation energies.

In 1969, he and John Polanyi, who received the 1986 Nobel Prize in Chemistry, applied microscopic reversibility to state-to-state reaction cross sections to quantify state-selectivity in laser-induced chemistry. In 1972, he and Raphael Levine introduced the information-theoretic approach to molecular collisions (considering the selectivity of energy consumption and the specificity of energy disposal in elementary reactions), including the now widely used method of surprisal analysis. In 1971, he reported the first study of the translational energy dependence of a total reaction cross section. In 1975 he made the first direct observation of the influence of reagent rotational energy upon reactivity, and of the relative efficacy of reagents' rotational vs. translational energy in promoting reaction. In 1976 he reported the first measurement of the intrinsic activation barrier from the translational energy threshold of a reaction cross section. In 1978 he introduced multiphoton ionization mass spectrometry for state-selective molecular beam detection. Using laser techniques, Bernstein returned to the study of oriented molecule reactions with a series of definitive experimental papers in 1981 and 1982 which showed directly the dependence of the reaction probability upon the angle of attack of the reagent.

In summary, Bernstein has been a pioneer in molecular beam chemistry and has played a significant role in the shaping of modern chemical dynamics.

Melvin Calvin
University Professor of Chemistry
Department of Chemistry
University of California
Berkeley, California

Citation: For his pioneering studies in the mechanism of photosynthesis and bioenergetics, and for the application of scientific theory toward the solution of the most fundamental problems of the age--energy, food, chemical and viral carcinogenesis, and the origin of life.

Summary of Achievements

Melvin Calvin is in the very first rank of contemporary American scientists. For his outstanding research into the mechanisms of green-plant photosynthesis he was awarded the Nobel Prize in Chemistry in 1961. Since that time he has maintained his stature as a brilliant and innovative research scientist.

In 1945, Professor Calvin started his pioneering research to exploit newly available isotope of carbon, ^{14}C. Calvin recognized ^{14}C's tremendous potential as a tracer in biological and chemical investigations. He organized an effective laboratory team that undertook the necessary syntheses and the tracer investigations. Calvin's skill as a research director, as well as a chemist, soon became very evident. Within a year after its formation, his "Bioorganic Chemistry Group" became the world's source of ^{14}C-labeled organic compounds. The group learned to handle, with high efficiency, extremely small amounts of organic compounds. Along with preparing dozens of key ^{14}C-labeled "tracer" compounds, the Calvin group began numerous tracer studies that greatly increased understanding of many biological mechanisms. These investigations contributed unique insight into such diverse matters as the molecular mechanisms involved in carcinogenesis and other disease states, food utilization, nutritional deficiencies, and green-plant photosynthesis.

Before Calvin's group began its studies on photosynthesis in the late 1940's, little was known of the molecular mechanisms by which living plants transform the CO_2 of the air and the bicarbonate in water into the major plant constituents and products (proteins, carbohydrates, fats, porphyrins, etc.). Carbon-fourteen labeled carbon dioxide, or $^{14}CO_2$, was the ideal tool for these investigations. The Calvin group administered the $^{14}CO_2$ to growing plants, isolated and identified dozens of labeled intermediates, and finally worked out all the major details of "The Path of Carbon in Photosynthesis." This was the title of a monograph on the subject that Calvin coauthored, with J. A. Bassham, in 1957. It was followed by "The Photosynthesis of Carbon Compounds" that Calvin published, with the same coauthor, in 1962.

It is notably characteristic of Calvin that his scientific interests and capabilities are very broad. Early in his studies he also directed his attention to the photophysics of the photosynthesis process. He began, in the mid-1950's, and using the most advanced physical techniques then available, to investigate the absorption of photons by the green plant's chlorophyll, and the ultimate conversion of the light's energy into the stored, chemical energy of the plant's products. His laboratory was one of the first to show the appearance of free radicals, or unpaired electrons, when light impinges on the plant's photoreceptors. This work, sparked by Calvin's constant direction and inspiration, has continued to the present time in his laboratory. It is certainly fair to say that no laboratory in the world has advanced the knowledge of photosynthesis as much as has Calvin's. It is equally fair to say that the most important ingredient in that advancement has been Calvin's day-by-day, and inspirational, direction.

Another example of Calvin's broad scientific capability is in his leadership in that area of science called "chemical evolution," a term that he himself introduced in 1953. His work in photosynthesis led him to speculate about the kind of chemistry that must have taken place on the very early, prebiotic Earth in order that living cells might finally appear. It is probable that these cells were autotrophs similar to the blue-green algae with which Calvin did most of his photosynthesis research. The question Calvin set to work on was this: How did the proteins, the nucleic acids, the porphyrin, etc., accumulate on the prebiotic Earth? Having set to work on this problem, Calvin quickly established his laboratory in this, as in all his researches, as a world leader. The great progress that was made in the understanding of the Earth's probable "prebiotic" chemistry, and the inspiration that his work has provided to many other laboratories, are evident in Calvin's book, Chemical Evolution, published in 1969.

In 1963, the new Laboratory of Chemical Biodynamics was established on the University of California campus in Berkeley; this Laboratory derived from his leadership and he served as its Director until his retirement in 1980 when it was renamed the Calvin Laboratory. The Laboratory under his direction has made important contributions to problems of chemical carcinogenesis. The photosynthesis research in this laboratory has also led directly into research on additional methods for the direct conversion of solar energy into electricity. His Laboratory is also searching for additional plants (of which rubber- and sugar-producing plants are examples) that might be available for economic exploitation. At the same time, the principles of photochemistry learned from green plants are being used to develop artificial systems capable of using light to produce stored chemical energy.

Harry G. Drickamer
Professor of Chemical Engineering, Chemistry & Physics
Department of Chemical Engineering
University of Illinois
Urbana, Illinois

Citation: For his discovery of the "pressure tuning" of electronic energy levels as a way to obtain new and unique information on the electronic structure of solids.

Summary of Achievements

Harry Drickamer is the recognized world leader in the field concerned with the influence of high pressure on the electronic structure of condensed matter systems. His fundamental discovery is that pressure perturbs different kinds of electronic orbitals to different degrees. The resultant "pressure tuning" of electronic energy levels has two major consequences: (1) Electronic transitions to new ground states, with very different and often unanticipated physical and chemical properties, can occur in a wide variety of materials, and (2) Theories concerning physical or chemical phenomena can be tested in unique and unequivocal ways using pressure as a variable.

With regard to electronic transitions, Drickamer's work has demonstrated that such transitions can have striking effects on the electrical, magnetic, or chemical properties of matter. In the case of electrical properties, the studies of insulator-conductor transitions have uncovered some dramatic effects and have stimulated the interests of many other workers in the field. Thus, his work has shown that iodine becomes a metal under high pressure. The studies on iodine included measurements of the optical absorption edge, in addition to determinations of electrical resistance and of the temperature coefficient of resistance under pressure. His work has also demonstrated that heavy alkali metals such as rubidium and cesium become transition metals under high pressure while the metals calcium and strontium become semiconductors. With regard to magnetic studies, his experiments employing Mossbauer spectroscopy under high pressure have disclosed transitions from a high spin state to a low spin state in a number of iron compounds. He has also demonstrated that transitions from a paramagnetic to a ferromagnetic state occur in FeO and in Pd-Co alloys under high pressure, while the reverse occurs in metallic iron as the metal changes from a bcc to an hcp structure. These transitions have important geophysical implications. In the case of electronic transitions with chemical consequences, Drickamer has shown that high pressure tends to stabilize the excited state of electron donor-acceptor complexes.

The work of Drickamer has been crucial in providing critical tests of theories, e.g., Mulliken's theory of donor-acceptor complexes. High pressure experiments performed in his laboratory also provided the earliest test of ligand-field theory, which plays such an important role in inorganic chemistry. Other important contributions in the testing of theories include the use of pressure to observe the types of transitions from high spin to low spin states which were predicted by van Vleck for transition metal ions in crystals and complexes. Still another is the demonstration of the validity of the Forster-Dexter theory of energy transfer in phosphors.

The impact of Drickamer's research is very broad. It has impinged significantly on fields ranging from solid state and chemical physics to physical, inorganic, and organic chemistry, as well as on geochemistry, geophysics, biochemistry, and biophysics. The research has contributed to scientific understanding in such diverse areas as the band structure of solids, insulator-conductor transitions, spin states of magnetic ions, reactivity in the solid state, the mechanism of radiant and non-radiant energy transfer, the composition of the interior of the earth, and denaturation processes in proteins. It has relevance for such technological processes as the design of semiconductor devices, the improvement of phosphor efficiency, the elucidation of some aspects of the photographic process, and the design of practical energy recovery systems.

Katherine Esau
Professor of Botany, Emeritus
Department of Biological Sciences
University of California
Santa Barbara, California

Citation: For her distinguished achievements in and contributions to the advancement of the botanical sciences; for furthering the understanding of the structure and development of plant food-conducting tissue; and for elucidating the virus-plant host relationship.

Summary of Achievements

Katherine Esau has had a greater impact on the development of the field of plant anatomy than any other botanist during this century.

Her initial employment in the U.S. was with the Sloan Seed Company in Oxnard, CA. She then moved to the Spreckels Sugar Company in the Salinas Valley to work on the problem of breeding strains of sugar beets resistant to the virus causing curly-top disease.

In 1928, Dr. Esau enrolled in the College of Agriculture at Davis, where she investigated the transmission of the curly-top disease and its effects on the phloem (food-conducting tissue), in which the virus is spread throughout the plant. She obtained her Ph.D. from Davis in 1931 and remained there to become a professor. Little information was available on phloem at the time so that her investigations were immediately of great significance.

Throughout her career, Dr. Esau has continued research on phloem both in relation to the effects of the phloem-limited viruses upon plant structure and development and to the unique structure of the sieve element as a conduit of food. Very early Dr. Esau demonstrated an exceptional ability for attacking basic problems. Her papers are notable for textual clarity and illustrational excellence. Almost immediately she set new standards of excellence for the investigation of anatomical problems in the plant sciences. Her studies on structure have always been accompanied by developmental studies, as she emphasized the necessity of knowing the ontogeny of a cell, tissue, or plant part in order to understand its mature condition.

In 1953, Dr. Esau's enduring classic, Plant Anatomy--known world-wide as the "Bible" of plant anatomy--was published. This was followed by Anatomy of Seed Plants in 1960. Both of these books have been published in several languages, including Russian, and have extended her influence on the quality of instruction of plant anatomy into classrooms all over the world. The developmental aspect of her studies matured into _Vascular Differentiation in Plants_ (1965), and her interest in virus-plant host relations into _Plants, Viruses, and Insects_ (1961) and _Viruses in Plant Hosts_ (1968).

Dr. Esau's distinguished career has been recognized by her election to the National Academy of Sciences, the American Academy of Arts and Sciences, and the American Philosophical Society. This remarkable woman continues to be actively engaged in research and currently is working on the third edition of _Plant Anatomy_.

Herbert E. Grier
Director, CER Corporation
2223 Avenida de la Playa
La Jolla, California

Citation: For his many pioneering scientific contributions and his leadership role in ultra-high-speed electronic stroboscopy, electro-optic innovations, national defense, and aerospace sciences.

Summary of Achievements

Herbert Grier joined in formal partnership with Dr. Harold E. Edgerton and Kenneth J. Germeshausen, and played a major role in the unprecedented work accomplished by the partnership in ultra-high-speed photography and development of the then unique stroboscopic and flashlighting techniques. This work, shortly before World War II, led to an M.I.T. project dealing with the improvement of aiming techniques for aircraft armament, as well as the use of electronic flash photography for night aerial reconnaissance which was employed effectively by the Army and Air Force.

Grier later became involved in atomic weapons research for the Manhattan Engineering District and its successor, the Atomic Energy Commission. The partners incorporated to form Edgerton, Germeshausen & Grier, Inc. in 1947. Grier was EG&G's first President and has been a significant force in its rise toward national prominence for over 30 years.

He came to Las Vegas in 1953 to direct a group of EG&G scientists assigned by the Atomic Energy Commission to support its nuclear test operations at the Nevada Test Site. Since then, the company has designed, built and operated the equipment that has armed, timed, fired, photographed and acquired performance data on almost every nuclear test blast in Nevada and the Pacific. They also provided instrumentation and photographic support for nuclear rocket test activities. Grier was President and Chairman of the Board of Reynolds Electrical & Engineering Co. Inc., the prime support services contractor at the Atomic Energy Commission's Nevada Test Site from 1969 until 1971.

Until his retirement in 1976, Grier was also President and a co-founder of CER Geonuclear Corporation. CER was formed in March 1965 by Continental Oil Company, EG&G, Inc., and several other companies. CER's principal endeavors have been concerned with the development and implementation of methods of using the power of nuclear explosives in commercial applications, with primary emphasis on improving methods for the extraction of underground natural resources. Subsequently named CER Corporation, the company is now involved in oil and gas research and technology, offering broad-based consulting services and computing software.

Herbert Grier has devoted his talents and abilities to the development of science and technology of significant value and importance to our nation. His outstanding and original contributions in ultra-high-speed synchronous detection and measurement techniques are responsible for many major breakthroughs in various branches of physical and engineering sciences over the past five decades.

Viktor Hamburger
Professor Emeritus
Department of Biology
Washington University
St. Louis, Missouri

Citation: For his steadfast work which led to the discovery and understanding of normally occurring neuronal death, nerve growth factor, and competitive relationships in the vertebrate nervous system.

Summary of Achievements

Viktor Hamburger's research has proceeded along four different but related lines of inquiry. The first of these, fundamental to the other three, has been his now classical studies of the normal development of the chick embryo. Largely because of Hamburger's work, the chick embryo has become the standard preparation for vertebrate neuroembryology. His paper with H. Hamilton in 1951, which summarizes the major developmental landmarks of the chick, is one of the most cited papers in the biological literature.

The second avenue of Hamburger's work, and perhaps the most important, has concerned the elucidation of neuronal death in normal embryonic development. Using the chick embryo, Hamburger showed that a major feature of normal neuronal development in sensory ganglia and spinal cord is the degeneration of a substantial fraction (on the order of 50%) of the nerve cells present at early stages of embryonic life. This finding, which has since been widely confirmed in other systems, solved an observation that puzzled embryologists in the 1930's and 1940's. A number of investigators had noted that removal of a peripheral target -- the limb bud in a tadpole or a chick embryo, for example -- resulted in developmental failure of the related nerve centers. Hamburger and R. Levi-Montalcini showed that this phenomenon is due to a modulation of normally occurring cell death in the neural centers dictated by the peripheral target. These studies on normal neuronal death in the chick embryo form the basis for present day thinking about competitive processes in the development of the nervous system.

The third line of Hamburger's research concerns the molecular basis for the interaction between nerve cells and the targets they innervate. His work with R. Levi-Montalcini and S. Cohen in the late 1940's and early 1950's led to the discovery of the protein nerve growth factor. Since the early 1950's, work in laboratories around the world has characterized the nerve growth factor molecule, and established a deep understanding of the biological significance of this agent.
The final line of Hamburger's research concerns the development of early behavior. Using his knowledge of the normal development of the chick embryo, Hamburger explored the earliest stages of

embryonic behavior in a series of experiments carried out in the 1960's. He showed that, contrary to the view widely held at that time, the earliest behavioral responses of embryos are not reflexly induced, but occur spontaneously. More importantly, he showed that the neural circuits which control limb movements arise intrinsically at very early embryonic stages.

The significance of these contributions is profound. To a considerable extent, Hamburger's research has determined the course of developmental neuroembryology in this century. The fundamental importance of neuronal death and trophic interactions in normal development is now a part of every student's working knowledge. Moreover, the concept of neuronal competition that arose from Hamburger's observations is at the center of a great deal of contemporary neuroembryological thought and work. Hamburger's crucial role in the discovery of nerve growth factor has also been widely recognized, although much of the credit has gone to his collaborators, R. Levi-Montalcini and S. Cohen, who received the 1986 Nobel Prize in Physiology or Medicine for this work. Had it not been for Hamburger, this story of nerve growth factor would not have come to light.

Samuel Karlin
Professor of Mathematics
Department of Mathematics
Stanford University
Stanford, California

Citation: For his broad and remarkable researches in mathematical analysis, probability theory and mathematical statistics, and in the application of these ideas to mathematical economics, mechanics, and population genetics.

Summary of Achievements

Samuel Karlin has made great advances in pure and applied mathematics. In pure mathematics, Karlin made basic contributions to various areas in real and functional analysis, approximation theory, the theory of inequalities and convexity. His work was of great importance in the development of the theory of total positivity, which has in turn been used extensively in researches on integral and differential operators, probability theory, mathematical statistics, and important classes of random processes. Even more, he has carried out extensive researches in applied mathematics, in game theory, mathematical economics and, since 1962, in theoretical population genetics.

In the 1950's, he collaborated with K. Arrow and H. Scarf in a series of pioneering papers that appeared in their book, Studies in the Mathematical Theory of Inventory and Production (1958). The work gave important insights into a significant class of dynamic and convex programming problems motivated by economic questions.

In the mid-1950's, Karlin formulated, refined and applied the concept of total positivity. Totally positive transforms play an important role in many problems on convexity, moment spaces, eigenvalues of integral operators, oscillation properties of solutions of linear differential equations, and the theory of approximation. Total positivity is also important in assaying optimal policy for inventory and production models, in the analysis of birth and death and diffusion random processes, as well as in the study of coupled mechanical systems.

In the early 1960's, Karlin initiated a joint research program in mathematical genetics with a number of population geneticists at Stanford. Earlier in population genetics there was principally concern with breeding problems of one-locus, two allele traits. Karlin applied the theory of total positivity to clines. He extended concepts for simple models to more complex genetic systems (multi-locus, multi-allele, multi-deme). He also constructed models that were the first to allow realistically for complex interactions of genetic mechanisms and population structure parameters. In the past few years Karlin has been concerned with the problem of classifying patterns and relationships within and between multiple letter sequences. Distinguishing non-random sequence patterns from chance configurations is clearly important for comparing DNA and protein sequences. Statistical significance can be assessed by using permutation procedures and by comparisons with theoretical random models. Powerful, explicit results have been obtained on the asymptotic distributional properties of long matching blocks within and between sequences.

Karlin has had almost 50 doctoral students in the areas of probability theory, mathematical statistics, operations research, approximation theory, as well as mathematical genetics and epidemiology. Many of these students are well known for their researches. In this way, Karlin has also helped contribute to the research potential of the United States.

Philip Leder
Professor & Chairman
Department of Genetics
Harvard Medical School
Boston, Massachusetts

Citation: For his innovative studies that have significantly advanced knowledge and provided new directions for research in molecular genetics, immunology and cancer etiology.

Summary of Achievements

Philip Leder is one of the leading biomedical scientists in the United States today. He has made seminal discoveries in a remarkably wide area of research, including molecular genetics, immunology, recombinant DNA technology and cancer, which have contributed greatly to the present understanding and future research direction in these fields.

In molecular genetics, Dr. Leder's early studies with Marshall Nirenberg played an important role in the elucidation of the genetic code, one of the major accomplishments of modern science. Simultaneously with other investigators, he discovered the interrupted nature of mammalian genes, and he elucidated the nature of exon assembly via RNA processing, leading to the discovery of processed "pseudogenes." Applying molecular genetics to immunology, Dr. Leder demonstrated the unique nature of immunoglobulin constant region genes, providing support to the somatic mutation model of antibody diversity. With others, he elucidated the genetic basis of somatic rearrangement of immunoglobulin genes. He demonstrated that immunoglobulin protein subunits are synthesized via a precursor and that immunoglobulin genes rearrange in a specified order. These and other discoveries played an important role in furthering our understanding of the genetic control of antibody production.

Dr. Leder's genetic studies have contributed significantly toward understanding the role of oncogenes in the etiology of cancer. With others he discovered the involvement of the c-myc oncogene in Burkitt lymphoma. He demonstrated that nuclear acting oncogenes are regulated by growth factors. He established the transgenic mouse paradigm for studying oncogene action, which he used to demonstrate the multi-hit nature of oncogenesis.

In the course of his genetic studies, Dr. Leder devised many new experimental techniques which have proved valuable in recombinant DNA technology. These contributions include the use of nitrocellulose filter binding assays, the enzymatic synthesis of triplet RNA codons, the use of oligo dT-cellulose for the purification of mRNA, the development of the P3 host vector system for gene cloning, and the first successful strategy for the cloning of mammalian genes.

From the foregoing examples, it is clear that Philip Leder is a highly creative scientist, establishing new research directions for others to follow. He is also an educational leader, serving as Chairman of an active new department at Harvard Medical School, as well as in responsible positions in the National Academy of Sciences and the Institute of Medicine. Though still relatively young, he has had, and will continue to have, important impact on the progress of biomedical science.

Joshua Lederberg
President
The Rockefeller University
New York, New York

Citation: For his work in bacterial genetics and immune cell single type antibody production; for his seminal research in artificial intelligence in biochemistry and medicine; and for his extensive advisory role in government, industry and international organizations which address themselves to the societal role of science.

Summary of Achievements

Joshua Lederberg has made enormous contributions in several areas of science, administration, and national government service. While still at Yale, Dr. Lederberg discovered, with Edward L. Tatum, the mechanism of genetic recombination in bacteria, for which he shared the Nobel Prize in Physiology or Medicine. This and his career-long work in bacterial genetics was a principal foundation for the contemporary mainstream of research and biotechnology involving gene manipulation in bacteria. In addition to his own research, he has forwarded the development of the U.S. biotechnology industry as a consultant to several corporations as early as the 1960's and early 1970's.

In 1957, while a visiting professor at Melbourne University, Lederberg and G. Nossal were the first to show that individual immune cells produced single types of antibodies, a finding which led directly to the development of the monoclonal antibodies which are of great contemporary importance in medical research and applications.

At Stanford, in addition to his genetics research, he also performed pioneering research in artificial intelligence in biochemistry and medicine. This research, with E. A. Feigenbaum, spawned one of the first expert systems (DENDRAL) which has been a prototype for practical applications of artificial intelligence, and of the Japanese "Fifth Generation" initiative.

Dr. Lederberg has been active on many government advisory committees and boards dealing with research on physical and mental health. He also was a member of the Advisory Committee for Medical Research of the World Health Organization, and is on the Board of Trustees of the Conservation Foundation, which is concerned with environmental health. In view of his long-standing interest in exobiology, Dr. Lederberg played an active role in the Mariner and Viking missions to Mars. He is a past member of the Board of the Center for Advanced Study in the Behavioral Sciences at Stanford. He is also chairman of the Board of Annual Reviews at Palo Alto, a cooperative non-profit scientific publisher, and serves on the boards of the Chemical Industry Institute for Toxicology in Research Triangle, N.C. and of the Institute for Scientific Information in Philadelphia.

His interest in improving communications among scientists, the general public, and government policymakers, has led Dr. Lederberg to write extensively for lay audiences, including a weekly syndicated column on the social impact of scientific progress entitled "Science and Man."

Robert P. Sharp
Professor of Geology, Emeritus
Division of Geological and
Planetary Sciences
California Institute of Technology
Pasadena, California

__Citation:__ For his research that has illuminated the nature and origin of the forms and formation processes of planetary surfaces and for teaching two generations of scientists and laymen to appreciate them; for his recruitment and leadership of a successful multidisciplinary department of earth and planetary scientists who have gained world recognition.

__Summary of Achievements__

Robert Sharp has made extraordinary contributions to U.S. science as a world recognized physical geologist focussed on the forms and processes of planetary surfaces, a nationally recognized science teacher, and a science administrator who organized a unique department repeatedly identified as the leader in earth sciences research both in the U.S. and abroad.

Versatile, energetic and disciplined, Sharp produced in 1940 a seminal study of ancient erosion surfaces of the Grand Canyon, which is still the most cited paper on the subject. Overcoming physical and logistical barriers, be became an expert on glaciers, permafrost and other Arctic environments in Alaska, so that in World War II he was able to contribute valuable engineering, route and survival information to the Army aviation program in Alaska. In 1948, with students at Caltech, he initiated an innovative program of observations and quantitative measurements of glacier forms and movements in Alaska and Washington, which was the foundation for a 1960 treatise on glaciers, since reprinted 17 times. Recent investigations of the dynamics of surging glaciers by his former students were built on this work. With geochemist colleague, Samuel Epstein, Sharp early used oxygen isotopes in glaciological research to interpret the sources and regimes of water in glaciers in North America, Greenland and Antarctica. In parallel with his glaciology studies, Sharp conducted investigations of the dynamic processes of wind erosion, transport and deposition in arid regions of the southwestern U.S. He provided critical genetic interpretations of desert landforms and their surfaces including domes, debris flows and desert varnish. They are now recognized as the leading efforts in that field. In 1968 he turned to other planetary surfaces and published a prescient assessment of surface processes operating on Mars. He participated in Mars Mariner, Viking Orbiter and Viking Lander observations, contributing his great experience to the interpretation of Martian forms, active surface processes, and polar caps. Altogether he has authored or coauthored more than 110 journal articles, three books, and many reviews.

He is an extraordinary teacher of science at all levels, to scientist and laymen alike. His introductory geology lectures at Caltech were repeatedly nominated as the best taught classes in the Institute. In 1950, he was selected as one of ten outstanding U.S. college teachers and featured in "Life" magazine. His graduate students are leaders in current glacial and planetary research. He contributed extensively to the geological training of Apollo astronauts. His field guides to the geology of California for laymen are widely used and his guided field trips throughout the western United States are always oversubscribed.

Throughout his career he has dedicated himself to raising the level of science and science education at Caltech, other American universities, and at the national level. These accomplishments were made while chairing the Division of Geological Sciences at Caltech. As division chairman he assembled a brilliant group of young geologists, physicists, chemists and planetary astronomers, which led his department to be recognized as the leading center for graduate research in frontier areas of the earth and planetary sciences in the country and perhaps the world. Seven of his young appointees are now members of the NAS. His emphasis on the synergism of integrated multidisciplinary attacks on research and his effectiveness in finding support and encouragement for talented young scientists has won him national recognition as a consultant on university earth science programs. He has, moreover, never failed to be a sage and effective servant of his institution and science when he has been called.

Saunders Mac Lane
Professor Emeritus
Department of Mathematics
University of Chicago
Chicago, Illinois

Citation: For revolutionizing the language and content of modern mathematics by creating and developing the fields of homological algebra and category theory, for outstanding contributions to undergraduate and graduate education in mathematics, and for incisive leadership of the mathematical and scientific community.

Summary of Achievements

Saunders Mac Lane has had a career without precedent in the history of American mathematics. By their invention of homological algbebra and category theory, he and his collaborators, especially Samuel Eilenberg, have forever changed the language and content of modern mathematics. Mac Lane has also pioneered in the development of many of the applications of homological algebra to topology and algebra, and he has initiated several of the areas of greatest interest in category theory.

Mathematical thought is limited by its means of expression. The clarity and beauty of the categorical language introduced by Eilenberg and Mac Lane have truly revolutionized the way people think mathematics. The new algebraic machinery of homological algebra has vastly extended the range and calculational power of such fields as algebraic topology and algebraic geometry. What is particularly striking is the philosophical depth and insight which Mac Lane has brought to mathematics. The new language of category theory, for example, was directly influenced by Mac Lane's reading of Kant. It is the perfect harmony and evident rightness of the new categorical and homological language that has led it to be adopted without change by mathematicians throughout the world. There are literally thousands of papers that have been written over the past 45 years that could not possibly have been conceived without the visionary foundational work of Mac Lane and his collaborators.

Mac Lane has also been an exceedingly influential educator. The textbooks he wrote in collaboration with Garrett Birkhoff have forever changed the way that modern algebra is taught to undergraduates. His graduate level textbooks are standard references. His 36 graduate students, several of whom are themselves among the leading American mathematicians, are a living legacy. His ebullient style of lecturing will long be remembered by those fortunate enough to have learned from him.

Mac Lane's contributions to undergraduate education were recognized in 1975 when he was awarded the Distinguished Service Award of the Mathematical Association of America. His contributions to research mathematics and graduate education were recognized in 1986 when he was awarded the Steele Career Prize of the American Mathematical Society. This is the most prestigious award available to the mathematical community to express its appreciation of continued productivity over a full career.

Mac Lane also has had a long history of extremely important and effective leadership of both the mathematical community and the broader scientific community in America. He has been president of the Mathematics Association of America, vice-president of the American Philosophical Society, and president of the American Mathematical Society. As both vice-president of the National Academy of Sciences and a member of the National Science Board, he has had a major impact on the development of science policy in the United States.

Rudolph A. Marcus
Professor of Chemistry
Division of Chemistry & Chemical Engineering
California Institute of Technology
Pasadena, California

Citation: For his fundamental, far-reaching, and eminently useful developments of theories of unimolecular reactions and of electron transfers in chemistry and biochemistry.

Summary of Achievements

Rudolph Marcus is the leading theoretician in the field of chemical kinetics. His theories of unimolecular reactions (RRKM) and of electron-transfer reactions in solution are not only textbook material, but continue to be the source of successful predictions and correlations. Marcus is also acclaimed for his many other seminal contributions, including his semiclassical theories of collisions and of bound vibrational states, of proton, atom and group transfer reactions, natural collision coordinate Hamiltonians, vibrationally adiabatic reactions, and new paths for tunneling in reactions.

Ruldoph Marcus' career of contributions to theoretical chemistry has chiefly involved the understanding of complex chemical reactions. The majority of his 200-odd papers have been in two general directions: creating, extending, and examining the theory of chemical reactions which is now known as "RKKM theory," and developing the view toward electron transfer which is now generally termed the "Marcus theory." Names given to bodies of knowledge are to be mistrusted--they are often the result of campaigns or of accidents of usage--but in these cases, the depth of Marcus' contributions to each are overwhelming. In both of these areas, his approach has been to simplify the description to a point where it may be useful to relate reaction rates and reaction products to measurable experimental quantities and to simple concepts capable of direct evaluation and understanding. Marcus has had the superb taste, and ability, to keep away from the infinitely detailed descriptions of the quantum chemists--the systems he is concerned with are really too large for such calculations, and, in addition, those calculations often are specific and incapable of generalization. Instead, his work focuses on the concepts and methods which go to the heart of the matter and transcend irrelevant detail. Beyond developing these points of view, he has also tested them by examining experimental literature and entering into experimental collaborations to probe the extent, and the new situations, to which these viewpoints can be pushed. This has led him into collaborations extending from picosecond gas-phase photoreactions to biological molecules and assemblies. He is intellectually stimulated by finding new situations and systems in which an underlying supposition is violated and exceptions to the theory are found--in short, he is a proponent of broad understanding of chemical dynamics, not a proponent of his theories. As a most rare and single honor, the anniversaries of his theories will be celebrated in a special issue of the Journal of Physical Chemistry.

It can truly be said that Marcus' work has had a profound and lasting influence on experimentalists and theoreticians in the fields of unimolecular processes and of electron-transfer phenomena. He has a remarkable ability to interact easily and fluently with experimenters and with experiment, to take the broadest oversight and the worm's eye view of experimentation--a rare gift. By the highest standards, his contributions have been central to the field of chemical dynamics.

Harden M. McConnell
Professor of Chemistry
Department of Chemistry
Stanford University
Stanford, California

<u>Citation</u>: For his seminal contributions in developing the power of nuclear and electron magnetic resonance spectroscopy, the introduction of the spin labelling technique, and for original discoveries on the structure, properties and functioning of cell membranes.

Summary of Achievements

The work of few living physical chemists has had an impact as profound as that of Harden McConnell. He has no peers in his ability to recognize an important area, to develop the underlying theory, to develop new experimental approaches, and to carry the work, theoretical and experimental, through to definitive results and conclusions.

His earliest independent work involved the application of nuclear and electronic magnetic resonance spectroscopy to the solution of fundamental problems in electronic structure, chemical kinetics, radiation chemistry, and solid state chemistry. He developed much of the basic theory relating NMR spectra to molecular conformation and electronic structure, and he modified the Bloch equations to include the effects of chemical reactions including fast electron exchange. In the field of electron magnetic resonance spectroscopy, his studies showed that the nuclear hyperfine interactions observed for organic radicals can be used to measure the spin density on the carbon atoms of unsaturated hydrocarbons. McConnell developed an equation relating the spin density at a carbon atom to the isotropic proton hyperfine splittings, an equation which has been widely used in studies of the electronic structures of unsaturated hydrocarbons and organometallic compounds. His investigations of anisotropic interactions laid the foundation for the analysis of the electron magnetic resonance spectra of free radicals in crystals in terms of the electronic structure of the radicals. The theory which he and his coworkers developed accounts for many of the properties of triplet excitons, including the magnitude and orientation of the triplet state fine structure interactions, the absence of nuclear hyperfine structure and the origin of the exciton creation energies.

In the early part of the 1960's, McConnell's interests began to turn in the direction of biophysics. He introduced the spin label technique to the study of systems of biological interest. Spin labelling has found wide applications in many laboratories in the study of the structures, motion, and conformational changes of biological molecules such as enzymes and nucleic acids and in exposing the dynamics of biological membranes. Hubbell and McConnell in 1968 showed that the phospholipids in some biological membranes are in a liquid-like state, permitting rapid molecular motion. During the course of these studies, extraordinary properties of binary mixtures of phosphatidylcholines and cholesterol were discovered-- two-dimensional periodically ordered fluid and solid domains, and immiscible liquid domains. Weis and McConnell showed that compression of a monolayer can lead to ordered arrays of spiral chiral crystal forms, and that the chirality can be correlated with the enantiomeric configuration of the phospholipid contained in the bilayer. In "Theory of Superstructures in Lipid Monolayer Phase Transitions," a treatment of the sizes and shapes of these crystals is offered. The theory takes into account short range attractive forces between molecules (which accounts for the existence of the crystals), long-range dipole-dipole repulsions between the molecules (which tends to elongate the crystals), and line tension (which tends to contract the crystals so as to minimize their perimeters).

McConnell's interest in the properties of membranes has evolved to trying to understand the molecular basis of cell-cell recognition. He has combined methods of biology with NMR techniques to map the combining site of an antibody molecule. He has introduced an original and powerful approach in defining the mechanism of cell recognition, which involves replacing one of a pair of natural cells by a reconstituted membrane having precisely defined physical and chemical properties. He and his coworkers have been able to use such synthetic membranes to mimic the cells of biological membranes in sophisticated recognition events.

They have demonstrated that the antigen-presenting cell (B-cell) which interacts with the T-helper cells can be replaced by a lipid bilayer on a glass slide. The biological response to the artificial B-cell has been shown to be quantitatively equivalent to that produced by the intact B-cell. This makes it possible to explore in a systematic way the events that are involved in recognition that is not possible with intact cells.

McConnell is a scientist in the best tradition. He is directed by curiosity about nature. His good motives are combined with powerful intellectual gifts and a powerful drive to get at the answers. He has already done great work; there is still much great work ahead of him, and it is likely that trying to understand the chemistry of life processes will continue to preoccupy him for the rest of his career. His work will continue directly to benefit human welfare.

Eugene N. Parker
Distinguished Service Professor
Department of Physics
University of Chicago
Chicago, Illinois

Citation: For his fundamental studies of plasmas, magnetic fields, and energetic particles on all astrophysical scales; for his development of the concept of solar and stellar winds; and for his studies on the effects of magnetic fields on the solar atmosphere.

Summary of Achievements

Eugene Parker's professional work has focused on a diversity of subjects, ranging from plasmas in the universe to the outer structure of the sun, cosmic rays, the interstellar medium, and fundamental problems in solar physics.

Parker has contributed fundamentally to establishing the general theoretical framework of our current understanding of magnetic fields in the universe. He opened up the field in 1955 by pointing out the essential role of cyclonic (i.e., helical) convective fluid motions that amplify the magnetic fields in the sun, in other stars, and in planets. A series of papers and a monumental book are testimony to his seminal contributions to this field.

In the late 1950's, Parker predicted the existence of the solar wind, which is a supersonic stream of charged particles emanating from the sun's corona and blowing through the solar system. It strongly affects the terrestrial environment, giving rise to such phenomena as aurorae and geomagnetic storms, and possibly causing long-term climatic changes. Our understanding of the wind's origin, its interaction with planetary magnetic fields, and its effect on cosmic rays is principally due to Parker. The theoretical foundation of this understanding has been applied to numerous other astrophysical problems: winds from stars, circumstellar accretion disks, and galaxies.

Cosmic rays are nuclear particles (protons and nuclei of the heavier elements) that travel with nearly the speed of light through the galaxy. In the 1960's, Parker made fundamental contributions to this field, particularly to the origin, acceleration mechanism, and propagation of cosmic ray particles, and to their interaction with other matter in the universe.

Parker's work on cosmic rays includes the establishment of an upper limit on the density of magnetic monopoles, which are hypothesized particles and whose possible existence has deep implications for elementary particle physics.

In the 1950's, Parker developed a comprehensive theory of the interstellar medium, in which he considered the streaming of interstellar gas, the presence of magnetic fields, and the passage of cosmic ray particles through the gas. He showed that the various forces that arise produce previously unknown instabilities, which contribute to the clumping of the gas and to star formation. They may also give rise to galactic radio coronae and possibly to galactic winds.

The sun is the only star that can be studied in detail. During the past decade, Parker has concentrated on studying this star, particularly the origin of solar activity and related topics, such as explosive flares in the sun's corona, sunspots, and the structure and amplification of the sun's magnetic fields.

Parker has demonstrated deep physical insights and imagination. He has contributed to the foundation of theoretical physics, and he has influenced the direction of scientific inquiry by a generation of scientists. This description is just a brief and shallow covery of Parker's accomplishments in cosmic plasma physics. Taken together, his contributions are truly extraordinary.

Donald C. Spencer
Professor of Mathematics, Emeritus
Department of Mathematics
Princeton University
Princeton, New Jersey

Citation: For his original and insightful research which has had a profound impact on twentieth-century mathematics, and for his role as an inspiring teacher to generations of American mathematicians.

Summary of Achievements

The early mathematical work of Donald Spencer is truly impressive and spans many fields in which he has made fundamental contributions. He worked in number theory, on lattice points and on sequences of integers; in applied mathematics, on fluid mechanics; and in the theory of one-complex variable, on mean-valent functions, schlicht functions, conformal mappings and Riemann surfaces.

At Princeton, Spencer's research turned to the study of several complex variables and complex manifolds. In joint work with K. Kodaira the use of potential-theoretic methods in the study of complex manifolds was developed into a major tool, the basis for a large body of subsequent research. They introduced the modern theory of deformations of complex and other structures. This work has had tremendous influence in large segments of mathematics, especially in algebraic geometry and recently in mathematical physics. At the same time Spencer introduced the use of potential theory in the study of complex manifolds with boundaries, and in particular formulated the "$\bar{\partial}$ -Neumann problem" which has led to very important new developments in both several complex variables and partial differential equations. In the 1960's, Spencer worked on overdetermined systems of partial differential equations, and on pseudogroups. The culmination of this period has been the seminal joint work with H. Goldschmidt on Lie equations.

In all his work Spencer shows remarkable originality and insight. His contributions go far beyond his published works. His influence on his students, his collaborators, and his many friends has also had a lasting impact on twentieth-century mathematics. Just as Spencer had an unfailing instinct in how to approach mathematical research, so he also had an unfailing instinct in how to inspire both students and fellow mathematicians. His patience and his dedication knew no limits and his enthusiasm was contagious. His students were a very individualistic lot, with different interests and different talents. Yet Spencer knew how to guide and lead them to use their talents in the most effective way.

Spencer's contributions were on two levels. One, as a highly individualistic and original mathematical thinker; the other, as a "team-player," ready to help organize seminars, conferences, assist and inspire students and colleagues, and, in general, through his enthusiasm, create an atmosphere which was conducive to a mathematical activity of the highest order.

Roger W. Sperry
Professor Emeritus
Division of Biology
California Institute of Technology
Pasadena, California

Citation: For his work on neurospecificity which showed how the intricate brain networks for behavior are effected through a system of chemical coding of individual cells, which has made fundamental contributions to the understanding of human nature.

Summary of Achievements

Roger Sperry has made fundamental contributions to the understanding of human nature. Early in his career, Sperry demonstrated that nerves are not functionally interchangeable nor the corresponding brain centers nearly so plastic and reeducable as previously thought. These still definitive findings set new conservative principles in the practice of nerve surgery.

In studies on the growth of brain connections, Sperry showed how complex nerve networks for behavior can be organized prefunctionally in the brain through a vast chemical coding scheme. Sperry demonstrated that fibers from retinal points grow selectively to matching target points in the midbrain, regardless of functional results, to form an orderly map-like projection. This retinotectal system became a model for future research on the formation and plasticity of brain connections. The chemoaffinity theory, which Sperry developed in the 1940's to account for these findings, linked functional interconnection of neuronal networks to principles of developmental differentiation, cell-to-cell interactions, cytochemistry, genetics and evolution.

In tests of several hypotheses for brain processing, Sperry introduced new techniques for brain surgery and behavioral testing on cats and monkeys. He performed criss-cross slicing of the cerebral cortex and made multiple implantations of dielectric and conductor elements that ruled out current hypotheses, including gestalt electric field concepts. During this period Sperry proposed the cerebral "corollary motor discharge" to account for positional constancy of the perceived world during bodily movement. In 1955 he published a transient "cerebral facilitatory set" explanation of new stimulus-response connections formed in conditioned response learning, which still stands.

In the early 1950's, Sperry and his students resolved one of the most puzzling challenges for theories of brain function--reports that complete surgical separation of the brain's two hemispheres produces no definite functional symptoms in human patients. Applying new surgical and behavioral testing procedures, Sperry was able to demonstrate numerous symptoms of hemispheric deconnection in animals, and established the split brain (and split mind) as a method for approaching problems of cerebral organization.

Extension of the split brainwork to human commissurotomy patients led to a revision of earlier views of the right hemisphere as word-blind, word-deaf, and lacking in higher cognitive functions. These and other developments led to the overthrow of the classic neurological doctrine of major one-sided dominance in favor of the concept of complementary hemispheric specialization, and triggered a surge of new research in the 1970's on cognitive asymmetry.

Sperry's contributions to psychobiology had significant impact on other scientific areas and have changed the course of many of these fields, including the biological, social and behavioral sciences.

Henry M. Stommel
Senior Scientist
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

<u>Citation</u>: For his original, penetrating and fundamental contributions to the physics of ocean circulation.

<u>Summary of Achievements</u>

Henry Stommel is the creator of modern dynamical oceanography. Through his own sometimes astonishing insights and 40 years of unceasing collaboration on almost all aspects of physical oceanography, he set the context in which the entire subject of physical oceanography has progressed from a purely descriptive taxonomy to a quantitative branch of physics.

His science is best characterized by an uncanny ability to recognize a question worth asking and then to answer it in the most deceptively simple physical terms with a minimum of mathematics. The characteristics are evident in his most famous paper, "The Westward Intensification of Wind-driven Ocean Currents," published in 1948. He recognized that the existence of the very strong westward intensification of the current systems of the world oceans (called, in the North Atlantic, "the Gulf Stream") was a peculiar phenomenon which should be explained as a consequence of the equations of fluid mechanics. Stommel then showed that the Gulf Stream could be understood from simple considerations of angular momentum conservation in a fluid (vorticity conservation).

This paper bears the earmarks of a true scientific classic: with hindsight it is all perfectly obvious. Only by examining the literature of the time does one perceive that before Stommel, no one even recognized the existence of the Gulf Stream as a dynamical entity requiring explanation. The paper spawned an enormous literature, in which the original model was elaborated to include non-linearity, stratification, topography, time dependence, etc. Much of his elaboration was the result of Stommel's own work or with collaborators. But the 1948 paper remains the clear cornerstone on which <u>all</u> theories of ocean circulation, including the most elaborate of today's numerical models, are built.

Stommel went on from the 1948 paper to produce a remarkable set of ideas about how the ocean "works." They include (with A. Arons) the only extant (30 years later) notions of the global scale abyssal circulation, the theory of the thermocline, the central demonstration of the extremely long response time of the circulation to changing forces, the invention of what has become the entire sub-field of double-diffusive convection, the demonstration of the strange properties of bottom water formation in the global ocean, and the beta-spiral method for absolute velocity determination. Some of his most significant work has been published very recently, at a time when most scientists are contemplating retirement. Frustrated by the difficulties encountered by the non-linearities of the partial differential equations governing the older thermocline theory, Stommel and collaborators recently re-formulated the problem in a new form, found a new range of possible solutions, and have spawned a renaissance of the theory of the large scale circulation, 40 years after Stommel's opening up of the field. He continues to strike out in completely new and innovative directions. His recent work (with N. Hogg) on baroclinic point vortices, the "hetons," has illuminated from a fresh viewpoint the interaction dynamics of strong oceanic eddies and the important process of baroclinic instability in the oceans and the atmosphere.

In understanding Stommel's contributions, it is important to recognize that a large part of his career has been spent in making observations first-hand, on ships. Many of his most important contributions have come from his drive to work at sea. To name only a few, he initiated the technology of the SOFAR float; his experience with long, trans-Pacific hydrographic sections gave rise to the global geochemical tracer program called GEOSECS; he founded the so-called Panulirus station at Bermuda, which 33 years later is the centerpiece of knowledge of oceanic time series behavior; and he provided a focus for the major programs studying monsoon response of the western Indian Ocean.

Harland G. Wood
University Professor, Emeritus
Department of Biochemistry
Case Western Reserve University
Cleveland, Ohio

Citation: For his pioneering work on the biochemistry of CO_2 fixation, for major contributions to medical education, and for leadership in biochemistry at the national and international level.

Summary of Achievements

Harland Wood has had a long, distinguished career in the life sciences beginning with his pioneering work with C. H. Werkman which demonstrated for the first time that CO_2 is utilized in heterotrophic organisms. In 1935, Wood demonstrated that the prevailing dogma that CO_2 was utilized only by autotrophs was incorrect in a series of studies which determined the products formed from the fermentation of glycerol by the propionic acid bacteria in a bicarbonate buffer system. He calculated the carbon and oxidation-reduction balances and found more carbon in the products than was supplied by the fermented glycerol. He subsequently found that the extra carbon was derived from CO_2 in the buffer and that oxidation balanced reduction. He then proposed that CO_2 and pyruvate combined to form oxalacetate which subsequently was reduced to succinate. This pyruvate-CO_2 reaction became known as the Wood-Werkman reaction.

When isotopic tracers of carbon became available in the 1940's, Dr. Wood was among the first to exploit these isotopes in biological studies. He was a true pioneer, not only developing procedures for the use of these isotopes for metabolic tracer studies, but also designing and building a column for the separation of ^{13}C isotopic carbon as well as a mass spectrometer for its measurement. His innovative work provided strong support for the tricarboxylic acid cycle when he demonstrated the differential labeling of citric acid cycle intermediates. The studies by Wood and his colleagues in 1945 clearly demonstrated the pathway of CO_2 incorporation into specific carbon atoms of glucose. These results provided excellent evidence of the now generally accepted principle that laboratory culture studies with enzymes reflect the events which occur in animal cells. Later, Dr. Wood established the mechanisms for the synthesis of lactose in the bovine mammary gland. In collaboration with Drs. Joseph Katz and Bernard R. Landau, Dr. Wood estimated the proportion of carbohydrate metabolized in the pentose cycle and glycolysis. These latter studies were instrumental in establishing the stoichiometry of the pentose pathway.

The focus of Dr. Wood's research over the past 57 years has continued to be on CO_2 fixation. During the last 30 years he has focused on transcarboxylase (TC). The kinetics of the reaction did not fit the recently described mechanisms, so Dr. Wood and his co-workers proposed a new kinetic mechanism that has since been found to apply to all biotin enzymes. Extensive work was done on the separation of its three subunits and on the reconstitution of enzyme activity. The quaternary structure of TC was approached first by electron microscopy, which, with 20 A resolution revealed the "Mickey Mouse" enzyme. With thin crystals of the enzyme, resolution of the structure at 10 A has been possible by electron crystallography; the x-ray diffraction at 2.5 A resolution is now proceeding. The primary amino acid sequence of the biotinyl subunit was determined several years ago and now, in collaboration with Dr. David Samols, the genes for all three subunits have been cloned and sequenced.

Dr. Wood is actively involved in the structure-function analysis of the biotinyl subunit. These studies are of great interest because of the complexity of the subunit structure of the enzyme and the ability to examine different aspects of function. These studies also underline Dr. Wood's life-time focus on various aspects of CO_2 metabolism in procaryotic organisms.

From the work described here, it is clear that Dr. Wood, over the 57 years he has been involved in research, has followed the trail of CO_2, always making important advances by utilizing the most modern methodology. He has remained extremely productive; in 1986, for example, he published 11 papers. He has three active NIH grants and has continued to work with his own hands at the bench besides directing this comprehensive program.

Dr. Wood's outstanding career has been marked by many innovations. As Chairman of the Biochemistry Department at Western Reserve University, Dr. Wood led the reform which resulted in an integrated medical school teaching curriculum which had a great impact on medical school education nationally. He served as Chairman of the Biochemistry Department for 20 years, as Dean of Sciences at Case Western Reserve University from 1967 to 1969, and finally as University Professor from 1970 to 1978.

Dr. Wood was President of the American Society of Biological Chemistry from 1959 to 1960. First as Secretary-General and then as President of the International Union of Biochemists in 1982-83, he revitalized that organization. He has been a member of many advisory boards, served as an editorial board member of a number of important journals and has received a number of prestigious awards. These include the Eli Lilly Award for Bacteriology, the Carl Neuberg Medal, the Lynen Lecture Medal, the Waksman Award and the Rosenstiel Award as well as honorary degrees from a number of universities, including Northwestern University and the University of Cincinnati. He is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the Biochemical Society of Japan.

Dr. Wood's long and distinguished career as a scientist and educator has spanned 57 years. His scientific contributions have significantly increased our understanding of life processes by establishing basic metabolic pathways in species as diverse as bacteria and mammals. He remains a vigorous and active practitioner of the science to which he has added so much.

Nominations for the National Medal of Science

Arnold O. Beckman, Vice Chairman of the Board, SmithKline-Beckman Corporation, Irvine, California.
For his leadership in the development of analytical instrumentation, and for his deep and abiding concern for the vitality of the Nation's scientific enterprise.

Richard B. Bernstein, Professor of Chemistry, Department of Chemistry and Biochemistry, University of California, Los Angeles, California
For his development and use of the technique of molecular beams, which has played a significant role in shaping the field of modern chemical dynamics.

Melvin Calvin, University Professor of Chemistry, Department of Chemistry, University of California, Berkeley, California.
For his pioneering studies in the mechanism of photosynthesis and bioenergetics, and for the application of scientific theory toward the solution of the most fundamental problems of the age--energy, food, chemical and viral carcinogenesis, and the origin of life.

Harry G. Drickamer, Professor of Chemical Engineering, Chemistry and Physics, Department of Chemical Engineering, University of Illinois, Urbana, Illinois.
For his discovery of the "pressure tuning" of electronic energy levels as a way to obtain new and unique information on the electronic structure of solids.

Katherine Esau, Professor of Botany, Emeritus, Department of Biological Sciences, University of California, Santa Barbara, California.
For her distinguished achievements in and contributions to the advancement of the botanical sciences; for furthering the understanding of the structure and development of plant food-conducting tissue; and for elucidating the virus-plant host relationship.

Herbert E. Grier, Director, CER Corporation, La Jolla, California.
For his many pioneering scientific contributions and his leadership role in ultra-high-speed electronic stroboscopy, electro-optic innovations, national defense, and aerospace sciences.

Viktor Hamburger, Professor Emeritus, Department of Biology, Washington University, St. Louis, Missouri.
For his steadfast work which led to the discovery and understanding of normally occurring neuronal death, nerve growth factor, and competitive relationships in the vertebrate nervous system.

Samuel Karlin, Professor of Mathematics, Department of Mathematics, Stanford University, Stanford, California.
For his broad and remarkable researches in mathematical analysis, probability theory and mathematical statistics, and in the application of these ideas to mathematical economics, mechanics, and population genetics.

Philip Leder, Professor and Chairman, Department of Genetics, Harvard Medical School, Boston, Massachusetts.
For his innovative studies that have significantly advanced knowledge and provided new directions for research in molecular genetics, immunology and cancer etiology.

Joshua Lederberg, President, The Rockfeller University, New York, New York.
For his work in bacterial genetics and immune cell single type antibody production; for his seminal research in artificial intelligence in biochemistry and medicine; and for his extensive advisory role in government, industry and international organizations which address themselves to the societal role of science.

Saunders Mac Lane, Professor Emeritus, Department of Mathematics, University of Chicago, Chicago, Illinois.
For revolutionizing the language and content of modern mathematics by creating and developing the fields of homological algebra and category theory, for outstanding contributions to undergraduate and graduate education in mathematics, and for incisive leadership of the mathematical and scientific community.

Rudolph A. Marcus, Professor of Chemistry, Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, California.
For his fundamental, far-reaching, and eminently useful developments of theories of unimolecular reactions and of electron transfers in chemistry and biochemistry.

Harden M. McConnell, Professor of Chemistry, Department of Chemistry, Stanford University, Stanford, California.
For his seminal contributions in developing the power of nuclear and electron magnetic resonance spectroscopy, the introduction of the spin labelling technique, and for original discoveries on the structure, properties and functioning of cell membranes.

Eugene N. Parker, Distinguished Service Professor, Department of Physics, University of Chicago, Chicago, Illinois.

For his fundamental studies of plasmas, magnetic fields, and energetic particles on all astrophysical scales; for his development of the concept of solar and stellar winds; and for his studies on the effects of magnetic fields on the solar atmosphere.

Robert Phillip Sharp, Professor of Geology, Emeritus, Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California.

For his illumination of the nature and origin of the forms and formation processes of planetary surfaces, and for leadership in multidisciplinary education to promote excellence among earth and planetary scientists.

Donald C. Spencer, Professor of Mathematics, Emeritus, Department of Mathematics, Princeton University, Princeton, New Jersey.

For his original and insightful research which has had a profound impact on twentieth-century mathematics, and for his role as an inspiring teacher to generations of American mathematicians.

Roger W. Sperry, Professor Emeritus, Division of Biology, California Institute of Technology, Pasadena, California.

For his work on neurospecificity which showed how the intricate brain networks for behavior are effected through a system of chemical coding of individual cells, which has made fundamental contributions to the understanding of human nature.

Henry M. Stommel, Senior Scientist, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

For his original, penetrating and fundamental contributions to the physics of ocean circulation.

Harland G. Wood, University Professor, Emeritus, Department of Biochemistry, Case Western Reserve University, Cleveland, Ohio.

For his pioneering work on the biochemistry of CO_2 fixation, for major contributions to medical education, and for leadership in biochemistry at the national and international level.

Recommendations for Award of the National Medal of Technology

Prepared for the
Secretary of Commerce

by the

National Medal of Technology Nomination
Evaluation Committee

The Committee met on May 24, 1988 and unanimously recommends the following individuals to receive the National Medal of Technology in 1989.

1. Jay W. Forrester
   Robert R. Everett

   For their creative work in developing technologies and applying computers to real-time applications. Their important contributions proved vital to national and free world defense and opened a new era of world business.

2. Helen Edwards
   Richard A. Lundy
   J. Ritchie Orr
   Alvin Tollestrup

   For their contributions to the design, construction, and initial operation of the TEVATRON particle accelerator. This scientific instrument was designed to explore the fundamental properties of matter. The innovative design and successful operation of the TEVATRON has been crucial to the design of the Superconducting Super Collider, the planned next generation particle accelerator.

3. Herbert W. Boyer
   Stanley N. Cohen

   For their fundamental invention of gene splicing techniques allowing replication in quantity of biomedically important new products, and beneficially transformed plant materials. This discovery of recombinant DNA technology has transformed the basic science of molecular biology into the modern biotechnology industry of the United States.

Gold Stamp Seal

Position Only

Presentation of

The National Medal of Science
and
The National Medal of Technology

??????? ?, 1989

To come!

THE WHITE HOUSE

Inside front cover

"Scientific and technological advancement have always been at the very heart of our nation's pioneer spirit, pushing the boundaries of our knowledge, creating economic opportunity, and certainly increasing our standard of living and making this a healthier and safer world in which to live. ... As a nation, we have no natural resource more precious than our intellectual resources"

George Bush
March 3, 1989

PROGRAM

Check sequence

REMARKS

The Honorable Robert A. Mosbacher

Secretary of Commerce

Verify correct data

The Honorable D. Allan Bromley

Science Adviser to the President

Check preferred title

THE PRESIDENT OF THE UNITED STATES

PRESENTATION OF AWARDS

THE PRESIDENT OF THE UNITED STATES

Recipients of the National Medal of Technology for 1989

JAY W. FORRESTER
ROBERT R. EVERETT

For their creative work in developing technologies and applying computers to real-time applications. Their important contributions proved vital to national and free world defense and opened a new era of world business.

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RICHARD A. LUNDY
J. RITCHIE ORR
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For their contributions to the design, construction, and initial operation of the TEVATRON particle accelerator. This scientific instrument was designed to explore the fundamental properties of matter. The innovative design and successful operation of the TEVATRON has been crucial to the design of the Superconducting Super Collider, the planned next generation particle accelerator.

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Recipients of the National Medal of Science for 1989

Behavioral/Social Sciences

ROGER W. SPERRY

For his work on neurospecificity which showed how the intricate brain networks for behavior are effected through a system of chemical coding of individual cells, which has made fundamental contributions to the understanding of human nature.

Biological Sciences

KATHERINE ESAU

For her distinguished achievements in and contributions to the advancement of the botanical sciences, for furthering the understanding of the structure and development of plant food-conducting tissue, and for elucidating the virus-plant host relationship.

VIKTOR HAMBURGER

For his steadfast work that led to the discovery and understanding of normally occurring neuronal death, nerve growth factor, and competitive relationships in the vertebrate nervous system.

PHILIP LEDER

For his innovative studies that have significantly advanced knowledge and provided new directions for research in molecular genetics, immunology and cancer etiology.

J. 239-573 Hollar 7-17-89 239573.5 Disk White House 6 FT 0253, 0254, 1291 JS. 8

JOSHUA LEDERBERG

For his work in bacterial genetics and immune cell single type antibody production; for his seminal research in artificial intelligence in biochemistry and medicine; and for his extensive advisory role in government, industry and international organizations that address themselves to the societal role of science.

HARLAND G. WOOD

For his pioneering work on the biochemistry of CO_2 fixation, for major contributions to medical education, and for leadership in biochemistry at the national and international level.

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RICHARD B. BERNSTEIN

For his development and use of the technique of molecular beams, which have played a significant role in shaping the field of modern chemical dynamics.

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RUDOLPH A. MARCUS

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HARDEN M. McCONNELL

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HARRY G. DRICKAMER

For his discovery of the "pressure tuning" of electronic energy levels as a way to obtain new and unique information on the electronic structure of solids.

HERBERT E. GRIER

For his pioneering scientific contributions and his leadership role in ultra-high-speed electronic stroboscopy, electro-optic innovations, national defense, and aerospace sciences.

Mathematics

SAUNDERS MAC LANE

For revolutionizing the language and content of modern mathematics by creating and developing the fields of homological algebra and category theory, for outstanding contributions to mathematics education, and for incisive leadership of the mathematical and scientific communities.

DONALD C. SPENCER

For his original and insightful research that has had a profound impact on twentieth-century mathematics, and for his role as an inspiring teacher to generations of American mathematicians.

SAMUEL KARLIN

For his broad and remarkable researches in mathematical analysis, probability theory and mathematical statistics, and in the application of these ideas to mathematical economics, mechanics, and population genetics.

Physical Sciences

ARNOLD O. BECKMAN

For his leadership in the development of analytical instrumentation, and for his deep and abiding concern for the vitality of the Nation's scientific enterprise.

EUGENE N. PARKER

For his fundamental studies of plasmas, magnetic fields, and energetic particles on all astrophysical scales; for his development of the concept of solar and stellar winds; and for his studies on the effects of magnetic fields on the solar atmosphere.

ROBERT P. SHARP

For his research that has illuminated the nature and origin of the forms and formation processes of planetary surfaces and for teaching two generations of scientists and laymen to appreciate them; for his recruitment and leadership of a successful multidisciplinary department of earth and planetary scientists who have gained world recognition.

HENRY M. STOMMEL

For his original, penetrating and fundamental contributions to the physics of ocean circulation.

The National Medal of Technology Nomination Evaluation Committee

GEORGE BUGLIARELLO

BOB O. EVANS

S. ALLEN HEININGER

RICHARD R. NELSON

WILLIAM C. NORRIS

GEORGE B. RATHMANN

ROLAND W. SCHMITT

ROBERT M. WHITE, Chairman

ELIAS R. ZENKICH

PAUL V. BRADEN

Executive Director

(Smith/Blessey)
Draft Three
October 13, 1989
TECH

PRESIDENTIAL REMARKS: SCIENCE & TECHNOLOGY
THE EAST ROOM
WEDNESDAY, OCTOBER 18, 1989

Jeanie Fix — acknowledgements 7788

Let me welcome you to the White House. And on behalf of each American, thank you for your magnificent efforts on behalf of this Nation and the world.

It is indeed an honor to address this singularly diverse and distinguished group of Americans. And to present America's highest honor in the areas of science and technology: The National Medal of Science and the National Medal of Technology.

draft from Sci & Tech, Jackie Clawson x2840 legislation

draft p. 2

Three decades ago the National Medal of Science was created by Congress. Its purpose was to recognize individuals for their "outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences."

Then, nine years ago, the National Medal of Technology was established. Its purpose was to "recognize scientists and engineers for projects that improve the well-being of the United States through the development or application of technology."

Over the past several decades, these contributions and projects have helped make America a richer, better place. New types of grain and fertilizers have spurred greater crop yields. (instrumentation) Diagnostic technology has helped combat disease. Progress in biology and biotechnology has begun unmasking the secrets of heredity. And the work goes on -- through pioneers, like you.

Judy

Dr. Bostock

For ours is a pioneering heritage -- from Eli Whitney to Lee De Forest to the Salk vaccine for polio. And this year's 27 recipients of the Science and Technology medals embody the best and brightest of that heritage -- Americans inspired by the belief that the trailblazers of today will be the heroes of tomorrow.

Think of Professor Richard Bernstein, whose work in molecular beams has helped shape modern chemistry. Or Professor Emeritus Katherine Esau, enriching the study of the botanical sciences. Or Jay Forrester and Robert Everett, helping technologies and computers enhance America's defense.

Since the 1940s, for instance, Robert Sharp has overcome physical and logistical barriers to illumine our knowledge of planetary surfaces. He's climbed glaciers, and felt permafrost -- dared mountains and ravines. Like each of you, he has shown that progress often comes neither quickly nor cheaply. It demands devotion and sacrifice. It knows adversity and pain. And like each of you, he knows that dreams realized make possible even bigger dreams.

Today, we celebrate those dreams -- dreams that you are making possible. And I only wish I had time to mention each recipient. For all of your dreams will keep America competitive. Dreams that will raise our standard of living -- and, moreover, our quality of life. They are dreams that presage a new Golden Age of information, understanding, and technology. Dreams that show how creativity comes from the human heart and mind.

In closing, then, let me first salute your achievements and your commitment. Many of you have been teachers. Some have served in government. All have shown that America has no natural resource more precious than her intellectual resources.

Next, let me promise you: Our Administration will do its part. We know that scientific knowledge must be renewed and expanded. And so we will continue the American tradition of strong, broad-based support for research and development in all areas of science and technology.

Our approach will be balanced, and fair: It includes both "large science and technology projects" as well as "small science principal investigator" funding.

In "large science and technology," look at the opportunities ahead: The Superconducting Super Collider and the Human Genome initiatives. Or Space Station Freedom, which will lead us toward the stars. And the "small science" potential is no less dazzling: We want to double the National Science Foundation budget over the next five years. And give our youth a special incentive to excel in science, mathematics, and engineering through our new program of National Science Scholars.

Ladies and gentlemen, these new initiatives -- this investment -- can help science and technology help America triumph in the future. Uplifting this generation. And inspiring generations to come. For you are America's true pioneers. Dreaming the dreams that enhance our energy and health, medicine and productivity, national security and education. The dreams that your remarkable deeds are helping to come true.

Again, my heart-felt congratulations on behalf of each and every citizen. And now it is my great pleasure to introduce my Advisor for Science and Technology, Allan Bromley, and ~~my~~ Secretary of Commerce, Bob Mosbacher, who will present you with America's highest technological and scientific achievement. But, you know, I like my end of the bargain. I get to shake your hands.

Thank you very much, God bless you, and God bless America.

# # # #

Sci. & Techn.

10/16/89

Jeanie Figg x7788

Acknowledgements

Congr. Robert Roe — Congr. LaFalce

" Larry Pressler

Robert Walker — Sen. Gorn

Doug Walgren

Derwinski

Cavazos

Moosbacher

10/17/89 → Congr. Silvio Conte

Steph –

Jeannie – Sec.

Office

re: ~~tomorrow's~~ ceremony

... Silvio Conte accepts

This year's Nobel prize

Norman F. Ramsey

For seminal investigations in broad areas of atomic, molecular, and nuclear physics, and for his dedicated service to the nation and to the scientific community.

Jack Steinberger

For incisive illumination of the properties of subnuclear particles, including exhaustive measurements of strange particles, neutral kaons, and high energy neutrino interactions.

Rosalyn S. Yalow

For contributions to the discovery and development of radioimmunassay, a technique that employs radioactive isotopes to detect and measure levels of insulin and hormones in the blood and body tissues.

THE WHITE HOUSE

WASHINGTON

October 16, 1989

INFORMATION

MEMORANDUM FOR THE PRESIDENT

THROUGH: CHRISS WINSTON CW

FROM: CURT SMITH CS

SUBJECT: REMARKS TO THE NATIONAL MEDAL OF SCIENCE AND NATIONAL MEDAL OF TECHNOLOGY WINNERS

I. SUMMARY

On Wednesday, October 18, at 2:00 p.m. you will address the recipients of the National Medal of Science and National Medal of Technology. About 200 guests will attend the ceremony in the East Room. The attendees will include the honorees, their colleagues and guests. Congressmen Robert Roe, Robert Walker, Doug Walgren, and John LaFalce, Senators Jake Garn and Larry Pressler and Secretaries Mosbacher, Derwinski and Cavazos will be attending. There are still some Congressmen and Secretaries who have not yet responded. We will include any additional notables on the speech cards.

II. DISCUSSION

The enclosed remarks (7 minutes) applaud the success of the scientists' achievements. The remarks also express your support for scientific and technological research and development.

Following the remarks, Secretary Mosbacher will read the citations and you will shake the recipients' hands.

(Smith/Blessey)
Draft Four
October 16, 1989
TECH

PRESIDENTIAL REMARKS: SCIENCE & TECHNOLOGY
THE EAST ROOM
WEDNESDAY, OCTOBER 18, 1989
2:00 P.M.

Dr. Bromley, Secretary Mosbacher, Secretaries Derwinski and Cavazos, Senators Garn and Pressler, Congressmen Roe, Walker, Walgren, and LaFalce, Award-Recipients and other distinguished scientists, ladies and gentlemen, friends.

Let me welcome you to the White House. And on behalf of every American, thank you for your magnificent efforts on behalf of this Nation and the world.

It is indeed an honor to address this singularly diverse and distinguished group of Americans. And to present America's highest honor in the areas of science and technology: The National Medal of Science and the National Medal of Technology.

Three decades ago the National Medal of Science was created by Congress. Its purpose was to recognize individuals for their "outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences."

Then, nine years ago, the National Medal of Technology was established. Its purpose was to "recognize scientists and engineers for projects that improve the well-being of the United States through the development or application of technology."

Over the past several decades, these contributions and projects have helped make America a richer, better place. New types of grain and fertilizers have spurred greater crop yields. Diagnostic technology has helped combat disease. Progress in biology and biotechnology has begun unmasking the secrets of heredity. And the work goes on -- through pioneers, like you.

For ours is a pioneering heritage -- from Eli Whitney to Lee De Forest to the Salk vaccine for polio. And this year's 27 recipients of the Science and Technology medals embody the best and brightest of that heritage -- Americans inspired by the belief that the trailblazers of today will be the heroes of tomorrow.

Think of some of last year's recipients. Think of Edwin Land, who invented a plastic material that absorbed light of a specific polarization. Or Maurice Hilleman, whose brilliant discoveries in basic research and vaccine creation are combating infectious disease. Or Rosalyn Yalow [YA-low], whose breakthrough diagnostic technique is helping to save thousands of lives.

Think, too, of how another of last year's recipients has been a trailblazer in the aircraft industry. Since the 1940s, Clarence (Kelly) Johnson has designed more than 40 aircraft -- including the world's largest aircraft and highest flying jet. He's not only led their development programs. But, on their maiden flights, was the flight test engineer himself -- laying his own life on the line. Like each of you, Kelly Johnson has shown that progress often comes neither quickly nor cheaply. It demands devotion and sometimes even danger. It knows adversity and pain. And like each of you, he knows that dreams realized make possible even bigger dreams.

Today, we celebrate dreams that **you** are making possible -- dreams that will keep America competitive, raise our standard of living, and improve our quality of life. Your dreams presage a new Golden Age of information, understanding, and technology. And show how **creativity comes from the human heart and mind.**

In closing, then, let me first **salute** your achievements and your commitment. Many of you have been teachers. Some have served in government. **All** have shown that America has no natural resource more precious than her **intellectual** resources.

Next, let me **promise** you: Our Administration will do its part. We know that scientific knowledge must be renewed and expanded. And so we will continue the American tradition of strong, broad-based support for basic research and R and D in the areas of science and technology.

Our approach will be balanced, and fair: It includes both "large science and technology projects" as well as "small science principal investigator" funding.

In "large science and technology," look at the opportunities ahead: The Superconducting Super Collider and the Human Genome Initiatives. Or Space Station Freedom, which will lead us toward the stars. And the "small science" potential is no less dazzling: We want to stay on the path to doubling the National Science Foundation budget if Congress will cooperate. And give our youth a **special** incentive to excel in science, mathematics, and engineering through our new program of National Science Scholars.

Ladies and gentlemen, these priorities constitute an investment in the future -- strengthening the education which is **crucial** **to** that future.

This investment in education is vital if America is to remain the leader of a very competitive world -- both intellectually and commercially. And if science and technology are to uplift **this** generation. As you **already have**. And inspire generations to come. As you **must**. For you **are** **America's true pioneers.** Dreaming the dreams that enhance our energy and health, medicine and productivity, national security and education. The dreams that your remarkable deeds are helping to come true.

Again, my heart-felt congratulations on behalf of each and every citizen. And now it is my great pleasure to introduce my Assistant for Science and Technology, Allan Bromley, and my Secretary of Commerce, Bob Mosbacher, who will present you with America's highest technological and scientific award. But, you know, I like my end of the bargain. I get to shake your hands.

Thank you very much, God bless you, and God bless America.

# # # #

SCIENCE & TECHNOLOGY / THE EAST ROOM
OCTOBER 18, 1989 / 2:00 P.M.

SECRETARY MOSBACHER, SECRETARIES SULLIVAN AND CAVAZOS, DR. BROMLEY, SENATORS GORE AND PRESSLER, CONGRESSMEN CONTE, WALKER, WALGREN, GREEN AND LAFALCE, AWARD-RECIPIENTS AND OTHER DISTINGUISHED SCIENTISTS, LADIES AND GENTLEMEN, FRIENDS.

LET ME WELCOME YOU TO THE WHITE HOUSE. AND ON BEHALF OF EVERY AMERICAN, THANK YOU FOR YOUR MAGNIFICENT EFFORTS ON BEHALF OF THIS NATION AND THE WORLD.

It is indeed an honor to address this singularly diverse and distinguished group of Americans. And to present America's highest honor in the areas of science and technology: The National Medal of Science and the National Medal of Technology.

Three decades ago the National Medal of Science was created by Congress.

Its purpose was to recognize individuals for their "outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences."

Then, nine years ago, the National Medal of Technology was established. Its purpose was to "recognize scientists and engineers for projects that improve the well-being of the United States through the development or application of technology."

OVER THE PAST SEVERAL DECADES, THESE CONTRIBUTIONS AND PROJECTS HAVE HELPED MAKE AMERICA A RICHER, BETTER PLACE. NEW TYPES OF GRAIN AND FERTILIZERS HAVE SPURRED GREATER CROP YIELDS. DIAGNOSTIC TECHNOLOGY HAS HELPED COMBAT DISEASE. PROGRESS IN BIOLOGY AND BIOTECHNOLOGY HAS BEGUN UNMASKING THE SECRETS OF HEREDITY. AND THE WORK GOES ON -- THROUGH PIONEERS, LIKE YOU.

FOR OURS IS A PIONEERING HERITAGE -- FROM ELI WHITNEY TO LEE DE FOREST TO THE SALK VACCINE FOR POLIO.

AND THIS YEAR'S 27 RECIPIENTS OF THE SCIENCE AND TECHNOLOGY MEDALS EMBODY THE BEST AND BRIGHTEST OF THAT HERITAGE -- AMERICANS INSPIRED BY THE BELIEF THAT THE TRAILBLAZERS OF TODAY WILL BE THE HEROES OF TOMORROW.

THINK OF SOME OF LAST YEAR'S RECIPIENTS. THINK OF EDWIN LAND, WHO INVENTED A PLASTIC MATERIAL THAT ABSORBED LIGHT OF A SPECIFIC POLARIZATION. OR MAURICE HILLEMAN, WHOSE BRILLIANT DISCOVERIES IN BASIC RESEARCH AND VACCINE CREATION ARE COMBATING INFECTIOUS DISEASE.

OR ROSALYN YALOW [YA-LOW], WHOSE BREAKTHROUGH DIAGNOSTIC TECHNIQUE IS HELPING TO SAVE THOUSANDS OF LIVES.

THINK, TOO, OF HOW ANOTHER OF LAST YEAR'S RECIPIENTS HAS BEEN A TRAILBLAZER IN THE AIRCRAFT INDUSTRY. SINCE THE 1940S, KELLY JOHNSON HAS DESIGNED MORE THAN 40 AIRCRAFT -- INCLUDING THE WORLD'S LARGEST AIRCRAFT AND HIGHEST FLYING JET. HE'S NOT ONLY LED THEIR DEVELOPMENT PROGRAMS.

BUT, ON THEIR MAIDEN FLIGHTS, WAS THE FLIGHT TEST ENGINEER HIMSELF -- LAYING HIS OWN LIFE ON THE LINE. LIKE EACH OF YOU, KELLY JOHNSON HAS SHOWN THAT PROGRESS OFTEN COMES NEITHER QUICKLY NOR CHEAPLY. IT DEMANDS DEVOTION AND SOMETIMES EVEN DANGER. IT KNOWS ADVERSITY AND PAIN. AND LIKE EACH OF YOU, HE KNOWS THAT DREAMS REALIZED MAKE POSSIBLE EVEN BIGGER DREAMS.

TODAY, WE CELEBRATE DREAMS THAT YOU ARE MAKING POSSIBLE -- DREAMS THAT WILL KEEP AMERICA COMPETITIVE, RAISE OUR STANDARD OF LIVING, AND IMPROVE OUR QUALITY OF LIFE. YOUR DREAMS PRESAGE A NEW GOLDEN AGE OF INFORMATION, UNDERSTANDING, AND TECHNOLOGY. AND SHOW HOW CREATIVITY COMES FROM THE HUMAN HEART AND MIND.

IN CLOSING, THEN, LET ME FIRST SALUTE YOUR ACHIEVEMENTS AND YOUR COMMITMENT.

MANY OF YOU HAVE BEEN TEACHERS. SOME HAVE SERVED IN GOVERNMENT. ALL HAVE SHOWN THAT AMERICA HAS NO NATURAL RESOURCE MORE PRECIOUS THAN HER INTELLECTUAL RESOURCES.

NEXT, LET ME PROMISE YOU: OUR ADMINISTRATION WILL DO ITS PART. WE KNOW THAT SCIENTIFIC KNOWLEDGE MUST BE RENEWED AND EXPANDED. AND SO WE WILL CONTINUE THE AMERICAN TRADITION OF STRONG, BROAD-BASED SUPPORT FOR BASIC RESEARCH AND R AND D IN THE AREAS OF SCIENCE AND TECHNOLOGY.

OUR APPROACH WILL BE BALANCED, AND FAIR: IT INCLUDES BOTH "LARGE SCIENCE AND TECHNOLOGY PROJECTS" AS WELL AS "SMALL SCIENCE PRINCIPAL INVESTIGATOR" FUNDING.

IN "LARGE SCIENCE AND TECHNOLOGY," LOOK AT THE OPPORTUNITIES AHEAD: THE SUPERCONDUCTING SUPER COLLIDER AND THE HUMAN GENOME [G NOME] INITIATIVES. OR SPACE STATION FREEDOM, WHICH WILL LEAD US TOWARD THE STARS.

AND THE "SMALL SCIENCE" POTENTIAL IS NO LESS DAZZLING: WE WANT TO STAY ON THE PATH TO DOUBLING THE NATIONAL SCIENCE FOUNDATION BUDGET IF CONGRESS WILL COOPERATE. AND GIVE OUR YOUTH A SPECIAL INCENTIVE TO EXCEL IN SCIENCE, MATHEMATICS, AND ENGINEERING THROUGH OUR NEW PROGRAM OF NATIONAL SCIENCE SCHOLARS.

LADIES AND GENTLEMEN, THESE PRIORITIES CONSTITUTE AN INVESTMENT IN THE FUTURE -- STRENGTHENING THE EDUCATION WHICH IS CRUCIAL <u>TO</u> THAT FUTURE.

THIS INVESTMENT IN EDUCATION IS VITAL IF AMERICA IS TO REMAIN THE LEADER OF A VERY COMPETITIVE WORLD -- BOTH INTELLECTUALLY AND COMMERCIALLY. AND IF SCIENCE AND TECHNOLOGY ARE TO UPLIFT THIS GENERATION. AS YOU ALREADY HAVE. AND INSPIRE GENERATIONS TO COME. AS YOU MUST. FOR YOU <u>ARE</u> AMERICA'S TRUE PIONEERS. DREAMING THE DREAMS THAT ENHANCE OUR ENERGY AND HEALTH, MEDICINE AND PRODUCTIVITY, NATIONAL SECURITY AND EDUCATION.

THE DREAMS THAT YOUR REMARKABLE DEEDS ARE HELPING TO COME TRUE.

AGAIN, MY HEART-FELT CONGRATULATIONS ON BEHALF OF EACH AND EVERY CITIZEN. AND NOW IT IS MY GREAT PLEASURE TO INTRODUCE THE SECRETARY OF COMMERCE, BOB MOSBACHER, AND MY ASSISTANT FOR SCIENCE AND TECHNOLOGY, ALLAN BROMLEY, WHO WILL DESCRIBE YOUR ACHIEVEMENTS.

BUT, YOU KNOW, I LIKE MY END OF THE BARGAIN. I GET TO PRESENT YOU WITH AMERICA'S HIGHEST TECHNOLOGICAL AND SCIENTIFIC AWARD. AND, YES, I GET TO SHAKE YOUR HANDS.

THANK YOU VERY MUCH, GOD BLESS YOU, AND GOD BLESS AMERICA.

# # # #

[redacted]

[redacted]