form of double dispersion relations. Later he made an effort to quantize string theories as ordinary quantum mechanical systems. He extended the work of Peter Goddard, Goldstone, Claudio Rebbi and Charles Thorn on the quantized free string to interacting strings. Mandelstam was among the first to make use of functional integration techniques in string theory.

Mandelstam obtained his PhD in mathematical physics from the University of Birmingham, in England, in 1956. After a year as a research assistant in mathematical physics at the university, he held a postdoctoral position in physics at Columbia University in 1957–1958 and then was an assistant research physicist at the University of California, Berkeley, until 1960. He then became a professor of mathematical physics at Birmingham, a post he held until 1963, when he moved to his present position at the University of California.

Previous Dirac Medalists included Ludwig D. Faddeev of the Steklov Mathematical Institute in Leningrad and Sidney R. Coleman of Harvard University in 1990, and Michael B. Green of Queen Mary College of the University of London, in England, and John H. Schwarz of Caltech in 1989.

IN BRIEF

The National Academy of Sciences will present several awards at a ceremony in Washington, DC, on 26 April. **Jerome B. Wiesner,** former president of MIT (now an emeritus physics professor there), will receive the NAS Public Welfare Medal for "his devoted and successful efforts in science policy, education, and nuclear disarmament and world peace."

John A. Simpson will receive the Arctowski Medal for "his pioneering studies of the properties of the charged particle environment of the Sun, the Earth and the other planets." Simpson is Arthur H. Compton Distinguished Service Professor of Physics at the University of Chicago.

The Comstock Prize will go to **Erwin L. Hahn,** emeritus professor of physics at the University of California, Berkeley, and **Charles P. Slichter,** a professor of physics and chemistry at the University of Illinois, Urbana–Champaign. Hahn was cited for "his revolutionary discoveries in magnetic resonance and coherent optics, in particular for the Hahn spin echo, the Hartmann–Hahn cross-polarization and self-induced transparency." Slichter was cited for "his seminal contributions to the development and application of magnetic resonance in condensed matter, including the first experimental proof of pairing correlations in superconductors and fundamental studies in surface science and catalysis."

Hiroo Kanamori, the John E. and Hazel S. Smits Professor of Geophysics at Caltech, will receive the Arthur L. Day Prize for "his outstanding contributions to the fundamental physics of the earthquake source process and to its application to earthquake prediction and mitigation of seismic risks."

The Henry Draper Medal will be shared by **Ralph A. Alpher,** Distinguished Research Professor of Physics at Union College, and **Robert Herman,** the L. P. Gilvin Centennial Professor in the department of civil engineering at the University of Texas, Austin. They were cited for "their insight and skill in developing a physical model of the evolution of the universe and in predicting the existence of a microwave background radiation years before this radiation was serendipitously discovered; through this work they were participants in one of the major intellectual achievements of the 20th century."

Harold S. Johnston will receive the NAS Award for Chemistry in Service to Society for "his pioneering efforts to point out that man-made emissions could affect the chemistry of of the stratosphere, in particular, the danger of the depletion by nitrogen oxide of the Earth's critical and fragile ozone layer." He is a chemistry professor at the University of California, Berkeley.

F. Sherwood Rowland, the Donald Bren Professor of Chemistry at the University of California, Irvine, was selected to give the Robertson Memorial Lecture for "his research which shows that mankind's activities, through the release of chlorofluorocarbons, lead to the destruction of the protective ozone layer in the upper atmosphere."

The NAS Award for the Industrial Application of Science will go to **Nick Holonyak Jr,** a professor in the department of electrical and computer engineering at the University of Illinois, Urbana–Champaign. He was cited for "his profound impact on industry and on the daily lives of the people around the world, through his prolific inventions in the area of semiconductor materials and devices including practical light-emitting diodes."

R. Eric Betzig will receive the NAS Award for Initiatives in Research for "the implementation of a near-field scanning optical microscope which extends the resolution of optical microscopy far beyond the diffraction limit to dimensions as small as one-fortieth of an optical wavelength."

The German Physical Society has given **Klaus Winter** the 1993 Stern–Gerlach Medal in recognition of his "fundamental research related to the structure of the weak neutral currents, in particular his precision experiments on the scattering of high-energy neutrinos on electrons and quarks." Winter is a senior physicist at CERN.

In January **Walter H. Munk**, a professor of geophysics at the Institute of Geophysics and Planetary Physics at the Scripps Institution of Oceanography, received the Vetlesen Prize from the G. Unger Vetlesen Foundation and Columbia University. He was cited for "his work in using sound waves to measure changes in ocean temperature."

The Alexander von Humboldt Foundation and the Max Planck Society have awarded the 1992 Max Planck Research Award to **Tomaso A. Poggio,** the Uncas and Helen Whitaker Professor of Vision Sciences and Biophysics at MIT, and **Manfred Fahle,** a professor at the Universitäts-Augenklinik Tübingen in Tübingen, Germany. They were chosen for their research in vision, brain science and learning.

On 28 April **Frank Press**, the president of the National Academy of Sciences, will receive the 1993 Japan Prize in the category of safety engineering and disaster mitigation. He will receive the prize from the Japanese government at a ceremony in Tokyo. The award citation recognizes him for his work in advancing scientific understanding of earthquakes and for encouraging international cooperation in reducing damage caused by natural disasters.

OBITUARIES

Nikolai N. Bogolubov

Nikolai Nikolaevich Bogolubov, a distinguished mathematician and theoretical physicist and the director of the Joint Institute for Nuclear Research in Dubna for almost a quarter of a century, died on 13 February 1992.

Bogolubov was born in Nizhny Novgorod, Russia, on 21 August 1909. He started his scientific career very early: At the age of 13 he joined a seminar led by Nikolai N. Krylov, a member of the Soviet Academy of Sciences, and at the age of 15 he wrote his first scientific paper. In 1930 the Presidium of the USSR Academy of Sciences conferred on him the degree of doctor of mathematics.

In 1932 Bogolubov, together with Krylov, started to develop a completely new field of mathematical physics: nonlinear mechanics. Bogolubov's fundamental ideas in this field formed the basis of numerous modern investigations in other fields, such as aerodynamics, control theory, condensed matter, optics, ecology and particle accelerators. Development of these methods allowed Bogolubov a different approach to the study of systems consisting of many particles—that is, most of the bodies surrounding us.

Bogolubov introduced the notion of the hierarchy of times during which characteristic changes occur in similar systems. This approach proved to be decisive in the development of the statistical theory of irreversible processes. This new step made it possible to create a universal method of obtaining general kinetic equations in statistical physics proceeding from microscopic conceptions. The results of his work have been applied in numerous fields of science, from physics to biology, and they represent the next fundamental stage in statistical physics after Boltzmann's and Gibbs's work.

During the first half of the 20th century two extraordinary microscopic phenomena were discovered: the superconductivity and superfluidity of liquid helium. In 1946 Bogolubov gave a brilliant physical explanation for the phenomenon of superfluidity. He showed that it was theoretically possible for helium particles with opposite momentums to "stick" together in pairs. By developing and summarizing these ideas, Bogolubov formulated a theory in which superconductivity is considered as a superfluidity of the electron gas in the metal. Many others investigated the microscopic theory of superfluidity and superconductivity, but only Bogolubov made clear the dominant role of the degenerated nonstable vacuum. This notion was transferred into quantum field theory and became a fundamental idea in modern theoretical physics.

Bogolubov's outstanding achievement was the creation of the axiomatic quantum field theory. On the basis of this theory he investigated a diversity of phenomena in the world of elementary particles and found intrinsic relationships among them. This work changed the style of the physical mentality and for many years influenced the development of theoretical and experimental high energy physics.

In the middle of the 1960s Bogolubov started to study hadron symmetries and the construction of baryons and mesons from new fundamental constituents: quarks. With his disciples, he introduced a new quantum number for quarks, which later would receive the name "color." The concept of color quarks is now the most important in the modern theory of strong interactions, quantum chromodynamics.

The key feature of Bogolubov's style was his skill in grasping the most important problem and then elaborating a universal and efficient method to solve it without any fear of difficulties. Bogolubov contributed to many branches of mathematics, mechanics and physics. Norbert Wiener once wondered if there were several Bogolubovs, each being a prominent specialist in his field.

From 1965 to 1989 Bogolubov was the director of the Joint Institute for Nuclear Research. Under his leadership the institute coordinated the development of physical investigations in its member states. He initiated an international cooperation with many science centers throughout the world. As the originator of new ideas and promoter of new trends in physics, Bogolubov contributed greatly to the position of the institute among centers investigating the physics of particles and nuclei.

Bogolubov had a broad and encyclopedic knowledge far beyond the exact sciences, as well as an unfailing kindness and generosity, which were known to several generations of physicists. A number of scientific schools were established around Bogolubov: mathematical physics and nonlinear mechanics in Kiev and theoretical and mathematical physics in Moscow and Dubna. His disciples now carry out research in Kiev, Moscow, Dubna, Tbilisi, Baku, Erevan, St. Petersburg, Nizhny Novgorod and other places in Russia as well as abroad.

Bogolubov was an outstanding and influential figure in world science and politics. His colleagues, disciples and friends, all those who knew and loved him, keep deep inside themselves the memory of this extraordinary man.

ALEXANDER M. BALDIN
VLADIMIR G. KADYSHEVSKY
ALEXEY N. SISSAKIAN
Joint Institute for Nuclear Research
Dubna, Russia

Feza Gürsey

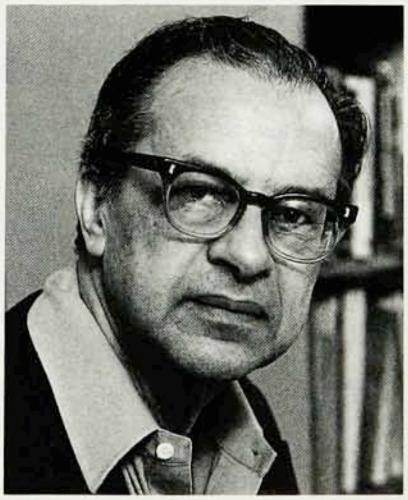
Feza Gürsey, the J. Willard Gibbs Professor Emeritus of Physics at Yale University, died on 13 April 1992 at the age of 71. He will be remembered for the originality, elegance and effectiveness of his uses of mathematical methods, especially group theory, in physical problems and as an outstanding teacher who was very dedicated to his numerous students.

Feza was born in Istanbul, Turkey. His undergraduate education was at the University of Istanbul, where he received a BS in physics and mathematics in 1944. In 1950 he obtained a PhD in mathematical physics from Imperial College, London. He was a docent at the University of Istanbul from 1954 to 1961 and a professor at the Middle East Technical University from 1961 to 1964. In 1965 he joined the faculty of Yale University first as a visitor and then in 1968 on a permanent basis.

Feza's early work on the group structure of elementary particles and the symmetries of strong and weak interactions drew immediate attention. It contained the first suggestion of chiral symmetry in the strong interactions, which was later fully formulated in the much celebrated nonlinear sigma model. In 1962, while spending the summer at Brookhaven National Laboratory, he wrote in collaboration with Luigi Radicati a paper on the spin and unitary-spin independence of the strong interaction, introducing the group SU(6) as an approximate symmetry of quarks at low energies. This paper had an enormous and lasting impact on the physics of elementary particles.

Feza made a major contribution to the construction of unified theories of elementary particle interactions with the introduction of symmetry based on the groups E(6) and E(7)—the first use of the exceptional Lie groups in physics. Such constructions have become even more relevant: One of the most promising superstring models, the heterotic string, has an $E(8) \otimes E(8)$ gauge symmetry group.

Feza Gürsey



Feza's contributions to mathematical physics were deep and innovative. He was a proponent of the use of quarternionic analyticity in gauge theories, an idea that was subsequently used, for example, in the solution of the multi-instanton problem. He used his profound and extensive knowledge of mathematics to help bridge the gap between physicists and mathematicians and had a strong influence at Yale in establishing a vigorous interaction between the departments of physics and mathematics.

Although physics and mathematics were Feza's first loves, he was in fact a much broader person. He had a vast knowledge of history, particularly that of physics and mathematics, as well as the history and the traditions of the Middle East. His interest extended to literature and the arts, world affairs and the plight of third world nations in their search for justice and development.

Feza was a very gentle, kind and good man. Open to people of the most diverse backgrounds, he was always willing to help people and to invite them to his house, and he had a special rapport with the young. His death is a great loss for the entire physics community, but Feza's legacy will live on among his friends and future generations of physicists.

SAMUEL W. MACDOWELL
CHARLES M. SOMMERFIELD
Yale University
New Haven, Connecticut

John Donovan Strong

John Donovan Strong died on 21 March 1992 in Amherst, Massachusetts, at the age of 87.

Strong was respected throughout the world for his skill in physics, particularly optical physics, and for his students, who proved to be highly competent physicists in their own right.

Strong attended Friends University for a time and graduated from the University of Kansas in 1926. Subsequently he received his MS in 1928 and his PhD degree in physics in 1930 from the University of Michigan. At the University of Michigan, he grew large crystals of KBr that allowed spectrometry at longer wavelengths in the infrared, and he experimented with the thermal evaporation of met-