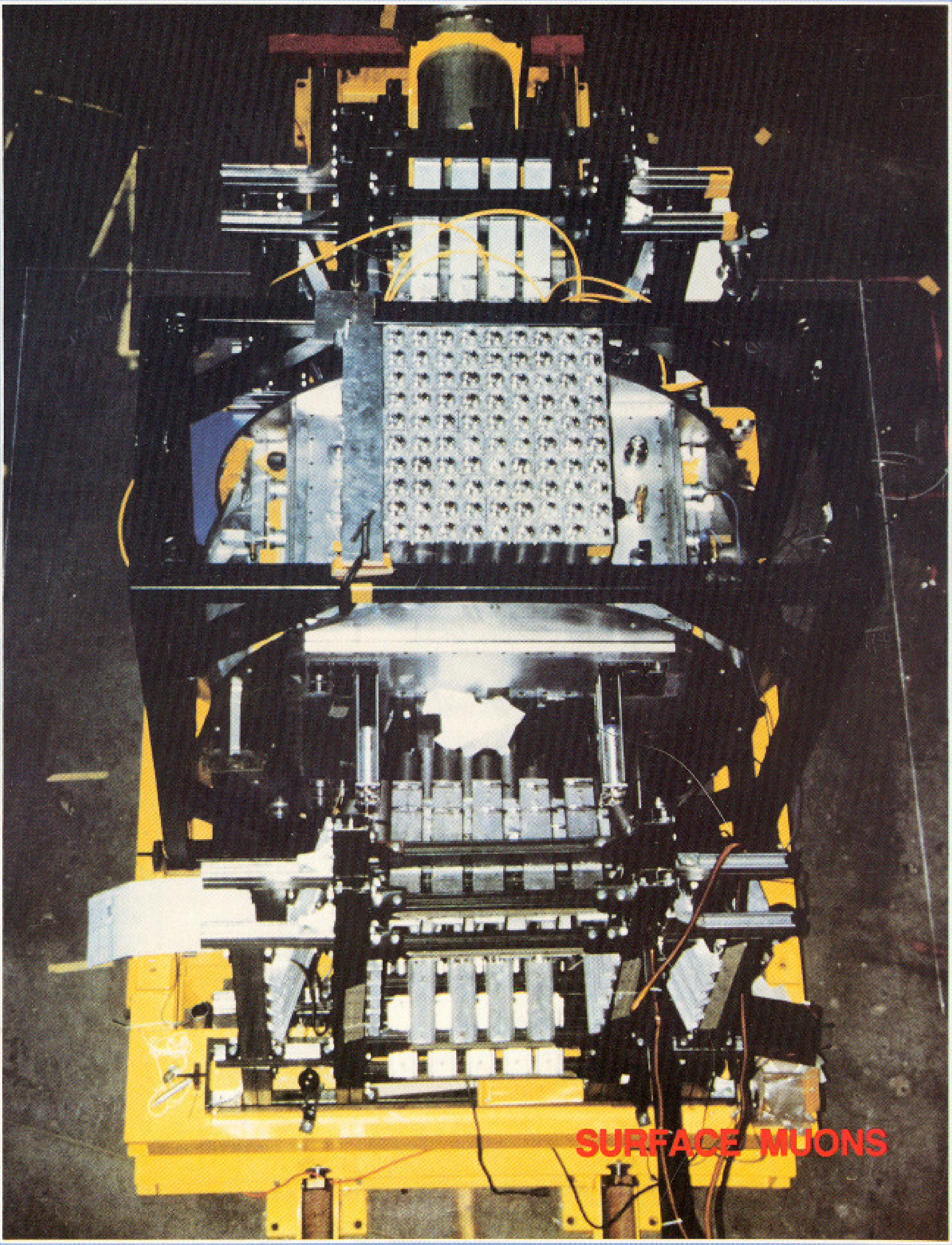
physics today

JULY 1985



JULY 1985
VOL. 38 NO. 7

physics today

EDITOR
Gloria B. Lubkin

MANAGING EDITOR
Thomas von Foerster

SENIOR ASSOCIATE EDITOR
Irwin Goodwin

ASSOCIATE EDITORS
Alexander Hellemans
Jeffrey D. Schmidt
Bertram M. Schwarzschild
William Sweet

ASSISTANT EDITOR
Margaret Marynowski

COPY EDITOR
Laura Stephan-Corio

CONTRIBUTING EDITOR
Barbara G. Levi

SENIOR ART EDITOR
Elliot Plotkin

ASSISTANT ART EDITOR
Maria F. Chumas

DESIGN CONSULTANT
Martin Saint-Martin

ADVISORY COMMITTEE
Anthony P. French (chair)
Charles P. Bean
D. Allan Bromley
Frederic Golden
Edwin L. Goldwasser
Theodor W. Hänsch
Richard W. Hoffman
Frank B. McDonald
John A. Thornton
Lewis Slack (staff liaison)

EDITORIAL OFFICES
335 East 45 Street
New York, NY 10017
(212) 661-9404
Telex
960 983 AMINSTPHYS NYK

Suite 739
2100 Pennsylvania Avenue NW
Washington, DC 20037
(202) 429-1908

ADVERTISING OFFICES
335 East 45 Street
New York, NY 10017
(212) 661-9404
Telex
960 983 AMINSTPHYS NYK

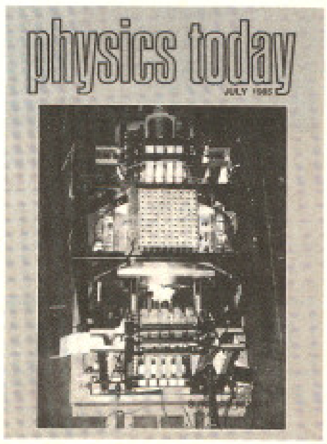
BPA

NEWS

ARTICLES

EDITORIAL

DEPARTMENTS



COVER: The Crystal Box experiment at the Los Alamos Meson Physics Facility. The drift chambers and scintillators shown here are designed to detect rare muon decays—with branching ratios as low as 10^{-12}. Such experiments are made possible by the surface muon technique, which is discussed by its inventor, Theodore Bowen, in his article on page 22. (Los Alamos photo courtesy of Richard D. Bolton.)

we hear that

Franklin Institute honors eight physicists

The Franklin Institute presented its 1985 awards in April. Andrei Sakharov and Robert N. Clayton, professor of chemistry at the University of Chicago, were named recipients of the Elliott Cresson Medal. William Cochran, professor of physics and vice-principal of the University of Edinburgh, received the Howard N. Potts Medal. Lynn A. Conway, professor of electrical engineering and computer science and associate dean of the college of engineering at the University of Michigan, and Carver A. Mead, professor of computer science at Caltech, were awarded John Price Wetherill Medals. Roy J. Glauber, Mallinckrodt Professor of Physics at Harvard University, was awarded the Albert A. Michelson Medal. Edward E. David Jr, president of Exxon Research and Engineering Company of Annandale, New Jersey, was presented the Delmer S. Fahrney Medal. George C. Pimentel, director of the chemical biodynamics laboratory at the University of California, Berkeley, received the Franklin Medal, which is the Institute's most prestigious award.

Clayton was cited for "the major role he has played in the application of mass spectroscopy to a wide variety of geoscience researches and, in particular, for his far-reaching contributions to the knowledge of the early solar system." In the mid-1960s, Clayton pioneered the use of bromine pentafluoride in mass spectrometry as a solvent for determining the total oxygen content of a material; it remains a standard analytical technique of today. In 1973, Clayton discovered an overabundance of the isotope O^{16} in certain compounds of the carbonaceous chrondrites, which are believed to be among the most primitive objects in the solar system. This discovery implies that the solar nebula was not completely homogenized and that one can therefore study the history of matter in presolar times.

Clayton received his PhD in 1955 from Caltech. He held an academic appointment at Pennsylvania State University (1956–58) before joining the faculty of the chemistry department of the University of Chicago. He was made a full professor there in 1966, has served as college master, department chairman and dean, and is currently the Enrico Fermi Distinguished Professor of Chemistry.

Sakharov was honored for "his scientific work in four areas: controlled thermonuclear reactions (tokamak), baryon synthesis and proton decay, induced gravity and the quark model." In 1950, with Igor E. Tamm, Sakharov suggested that fusion processes could be maintained and controlled by magnetically confining a hot plasma. He proposed the design for the toroidal magnetic bottle that has since become known as the tokamak. Sakharov further detailed the generation of ultrahigh magnetic fields by chemical or nuclear implosion, as well as the μ-meson catalysis of fusion in cold deuterium. In 1966, Sakharov suggested that the baryon number need not be conserved and that the excess of baryons in the present universe arose as a result of disequilibrium processes in the early universe. That same year, he and Ya. B. Zel'dovich derived a semi-empirical formula for mesons and baryons from their quark substructure formulation. In 1975 and later, while in forced isolation in Gorki (1980), Sakharov extended these results to charmed quarks. In 1967 he suggested that the Einstein gravitational interaction may be an induced effect of the quantum fluctuations of matter fields.

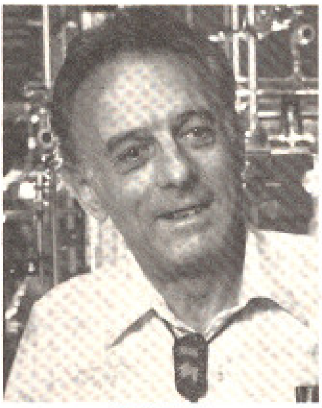
Sakharov received his doctoral degree in 1945 from Lebedev Institute. In 1953 he was elected a full member of the USSR Academy of Sciences. At that time, Sakharov was the most decorated civilian in the USSR: He held the Order of Lenin, was named Hero of Socialist Labor three times, and was awarded the Lenin Prize and the State Prize. Sakharov was awarded the Nobel Peace Prize in 1975.

Cochran was recognized for his "important work in x-ray crystallography of biologically important compounds, the formulation of diffraction scattering by helices, analysis of lattice vibrations in crystals and research on the soft-mode concept in phase transitions." Early in his career, Cochran determined the structures of purines and pyrimidines and concurrently developed a formulation for scattering by atoms lying on helices. His results in both instances were crucial to the success of James Watson and Francis Crick in determining the structure of DNA. Cochran's investigations of anisotropic thermal lattice vibrations and ferroelectricity led to his 1959 discovery of the soft-mode concept in phase transitions: The term soft mode refers to the low-frequency oscillations, near second-order phase transitions, of the collective coordinate corresponding to the order parameter. Soft modes are also observed in first-order phase transitions that occur near second-order transitions, as in the case of ferroelectric phenomena.

Cochran received his PhD in 1943 from the University of Edinburgh. He remained there as an assistant lecturer until 1946, when he became a Rockefeller Fellow at Caltech. In 1948 he joined the faculty of Cambridge University, advancing in 1962 to the position of reader of physics. In 1964, Cochran was made professor of physics at the University of Edinburgh; he became vice-principal of the university in 1984.

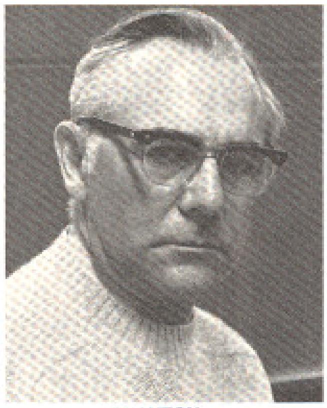
Conway and Mead were cited for "the major impact of their method of obtaining silicon chips in small quantities at reasonable cost." In 1980, Mead and Conway wrote *Introduction to VSLI Systems*, which presents a systematic approach to the design of very-large-scale integrated circuits. In designing such a circuit, the Mead–Conway method assigns the required primitive functions to cells that may then interact to form the next, higher level of functions. Successive levels are built up in similar fashion, with each level containing and controlling the one below it. The chip's mask design is then optimized by algebraically manipulating symbols that are used to represent the primitive cells. In addition to providing a system by which chips may be quickly designed and economically prototyped, even in small numbers, Mead and Conway's book presented a simple and understandable format for teaching the subject at the university level.

Conway received her MS in electrical



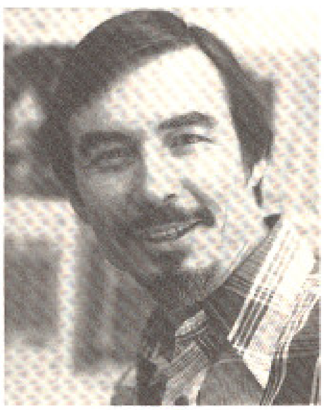
PIMENTEL

SAKHAROV



CLAYTON

CONWAY



MEAD

DAVID

JANE REED/HARVARD UNIVERSITY

GLAUBER

engineering in 1962 from Columbia University. She has held research positions at IBM (1964–69) and Memorex (1969–73). She has served as research fellow and manager of the VLSI systems area at the Xerox Palo Alto Research Center (1973–83). For 1983–85, Conway served as chief scientist and assistant director for strategic computing at DARPA.

Mead received his PhD in electrical engineering in 1959 from Caltech. He began teaching there in 1957 as an instructor and was made a full professor in 1967. In 1980, Mead was appointed the Gordon and Betty Moore Professor of Computer Science at Caltech.

Glauber was honored for "his formulation of the quantum theory of optical coherence and for his additional important contributions to the dynamics of Ising chains and high-energy scattering." Glauber presented the basic elements of the quantum theory of optical coherence, which provides a framework for describing how, for example, the photon structure of coherent laser light differs from that of incoherent monochromatic light from a discharge lamp, in a letter and a series of papers published in *Physical Review* in 1963. In the early 1950s, Glauber began developing a diffractive approach to the scattering of particles by complex nuclei, which later became known as the Glauber approximation. In 1955, he discovered the process of diffraction dissociation. During this period Glauber also studied quantum-mechanical shadowing and multiple-scattering effects. He subsequently worked on extending these results, in the late 1960s, to the effects of internal correlations on the scattering of particles by nuclei, and, more recently, to hadron–hadron scattering phenomena. In the early 1960s, he suggested the first time-dependent generalization of the Ising chain—a version of the Ising model described by time-dependent stochastic processes.

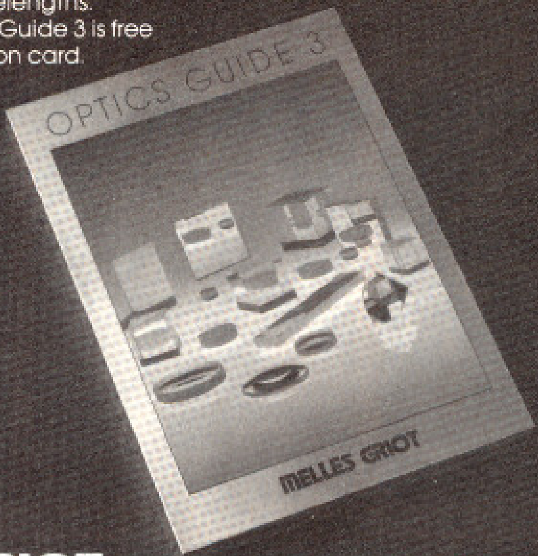
Glauber received his PhD in physics in 1949 from Harvard University. He worked at Los Alamos in 1944–46, then held a research position at the Institute for Advanced Study (1949–51). After teaching for a year at Caltech, he joined the faculty of Harvard University in 1952, becoming a full professor in 1961. He was named Mallinckrodt Professor of Physics in 1977.

David was cited for his "continuing leadership nationally to industry, education and to his country in many fields of science and technology." After receiving his ScD in electrical engineering from MIT in 1950, David became a member of the technical staff of Bell Labs. He was appointed executive director of communications research there in 1962. From 1964 until 1970 he also served as the co-director of the NSF-sponsored Engineering Concepts Curriculum Project. David then be-

Optics Guide 3

More than 500 pages of optical components and hardware. Clearly described, specified, defined, illustrated. Optical tables. Lenses, prisms, mirrors. Benches. Lasers. Holders, positioners, translators. New components, new devices, new wavelengths.

Your copy of Optics Guide 3 is free if you fill in a qualification card. For a copy of the qualification card, give us a call or circle our number on this magazine's reply card. It's the best, most useful optics catalog ever, anywhere.



MELLES GRIOT Optical Components

U.S.A. (714)261-5600 · Netherlands (8360)33041 · England (0252)334411 · Japan (03)407-3614 · France (03)460-5252 · West Germany (06151)595353

Circle number 37 on Reader Service Card

QUADRUPOLE GAS ANALYZER

COMPLETE INSTRUMENT

$4995.00

(MADE IN U.S.A.)

Now Available with Particle Multiplier

STANDARD FEATURES

- 1-100 AMU
- Faraday Cup Detector
- Dual Filaments
- 100% Front Panel Control
- 12" High Resolution Display
- Graph or Tabular Data Display
- RS232 Computer Interface
- 10^{-4} to 5×10^{-12} Torr Pressure Range
- Background Subtraction

OPTIONAL FEATURES

- Pressure vs. Time Display
- 1-200 AMU
- Graphics Printer For Hard Copy
- Sample System For Higher Pressures

With Dycor's Quadrupole Gas Analyzer you will no longer have to guess about what's in your Vacuum System. A glance at the screen will tell you exactly what is there. Our engineers would be happy to discuss your application.

Dycor Inc. 1023 Wm. Flynn Hwy • Glenshaw, PA 15116 • (412) 486-4700

Circle number 38 on Reader Service Card

came President Nixon's science adviser and the director of the Office of Science and Technology, where he worked on several projects concerning satellites, the space shuttle, the national cancer program, energy research and technology policy. In 1973, David became executive vice-president of Gould Inc and president of that company's laboratories. He moved to Exxon Corporation in 1977, becoming president of Research and Engineering. He served as the president of the American Association for the Advancement of Science in 1978.

Pimentel was honored for "his experimental work in matrix-spectroscopy and in the realization of the chemical laser." In the early 1950s, Pimentel began developing the method of matrix separation, in which highly reactive molecules are stabilized for spectroscopic study in a matrix of frozen inert gas. His technique made possible the detection of many previously unknown, highly unstable molecules. In addition, he developed rapid scan techniques for infrared spectroscopic studies of transient gaseous molecules. These techniques found direct application on the 1969 Mariner mission in an infrared spectrometer that was used to determine the atmosphere of Mars. In 1964, while conducting studies of photochemical reactions, Pimentel and his student, J.V.V. Kasper, discovered the first chemically pumped laser, based on the production of hydrogen chloride molecules from the reaction of hydrogen atoms with chlorine molecules.

Pimentel joined the faculty of the chemistry department of the University of California, Berkeley, upon receiving his PhD from that institution in 1949; in 1959 he was made a full professor. Pimentel served as deputy director of NSF from October 1977 to June 1980. He then became the director of LBL's chemical biodynamics laboratory and head of an organized research unit of the University of California's chemistry department.

Bethe receives NSF Vannevar Bush Award

The National Science Foundation has presented the Vannevar Bush Award to Hans Bethe (Cornell University) for "pioneering with vision and boldness, the exploration, charting and settlement of new frontiers in science, education and public service."

Bethe received his PhD in physics under Arnold Sommerfeld from the University of Munich in 1928. He taught at several European universities: Frankfurt (1928–29), Stuttgart (1929) and Munich and Tübingen (1930–33). During 1930–32, he worked