

charge effects in cold-cathode discharges; and pioneering work in the application of photolithographic techniques to semiconductor devices and microminiaturization. After the announcement of the "photolithographics" transistor and the two-dimensional wafer-type electronic circuit, his area became recognized worldwide in this field.

In the final years of his scientific career, his love for independent basic research led him to gas lasers. He was one of the first to recognize the importance of electron temperature in gas lasers. He extended early theories to obtain fundamental relationships between simple physical parameters and average electron temperatures in the region of the positive column—relationships which were applicable to the binary, noble-gas mixtures being extensively studied as common gas laser-active media in the early sixties. He also recognized early that hollow-cathode discharges had properties that should make them ideal gas laser excitation media. The hollow-cathode configurations he designed in the late sixties have been shown to be the most suitable for the shortest-wavelength gas lasers that have been operated in a continuous mode.

MARTIN J. REDDAN
Bethesda, Maryland

C. S. Willett and T. Liimatainen contributed to this obituary.

Stuart T. Butler

Stuart Thomas Butler, known to nuclear physicists for his deuteron stripping theory, died in Sydney, Australia, on 15 May 1982 at the age of 55.

He developed the theory of deuteron-induced transfer reactions in

BUTLER



1951 in his PhD thesis at Birmingham University, under the direction of Rudolf Peierls. The theory considers one nucleon of the incident deuteron to be captured into a sharp energy level of the product nucleus, while the other nucleon is only a "spectator" that conserves energy and momentum. Butler's insight was that the captured nucleon would tend to enter a definite single-particle state of the shell model and that its single-particle quantum numbers could be deduced from the angular distribution of the spectator nucleon. This approach deviated sharply from the compound-nucleus reaction models that had been standard at the time; it served as a prototype for subsequent emphasis on direct nuclear-reaction models. Deuteron stripping provided crucial support in the early development of the shell model by allowing direct measurement of single-particle properties of nuclear states. It has been exploited extensively since that time.

Butler was born in South Australia on 4 July 1926. After a distinguished undergraduate career in Adelaide University in the department established by William Bragg, he sailed for England to do graduate work at Birmingham. Two further years as a research associate at Cornell University were followed by his return to Australia in 1953, where he later became Professor of Theoretical Physics at Sydney University.

Although Butler continued work in nuclear theory in Sydney, making important contributions to the theory of direct nuclear reactions and to the Bethe-Goldstone approach to nuclear structure, his interests broadened to include atmospheric tides, statistical physics, plasma physics and cosmic rays. He devoted a major effort to an electron-pairing model of superconductivity, in collaboration with John M. Blatt and M. Robert Schafroth, at about the same time the BCS theory was first introduced.

In his concern to make science understandable to the general public, Butler contributed frequent articles to the popular press, as well as a long-running comic strip series on science. When the first Sputnik was launched in 1957 he helped organize a program of public education about the scientific background of rockets and satellites. This led to a series of lectures and TV programs. During the 1960s he became more active in educational matters in New South Wales. He helped organize and write new textbooks to respond to drastic changes of secondary-school curricula.

In 1977 his career of public service broadened when he resigned from Sydney University to become Director of the Australian Atomic Energy Com-

mission Research Establishment at Lucas Heights, New South Wales. He oversaw both its diversification from fission research to other forms of energy research and its involvement in the Synroc project for nuclear-waste disposal.

NORMAN AUSTERN
University of Pittsburgh
BRUCE H. J. MCKELLAR
University of Melbourne
HUGH McMANUS
Michigan State University
EDWIN E. SALPETER
Cornell University

Austin Rogers Frey

Austin Frey, probably best known in the physics community as the co-author of *Fundamentals of Acoustics* with L. E. Kinsler, died on 28 June.

Austin was born 1 April 1897 in Newark, New Jersey. He studied at MIT and went on to receive his BS, MS and PhD degrees from Harvard University between 1920 and 1929. After teaching at Williams College, he served, from 1929 to 1942, on the faculty of Lehigh University. Afterwards he worked at the Office of Scientific Research and Development from 1942 to 1945, assisting in the development of the radio proximity fuse. He joined the Naval Postgraduate School in 1946, serving as chairman of the physics and electronics department 1947-53 and of the physics department 1953-64. During a leave of absence 1955-56, he served as the first dean of the Navy's Nuclear Power School at New London, Connecticut, under Admiral Hyman Rickover. He retired from the Naval Postgraduate School in 1967 as distinguished professor emeritus.

EUGENE C. CRITTENDEN JR
OSCAR B. WILSON JR
Naval Postgraduate School □

FREY

