

particles in pairs and forbid their decay by the strong interactions. The nature of these selection rules was explained later by Murray Gell-Mann and others who concluded that there is a quantum number (strangeness) conserved in the strong interactions but violated by the weak interactions. This is obvious now that we know about quarks and their quantum numbers. But Bram's principle of associated production and Gell-Mann's introduction of strangeness broke a theoretical logjam.

In a related, but even more striking theoretical discovery, Bram and Gell-Mann described the particle we now call the K_S (kay-short) as a quantum mechanical mixture of a strange particle, the K^0 , and its antiparticle, the $\bar{K}^0$. And they predicted the existence of a different combination, the K_L (kay-long) with a much longer lifetime and an almost infinitesimally different mass. This construction was so far from the classical notion of what a particle is, so bizarrely and ineluctably quantum mechanical, that it still seems strange today. It is almost impossible even to talk about in our everyday language (witness the long list of popular articles and books that get it wrong). If you think you understand the K_S in your bones, you are just not thinking hard enough. But the quantum mechanical arguments of Pais and Gell-Mann were absolutely compelling and essentially correct. They did not know at the time that some of the symmetries they used in their analysis were only approximate, but that did not invalidate their astonishing conclusion. This, to borrow a phrase from my colleague Sidney Coleman, was "quantum mechanics in your face."

With Oreste Piccioni, Bram developed the theory of "regeneration" that describes how these weird quantum mechanical mixtures interact with ordinary matter. Regeneration allows experimenters to manipulate beams of the mixture-particles. The technique is still used today to study them.

Richard Feynman found this description of the K-meson system to be a convincing argument for quantum mechanics itself. In his book *The Theory of Fundamental Processes* (W. A. Benjamin, 1962), Feynman said, "One of the most strikingly brilliant predictions of this theory of strangeness was made by Pais and Gell-Mann. . . . This is one of the greatest achievements of theoretical physics. It is not based on an elegant mathematical hocus-pocus such as the general theory of relativity yet the

predictions are just as important as, say, the prediction of positrons. Especially interesting is the fact that we have taken the principle of superposition to its ultimately logical conclusion. . . . It does not prove it right, but for my money, the principle of superposition is here to stay."

Bram moved to Rockefeller University in 1963 to lead the theoretical physics group, part of Rockefeller's transition from a medical institute to a university. For the rest of his physics career, he remained at Rockefeller, where he was the Detlev W. Bronk professor emeritus. He poured much of his energy into working with younger colleagues and students and building the Rockefeller group. After his retirement, he and his wife Ida Nicolaisen spent half of each year in Denmark where Bram worked at the Niels Bohr Institute.

In the late 1970s, Bram turned to history and biography. Always a master storyteller, he believed that he was in a unique position to help unravel the history of 20th-century particle physics. He knew the cast of characters. He had a feeling for their cultures. He could speak their languages. And most of all, he understood the physics. Perhaps also, he turned to history because the pace of discoveries in experimental particle physics had slowed. For Bram, this took much of the fun out of physics. His book *Inward Bound: Of Matter and Forces in the Physical World* (Oxford University Press, 1986) is dedicated to "those who built the machines, the beams, and the detectors, and those who used them, and those who reflected on their results." It was the complicated interplay among the machine builders, the experimenters, and the theorists that brought physics to life for him. He sought to bring this alive for the reader in his histories and biographies.

His books are wonderful reading. For example, *Subtle is the Lord: The Science and the Life of Albert Einstein* (Oxford University Press, 1982) has won acclaim and awards despite the difficult physics it contains. But the books are probably even more important for their immense scholarship. They are treasure troves that future science historians will quarry for insights into 20th-century physics.

Bram thought hard about the titles of his books. *Subtle is the Lord* speaks for itself. But I think perhaps he was most proud of *Inward Bound*, because it captures some of the excitement and mystery of particle physics. He says in the preface, "Along this incompletely

traveled road inward man has established markers that later generations will rank among the principal monuments of the twentieth century."

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Thomas John Ypsilantis

Thomas John Ypsilantis, codiscoverer of the antiproton and codeveloper of the Čerenkov ring-imaging particle-identification technique, RICH, died on 16 August 2000 in Geneva, Switzerland, of a heart attack.

Tom was born in Salt Lake City, Utah, on 24 June 1928. He was the second of three children of Eugenia and John Ypsilantis, who had immigrated to the US from Greece in 1924. His father died when Tom was only 2½ years old, and his mother, then a 26-year old widow, was faced with the daunting task of raising her children during the Depression.

In 1950, Tom graduated from the University of Utah with a BS in chemistry. As a graduate student at the University of California, Berkeley, he soon apprenticed himself to Emilio Segrè. In his book *Mind Always in Motion: The Autobiography of Emilio Segrè* (University of California Press, 1993), Segrè comments, "Among the students was Tom Ypsilantis, who had studied chemistry but had recently come to me because he wanted to change to physics. I soon recognized his human qualities as well as his uncommon scientific ability. During my absence Tom and Clyde [Wiegand] succeeded in polarizing the proton beam of the synchrocyclotron by collision. The success obtained and Ypsilantis's spirit of initiative impressed me, and I proposed a faculty appointment for him. He was one of the most promising physicists at Berkeley." The polarization program that Tom pioneered at Berkeley led to a series of double and triple scattering experiments that yielded the data used by Nicholas Metropolis, Henry Stapp, and Ypsilantis in the first comprehensive phase shift analysis of nucleon-nucleon scattering at 310 MeV using the MANIAC computer at Los Alamos National Laboratory.

Shortly before receiving his PhD in physics in 1955, Tom joined with Owen Chamberlain, Segrè, and Wiegand to search for the antiproton. They designed an experiment based on measuring the masses of momen-



THOMAS JOHN YPSILANTIS

tum-selected particles in a secondary beam using time-of-flight and Čerenkov counter techniques. Wiegand and Ypsilantis were key participants in this experiment, but, unfortunately, they were not chosen to share the 1959 Nobel Prize in Physics, which was awarded to Chamberlain and Segrè for this discovery.

In the mid-1960s, Tom married Beverly Allen, and seemed well on the way to a conventional future as a Berkeley physics professor. But as his friends and colleagues well know, Tom was never conventional, so perhaps it should not have come as a surprise when he decided to resign his tenured position and move first to Brookhaven National Laboratory and then to Europe. For the next 32 years, he worked mostly at CERN in Geneva, but also in France, Italy, and Greece.

A dominant theme in Tom's research activities was to advance the frontiers of detector technology in order to explore fundamental issues in particle physics. In the 1970s and 1980s, a key challenge was to make reliable particle identification in large-volume detectors over as much of the available phase space as possible. To this end, he and one of us (Seguinot) developed the RICH technique. In a series of innovative experiments, they succeeded in finding gases with low ionization thresholds, designing clever optical configurations, and continually refining the method until high-quality ring images were produced. Over the years, they continued to improve the RICH technique so that it has now been adopted as an essential feature of major experiments such as Delphi and Omega at CERN; E605 and BTeV at the Fermi National Accelerator Laboratory; and SLD at SLAC.

Tom's dedication to physics is well demonstrated by the fact that, after his contract at CERN had expired, he continued to do physics there even though he was no longer receiving any salary. Fortunately, the French National Center for Scientific Research (CNRS) and the Lepton Asymmetry Analyzer (LAA) Project at CERN, together with the National Institute of Nuclear Physics (INFN) in Rome, supported him and his activities for more than a decade. Tom assumed major responsibilities for the R&D work of the LAA group led by Antonino Zichichi. Tom enjoyed the stimulating intellectual atmosphere of this group, and the fruitful collaboration that ensued contributed greatly to the success of his new ideas and imaginative projects. This collaboration continued after his retirement, and he continued to work at CERN with undiminished vigor as a University of Bologna and INFN research professor.

For Tom, detector development was the means to the end of doing interesting physics. Together with Seguinot, Zichichi, and their colleagues, he embarked on a number of ambitious experimental proposals to study neutrino interactions. One of these, called HELLAZ, was a time-projection chamber containing 20 tons of helium gas at a pressure of 20 bars (2 MPa), operated at liquid nitrogen temperatures and shielded by blocks of solid carbon dioxide to detect solar neutrinos. Another was a 27-kiloton liquid water target and radiator with a RICH photon counter to search for oscillations in the CERN–Gran Sasso neutrino beam. More recently, in 1996, he proposed AQUA-RICH, a 125-meter diameter spherical detector containing 1 megaton of water for the observation of atmospheric neutrinos. He was passionate about these projects. He knew only too well that these grandiose ideas were technically difficult, but believed they were indispensable for progress.

From 1995 until his death, Tom served as an editor of the journal *Nuclear Instruments and Methods*. He was a quiet, unassuming person who did not seek personal glory. Nevertheless, his scientific accomplishments were recognized by a number of honors: Doctor Honoris Causa from the University of Uppsala in Sweden, member of the Scientific Academy of Greece, and in 1999, together with Seguinot, the French Physical Society's Special Prize for the development of RICH.

As a scientist, Tom was creative, tenacious, and an eternal optimist. On a personal level, he was a man of char-

acter—sincere, open, warm, and charming. He leaves a large void in the physics community, not only because of his extraordinary scientific contributions, but because of his personal qualities as a friend and colleague.

JACQUES SEGUINOT
CERN

Geneva, Switzerland

HERBERT STEINER

University of California, Berkeley

ANTONINO ZICHICHI

University of Bologna

Italy

George Wilse Robinson

George Wilse Robinson, Robert A. Welch Professor of Chemistry and Joint Professor of Physics at Texas Tech University, died from a stroke on 7 September 2000 in Lubbock, Texas. Through innovative experiments and insightful theory, Wilse and his coworkers brought fundamental understanding to some of the most important problems in molecular structure, electronic energy relaxation in molecules, crystal spectroscopy, reaction dynamics in liquids, and, more recently, the structure and properties of liquid water.

Born in Kansas City, Missouri, on 27 July 1924, Wilse attended schools in Kansas City and Clearwater, Florida. After serving in the US Navy during World War II, he enrolled at the Georgia Institute of Technology, where he earned a BS in 1947 and an MS in 1949, both in chemistry. He received his PhD in physical chemistry at the University of Iowa in 1952.

In 1954, after two years as a research fellow at the University of Rochester, Wilse received his first faculty appointment—an assistant professor of chemistry at the Johns Hopkins University. At Hopkins, he was the first to successfully develop techniques for detecting electronic spectra of isolated molecules and free radicals trapped in crystalline inert gases at liquid helium temperature.

Wilse joined Caltech as an associate professor of chemistry in 1959. Two years later, he was promoted to professor. The Caltech years were highlighted by landmark theoretical and experimental work on radiationless loss of excited-state electronic energy in molecular aggregates. The 1962 and 1963 *Journal of Chemical Physics* articles by Wilse and Peter Frosch are considered to be key papers in radiationless transition theory. This work, for which Wilse is widely known, continues to have a