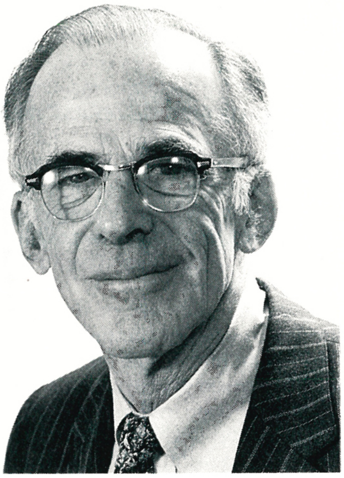
Lyman Spitzer Jr

March 31, 1997, began as an ordinary day for Lyman Spitzer. He worked on a manuscript using data from the Hubble Space Telescope—which he had proposed, helped design and nurtured through construction. His paper analyzed the implications of the HST data for the theory of interstellar matter, which he had helped found. During the morning, he had coffee and talked happily about the latest developments in astronomy with his colleagues in the Princeton University astronomy department, which he had directed from 1947 until 1979. In the evening, after a full day at work, he collapsed and died at home, concluding a life of exemplary style and major scientific contributions.

Born in Toledo, Ohio, on 26 June 1914, Spitzer studied physics at Yale University, earning a BA in 1935, after which he attended the University of Cambridge as a graduate fellow. Stimulated by Subrahmanyan Chandrasekhar's lectures and Bengt Strömgren's physically lucid papers, Spitzer moved to Princeton in 1936 to study astrophysics with Henry Norris Russell, then the dean of American astronomy. After earning his PhD in astrophysics in 1938, he spent 1938–39 as a postdoctoral fellow at Harvard University, where he met Martin Schwarzschild. The two became lifelong close friends.

Following a short period on the Yale faculty, Spitzer did underwater sound research in World War II (his team led the effort to develop sonar), after which he returned briefly to Yale. At the age of 33, he succeeded Russell as chair of Princeton's astrophysical sciences department, and immediately recruited Schwarzschild as a colleague. Together, they created in the department an en-



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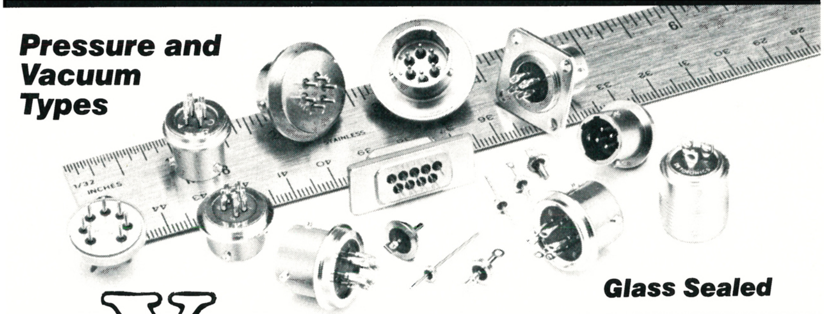

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Spitzer's research shaped three different fields of science: interstellar matter, laboratory plasmas and star clusters. His interest in interstellar matter dated back to the late 1930s, when he was struck by the fact that elliptical galaxies contained old stars but no large amounts of interstellar gas, whereas spiral galaxies, which contained gas, also had young stars. He concluded that stars must still be forming from clouds of gas and dust, and he began a theoretical study of the physics of interstellar matter that lasted almost six decades. Spitzer worked on the theory of the heating and cooling of interstellar gases, stressing the presence and importance of interstellar magnetic fields, the likelihood of pressure equilibrium among various components and the significance of interstellar dust grains. His investigations, which established the field of interstellar matter as a rich discipline, culminated with the publication of his classic book *Diffuse Matter in Space* (Interscience Publishers, 1968).

Spitzer, Hannes Alfvén and other visionary pioneers established the foundations of plasma physics in the 1950s. Recognizing early the importance of determining the transport coefficients in a fully ionized gas, Spitzer made the initial calculations of these quantities and also the first computations of toroidal containment, ohmic heating and the diffusion losses of a confined plasma. These studies were summarized in his influential book *Physics of Fully Ionized Gases* (Wiley, 1956).

Following up on his theoretical work in plasma physics, Spitzer convinced the US Atomic Energy Commission to try to contain and harness the nuclear burning of hydrogen at temperatures found in the Sun. In 1951, he invented the stellarator, a plasma confinement configuration. Two years later, Project Matterhorn was approved at what became the Princeton Plasma Physics Laboratory. Sited on the James Forrestal campus, PPPL became the leading laboratory in this field. After presiding over its creation, Spitzer led the laboratory until 1967.

In stellar dynamics, Spitzer helped define "relaxation," and showed how this process causes a stellar system to approach a singular state. Relaxation and the associated phenomenon of core collapse are accelerated by the existence of a spectrum of stellar masses but retarded by the presence of binary stars. Spitzer's many contributions to this field were summarized in *Dynamical Evolution of Globular Clusters* (Princeton University Press, 1987).

Spitzer's seminal contributions to space astronomy are known to school children (and curious adults) throughout the world. In 1946, Spitzer proposed the development of a large space telescope. He outlined the advantages of greater angular resolution, increased wavelength coverage and more stability. These goals have guided generations of space scientists and engineers, and resulted in revolutionary discoveries. Spitzer himself led the highly successful project to develop a satellite to study the interstellar medium—the Copernicus satellite launched by NASA in 1972—which gave us the first reliable estimates of the cosmologically important abundance of deuterium.

The large space telescope that Spitzer proposed in 1946 was realized as HST, which was launched in 1990, with Spitzer and his family observing the event. In the years between 1946 and 1990, and indeed afterward, Spitzer provided gentle but insightful scientific, technical and political guidance, which helped lead to the extraordinary successes of the HST. The modest and somewhat humorous way he regarded his own eminence is typified by a remark he once made to John Bahcall during one of their innumerable trips in the 1970s to support what was to become the HST: "You know, all the objectives of this trip would be fulfilled, and much effort and money would be saved if they would just allow us, instead of appearing directly, to send wax images of ourselves."

Lyman Spitzer lived a graceful life, exuding dignity and fairness. He was admired and loved by all who knew him.

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J. Carson Mark

J. CARSON MARK

J. Carson Mark, the leader of the theoretical division at Los Alamos National Laboratory for more than 25 years after World War II, died in Los Alamos, New Mexico, on 2 March 1997, at the age of 83, after a long illness.

Born in Lindsay, Ontario, Carson earned a BA from the University of Western Ontario in 1935 and a PhD in mathematics from the University of Toronto in 1939. He was a mathematics instructor at the University of Manitoba from 1938 until 1943, when he moved to the National Research Council of Canada in Montreal. In the spring of 1945, he moved to the US to work on the Manhattan Project as part of the British mission.

In 1947, Carson took charge of Los Alamos's theoretical division, then the central division of the laboratory. In that year, both the division and the lab were very small because many of the wartime staff members had returned to their universities. Nevertheless, in Carson's first years as division leader, fission weapons were enormously improved, becoming much lighter and more efficient.

In January, 1950, President Truman issued the directive to develop the hydrogen bomb. At first there were great technical difficulties. In early 1951, when Stanislaw Ulam had an idea about how to overcome them, Carson brought him together with Edward Teller. Jointly, Ulam and Teller conceived the principle of thermonuclear weapons. Carson always insisted that they could never have worked if the fission weapons had not been perfected first.

Under Carson's guidance, the theoretical division flourished. Many brilliant young people were recruited, some of the wartime experts were brought back as consultants or visiting scientists and all the early US thermonuclear devices were developed. As staff member Ted Taylor said of Carson, "He had a unique way of stimulating no-nonsense approaches to creativity. He kept intimate track of the many new and complex accomplishments of an incredibly productive group of staff members and eminent consultants."

Carson could always be relied on for good judgment, so that his counsel was sought both inside and outside the lab. It was always clear to all the staff that the division leader knew what was going on and could be approached for help on both technical and administrative matters. As a participant with a balanced view, he wrote the most reli-