Henry Hurwitz, Jr

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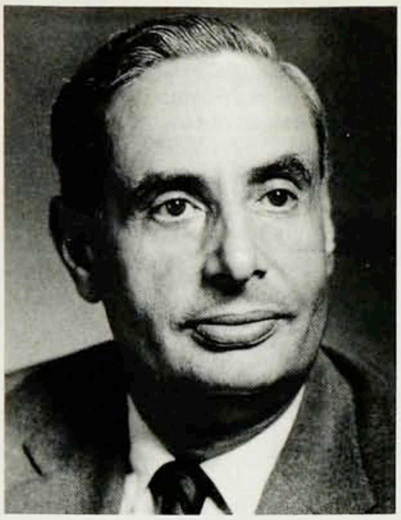

Walter M. Elsasser

century, died on 14 October 1991 at the age of 87.

Elsasser began his career in theoretical physics as an undergraduate with Arnold Sommerfeld in Munich. He went on to graduate work with Max Born and James Franck in Göttingen in 1924. There he recognized that some puzzling experimental results obtained at Bell Telephone Laboratory in New York were in fact the first demonstration of the matter waves proposed by Louis de Broglie in 1924. Elsasser left Germany in 1933 with the advent of the Hitler regime and continued his theoretical work in the Paris laboratory of Frederic Joliot. Theoretical calculations led him to the concept of magic numbers that determine the stability of the atomic nucleus. Others later expanded Elsasser's ideas into the shell model of the atomic nucleus. While in Paris, Elsasser befriended the physiologist and philosopher of biology Theophile Kahn. From his discussions with Kahn, Elsasser was eventually led to the idea that it is intrinsically impossible to order the phenomena of life exhaustively in logical and mathematical terms. The attempt to find a suitable logical structure for understanding the living state was to occupy much of his attention for the rest of his life.

In 1936 Elsasser settled permanently in the US, where he was associated sequentially with Caltech (1936–41), the US Army Signal Corps (during World War II), the University of Pennsylvania and the RCA laboratories in Princeton (1945–50), the University of Utah (1950–56), the Scripps Institution of Oceanography (1956–62), Princeton University (1962–67), the University of Maryland (1967–74) and Johns Hopkins University (1974–91). In all these wanderings, his official activities were connected with the physical sciences and included work in meteorology, atmospheric radiation, plate tectonics and terrestrial magnetism. He made basic contributions in all these fields, as he had a talent for eliminating the accessories and getting at the fundamentals of a problem.

Elsasser was perhaps best known for his work on dynamo theory for the origin of magnetic fields in planets and stars. In a series of papers published from 1945 to 1950, he demonstrated how a metallic fluid dynamo can be self-sustaining for indefinite periods of time as a result of ordinary electromagnetic induction. He demonstrated mathematically how the kinetic energy of the fluid motion in the Earth's core can be converted to electromagnetic energy. Elsasser identified a positive feedback process in which energy is exchanged between two components of the magnetic field: the poloidal field (the part extending to the Earth's surface and beyond) and the toroidal field (the part contained within the core). He proposed that convective motion of the fluid is the agent in the exchange process.

Elsasser also derived an important formula for predicting the strength of magnetic fields in celestial objects. By balancing Coriolis and Lorentz forces acting on the conducting fluid, he concluded that the Earth's dynamo is characterized by a particular value of a dimensionless parameter—now called the Elsasser number—that includes the magnetic field strength, the electrical conductivity of the core and the rotation rate of the Earth.

When the concept of plate tectonics revolutionized the geological sciences in the 1960s, Elsasser analyzed how stress diffuses across tectonic plates, thus explaining the phenomenon of postseismic deformation observed in seismically active plate boundary regions, such as the San Andreas fault zone, following large earthquakes.

Besides his memoirs, Elsasser published four books over three decades beginning in 1958, all of them in biology. He felt that immense complexity was an intrinsic characteristic of the living state, even in the simplest organisms, and that biology required a logic suitable to such complexity. By the time he wrote his third book, *The Chief Abstractions of Biology*, in 1975, he felt it necessary to escape completely from the preoccupation with reductionism and mechanism that characterizes conventional biological science. Elsasser developed a set of postulates for a holistic theory unique to organisms, which supplemented rather than replaced the reductionist approach. He concentrated his attention on the behavior and function of the intact cell or organism, rather than on the molecular constituents and biochemical mechanisms. He based his theory on the intrinsic molecular heterogeneity that characterizes even the simplest cell, combined with the ordering effect of the intact living organism. Nature selects the actual molecular states of living organisms from the immense number of such states possible under quantum mechanics. However, the existence of choice in reproduction renders complete prediction of causal chains from physical law impossible.

Elsasser's proposals were made during the heyday of molecular biology, and molecular biologists tended to ignore them. His response was to create a theoretical foundation for a new way of understanding many old problems, such as dauermodifications (adaptive changes in organisms), embryological development and cancer. He believed that simplicity is not a hindrance but a help. His postulates have recently borne fruit in the demonstration that cells of higher organisms, when separated from one another in culture, exhibit great heterogeneity for many characteristics and that selection among the varying phenotypes gives rise to long-lasting changes in the heritable behavior of all cells. Although Elsasser was pessimistic about the early acceptance of his ideas by biologists, recent experimental verification should speed the process.

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Henry Hurwitz Jr

Theoretical physicist Henry Hurwitz Jr died in Schenectady, New York, on 14 April 1992, after a long fight with cancer. He was 73.

Hurwitz received a BS degree in physics from Cornell University in 1938 and a PhD in physics from Harvard in 1941. His thesis was in quantum mechanics. After a period as an instructor in physics at Cornell, he joined the Manhattan Project at Los Alamos, where he worked with Edward Teller in Hans Bethe's theory group.

In 1946 he joined the General Electric Research and Development Center in Schenectady, where Kenneth Kingdon was setting up a group to design and develop nuclear power reactors. This group was the nucleus of the Knolls Atomic Power Laboratory, which later became a center for the development of reactors for naval propulsion. Hurwitz played a major role in the theory group there. He proposed in 1955 that a full-scale naval propulsion reactor being built in nearby West Milton, New York, be enclosed in a spherical steel containment vessel. The proposal helped establish a major safety precedent for US power reactors.

Hurwitz transferred back to the GE Research and Development Center in 1955 and soon afterwards he became manager of a nucleonics and radiation section that sought to advance knowledge in plasma physics and to develop controlled fusion with a theta-pinch device. He also participated in the study of magnetohydrodynamics for power generation and conversion. From 1972 until his retirement he was also associated with studies in laser-driven inertial fusion at the Laboratory for Laser Energetics at the University of Rochester. He was for many years a member of the Atomic Energy Commission's Advisory Committee on Reactor Safeguards, and he was a vocal activist for a rational approach to nuclear power that compared its risks to other risks assumed by society.

Hurwitz continued as a consultant to GE after his retirement. As Walter Robb, then vice president for research at the GE Research and Development Center, noted, "Henry Hurwitz was always the teacher, clothing his unanswerable analyses with humor and clarity."

Recently Hurwitz was involved in a research problem with colleagues at Union College; two days before his death he refused the relief of morphine so that he could produce a short manuscript with some of his further thoughts on this problem. As another measure of the man, we note that in his later years he became a competitive downhill skier, windsurfer and sailor, and he was very proud of earning medals in these endeavors. Once he had mastered sailing to his own satisfaction, he contributed to its science with a technical paper in *Yachting Magazine* on an optimal strategy for sailing upwind. In sum, Hurwitz was an active and productive physicist to the very end.

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