

physics. He demanded no more from his peers and students than from himself—but definitely no less either!

Uhlenbeck often expressed the opinion that "In physics one must follow a master." Unlike mathematics, physics is not a purely deductive discipline, and personal taste and intuition play an important role. Uhlenbeck strongly believed that at each stage there are certain individuals who have special insight in recognizing which phenomena, which theoretical ideas and which redirections are important for the development of physics. "They have a special nose for the future," he used to say. For Uhlenbeck, with his strong commitment to logic and coherence, such innovations had to be balanced against the demands of the existing structure. He believed that very few individuals possessed the right mix of creativity and structure to be considered as reliable guides for research. His early "masters to follow" were Lorentz, Ehrenfest and Kramers. This trio was soon augmented by Pauli, Fermi and Oppenheimer. Uhlenbeck certainly recognized Dirac as a genius, but not a "master to follow." He said of Dirac what he was later to say of Feynman: "He is just too original." Uhlenbeck's highly deductive style was not easily compatible with the brilliant, fanciful exploits of a Feynman, a Wheeler or a Dirac.

Any discussion of Uhlenbeck's life and physics must recognize the central role of statistical mechanics. He became interested in kinetic theory as a young student, and with the expert instruction of Ehrenfest it became one of his scientific passions. Later he became the scientific conscience of the whole field. It was Uhlenbeck, with his systematization and organization of the Bogoliubov procedure, who produced the first analytic calculation of the virial expansion of the transport coefficients. There is little doubt that Uhlenbeck was extraordinarily pleased that he and his student Soon Tok Choh were able to derive the Choh-Uhlenbeck equations for dense gases using Bogoliubov's ideas.

It is interesting that the organization of Uhlenbeck's thesis is very similar to the outline he wrote in 1972 for a planned book on statistical mechanics. Very much in Ehrenfest's style, the outline contains a section on "Criticism of the Gibbs Theory," and in the thesis the Gibbs theory is hardly mentioned. Similarly, a lecture course given by Uhlenbeck in Ann Arbor in 1940 contained practically no Gibbs ensemble theory. Uhlenbeck was preoccupied with statistical mechanics throughout his

life, but his ideas and approach changed little.

He applied statistical ideas to problems in cosmic ray physics, where he introduced the celebrated Master Equation. He dominated and guided statistical mechanics until the middle fifties. He remained interested for some time after that, but the field evolved in unanticipated directions and Uhlenbeck found it hard and possibly unnecessary to modify his approach. He never felt totally convinced of either scaling or universality.

Uhlenbeck got his share of recognition and won a number of awards. In a typical magnanimous gesture, he shared the 1979 Wolf Prize (awarded for the discovery of electron spin) with Irene Goudsmit, the widow of Sam Goudsmit. This was a truly marvelous demonstration of decency and fair play. It is hard to be sure, but it is a good guess that Uhlenbeck enjoyed an honor bestowed on him by the Dutch Government in 1977 as much as any recognition. It was especially important to Uhlenbeck, who always retained close ties to Holland. Before World War II, he always expressed the desire to grow old in Holland. Scientific and personal circumstances made that impossible.

Uhlenbeck was especially pleased when, after World War II, he was made the first Lorentz Professor at the University of Leiden. His inaugural lecture was on "Old and New Questions in Physics," the identical title Lorentz had used for a very famous lecture many years before. Obviously, Uhlenbeck wished to emphasize the intellectual continuity of physics and the continuing importance of Holland as a scientific and intellectual center. In the lecture he referred to Lorentz, Ehrenfest and Kramers as "the unforgettable trio, scientifically and personally." In much the same way, Uhlenbeck is an "unforgettable" figure. His scientific work will be incorporated into the scientific tradition of the future. Those who have heard him lecture will remember the occasions as one remembers a symphony concert of rare beauty.

In a lecture dedicated to George Uhlenbeck—appropriately enough, on the occasion of the centennial of Ehrenfest's birth—Martin Klein¹ in an eloquent and sensitive manner describes Ehrenfest's greatest legacy to science. It is almost inevitable that the identical words would describe Uhlenbeck's approach to physics: "a joyful fascination with understanding that could be caught like a contagion from the lips of a living teacher and

becomes the guiding principle of life."

Reference

1. M. J. Klein, *Physica* **106A**, 3 (1981).

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James C. Kemp

James C. Kemp was born in Detroit, Michigan, on 9 February 1927, and died of cancer in Eugene, Oregon, on 29 March 1988 after a distinguished career as a physicist and astronomer.

His first degree was in Slavic languages. In 1960 he completed a PhD in electrical engineering at Berkeley, under Jerome R. Singer. Immediately thereafter, he joined Erwin Hahn in the physics department at Berkeley, to work on spin resonance. In 1961 Kemp came to the University of Oregon. For the remainder of the decade he and his students were engaged in magneto-optical studies of color centers in alkaline-earth oxide crystals. In 1969 he developed a piezo-optical birefringence modulator that allowed rapid and convenient measurement of circularly polarized light. This device played a crucial role in his subsequent development as an astrophysicist.

In 1970 Kemp used his polarimeter to infer the magnetic field of the white dwarf star in Draco. His data, taken at the University of Oregon's Pine Mountain Observatory, indicated a field of $1-3 \times 10^7$ gauss, which could only be generated by the collapse of a normal star to a white dwarf. It was the first determination of the magnetic field of a white dwarf. The success of this measurement was characteristic of Kemp's scientific style: making novel instruments (often by himself in the student machine shop) and using them to make significant new discoveries, possibly in a field far from his original interests.

His early success with the magnetic field measurements led Kemp to reduce his research in condensed matter physics and take an increasing interest in astrophysics, using the 61-cm reflector at Pine Mountain Observatory. He began a series of systematic observations on the black-hole binary Cygnus X-1. Soon he was able to convince the state to install an 81-cm reflector, which has remained the largest instrument at Pine Mountain. Indeed Kemp was a champion of small observatories and telescopes, dedicated to long-term programs of observation. At the time of his death, Kemp had accumulated 14 years' worth of data on Cygnus X-1 and had produced over 50 papers on astronomy.

