

A Varian E-4 EPR Spectrometer

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Electron paramagnetic resonance (EPR), otherwise known as electron spin resonance (ESR), is based on the microwave excitation of unpaired electrons in a strong magnetic field. First reported for the Cu^{2+} ion by the Russian physicist, Yevgeny Zavoisky (figure 1), in 1945 (1), and for an organic radical species by Kozyrev and Salkov in 1947, the method was first summarized in book form in the 1955 monograph, *Spectroscopy at Radio- and Micro-wave Frequencies*, by D. J. E. Ingram (2). Like its close cousin, nuclear magnetic resonance (NMR), it can be used to deduce important structural information about a molecule and both kinds of spectroscopy helped to revolutionize the practice of organic chemistry in the 1960s and 1970s.

The first commercial EPR instrument was marketed in 1956 by Varian Associates, the same company that had produced the first commercial NMR instrument in 1949. This company was founded by the brothers Russell (figure 2) and Sigurd Varian (figure 3) in 1948 to exploit the uses of the “klystron” tube,

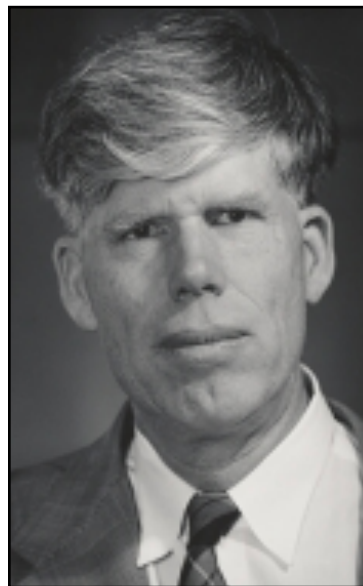


Figure 2. Russell Varian
(1898-1959)



Figure 1. Yevgeny Zavoisky
(1907-1976)



Figure 3. Sigurd Varian
(1901-1961)

which they had invented in 1937 and which was used to detect and amplify both radio and micro waves.

The first EPR instruments, like the first NMR instruments, used enormous floor-mounted, water-cooled, magnets weighing several tons. However, starting around 1965 Varian became interested in producing smaller bench-top versions of the instrument, known as the E line, that were based on solid-state electronics rather than the older, bulky, vacuum-tube technology. When coupled with an assay technique known as spin labeling, these instruments initially found use in testing for drug abuse among soldiers serving in Vietnam (3).

The model (figure 4) recently acquired by the Oesper Collections is a Varian E-4 Instrument purchased by Professor Albert Bobst of the UC Chemistry Department in the early 1970s for work in the field of biochemistry. Like the electron microscope that was the subject of an earlier installment of *Museum Notes*, this instrument is currently on display on the mezzanine of the former Chemistry-Biology Library (4).

References and Notes

1. Y. Zavoisky, "Spin-magnetic resonance in paramagnetics," *Fizicheskii Zhurnal*, **1945**, 9, 211–245. This was based on Zavoisky's 1944 Ph.D. thesis and for this reason many sources report this earlier date for his discovery.
2. W. B. Jensen, *Philosophers of Fire: An Illustrated*



Figure 4. The Varian E-4 EPR instrument as it appeared while still in use in Dr. Bobst's laboratory.

Survey of 600 Years of Chemical History for Students of Chemistry, Oesper Collections: Cincinnati, OH, 2003, pp. 237-238. Available on line.

3. J. S. Hyde, "EPR at Varian: 1954-1974," in G. R. Eaton, S. S. Eaton, K. M. Salikhov, Eds., *Foundations of Modern EPR*, World Scientific: River Edge, NJ, 1998, pp. 695-716.
4. W. B. Jensen, "The Siemens Elmiskop IA Electron Microscope," *Museum Notes*, January/February, 2015. Available on line.