



*J. W. Miller*

# Erwin Wilhelm Mueller

## 1911-1977

By Rustum Roy

Erwin W. Mueller, Evan Pugh Research Professor Emeritus of Physics at the Pennsylvania State University, died on May 17, 1977, at the age of sixty-five following a stroke suffered at a National Academy of Sciences meeting in Washington, D.C. He was the inventor of the field-emission microscope, the field-ion microscope, and the atom-probe field-ion microscope. It is no exaggeration to state that Erwin W. Mueller was the first man to *see* an atom, and the various micrographs he obtained with these microscopes adorn virtually every elementary science school book, encyclopedias, and the world's great museums.

He was born on June 13, 1911, in Berlin, Germany, and had his early education at the Technical University of Berlin. He studied physics under Nobel Laureate Gustav Hertz and obtained his Dr. Ing. in physics in the year 1936. Soon afterwards, he conceived the idea of the field-emission microscope, which enabled him to image the surface of submicroscopic metal crystals with a resolution of about twenty angstroms. For the first time, the diffusion and reconstruction of surface layers could be vividly seen. In 1941 he discovered the principle of field desorption, i.e., the removal of surface atoms at low temperature by the application of a high positive electric field. This laid the basis for his later concept of the field-ion microscope. He had by then realized the use of field-desorbed ions to image their sites at the specimen surface, to improve the resolution of the field-emission microscope by an

order of magnitude. However, he was quick to recognize the need for a million-fold image intensification and prognosticated the possibility of a field-desorption microscope if only an image intensifier were available. It is only fitting that after nearly thirty years this was made possible in his own laboratory when under his direction his student R. J. Walko obtained the first field-desorption micrograph using a channelplate image intensifier.

In 1951, while at the Fritz Haber Institute of the Max Planck Society in Berlin, he invented the field-ion microscope by supplying the absorbate continuously in the form of a neutral ambient gas, which in turn could be continuously desorbed in the form of ions to produce a projection image. However, it took him four more years before he could finally achieve atomic resolution by cryogenic cooling of the specimen. "It was a sticky day in August 1955, that I became the first person to *see* an atom," he often recalled.

In 1952 he was invited to the United States for a lecture tour. Immediately after conducting an inspiring colloquium, he was invited to take a position in the Physics Department of the Pennsylvania State University as a Professor of Physics. In 1956 he was made Research Professor of Physics and in 1969 he was named Evan Pugh Research Professor.

In 1967 he introduced the atom-probe field-ion microscope—a combination of a field-ion microscope with a time-of-flight mass spectrometer—which opened a new dimension in field-ion microscopy. Now, like the mythical Maxwell demon, he could not only see an atom, but could also pull it out of the tip of the metal and pass it through the mass spectrometer to ascertain its chemical identity. This atom-probe microscope is in principle the ultimately sensitive analytical tool, being capable of analyzing a single atom.

Erwin Mueller's numerous scientific contributions have been described in his two books, four book chapters, three patents, and more than 200 papers.

His scientific achievements were recognized by the science community with numerous awards, such as the Bronze Medal for outstanding work by the Technical University of Berlin (1936); the C. F. Gauss Medal, Braunschweig (Laudatio by M. V. Laue) (1952);

the Achievement Award by Instrument Society America (1960); the H. N. Potts Gold Medal by the Franklin Institute, Philadelphia (1964); the Centenary Lectureship Silver Medal by the American Vacuum Society (1970); the John Scott Medal by the City of Philadelphia (1970); and the Davison-Germer Prize of the American Physical Society (1972). He became the Scientific Member-at-Large of the Max-Planck Institute, Berlin, in 1957; was elected as a Fellow of the American Physical Society in 1961; as a Member of Academy Deutscher Naturforscher, Leopoldina, in 1968; as Honorary Fellow, Royal Microscopical Society, Oxford, in 1969; and as a Member of the National Academy of Engineering and National Academy of Sciences in 1975. He served the National Academy of Engineering Committee on Membership, General Engineering Peer Group.

Erwin Mueller participated at numerous national and international scientific conferences by invitation. He was the Chairman of the Annual Field Emission Symposium in the years 1957, 1965, and 1973 and Chairman of the Division of Electron Physics, American Physical Society, in 1962-63. He served as a Member of the editorial boards of the journals *Physics Status Solidi* and *Surface Science*.

An energetic scientific ambassador, he spent his summer vacations traveling in Europe, particularly France, Germany, and England, where he helped to establish programs of research in field-emission and field-ion microscopy. Following invitations to various institutes in Venezuela, Russia, Israel, Italy, India, and Japan, he spent weeks lecturing at conferences and seminars in these countries.

A hands-on scientist with undiminished energy till the end of his life, Erwin W. Mueller participated in the construction of elaborate instruments. His knowledge of practical experimental techniques was enormous. A student could not only benefit from discussing scientific problems with him, but also learn from him practical techniques such as glass-blowing of elaborate apparatus.

His unexpected death was a great loss to his Pennsylvania State University colleagues and to the scientific community.