The Creation of a Technique

The Beginnings of Electron Microscopy. PETER W. HAWKES, Ed. Academic Press, Orlando, FL, 1985. xx, 633 pp., illus. $88. Advances in Electronics and Electron Physics, supplement 16.

The origins of electron microscopy have never commanded the respect as a breakthrough in science that has been accorded, for example, the first observations of x-ray diffraction by von Laue's students Friedrich and Knipping in 1912 or the first evidence of electron diffraction in the experiments of Davisson and Germer and Thompson and Reid in 1927. There was no fundamental principle of physics involved. There was no immediate promise of insight into the atomic structure of matter, even though the more far-sighted participants may have had high hopes.

The wave nature of electrons proposed by de Broglie in 1923 had been clearly demonstrated in the electron diffraction experiments. The fact that electron wavelengths could be very much shorter than those for light suggested that an electron microscope could in principle have a resolution very much better than the light microscope. However, this was little more than a philosophical concept, with little relevance for the practical experimental concerns of those struggling to produce the first magnified images with electrons. It would be many years before the wavelength of the electrons would be at all significant for interpreting what was seen. The electron microscope grew, in fact, through a series of technical advances from a background of experience in the development of cathode ray oscilloscopes. The theoretical basis was limited to the purely classical considerations of the bending of electron beams by magnetic and electrical fields. The practical aim was to make a better microscope.

Without the drama of a major scientific advance, the beginnings of electron microscopy have remained relatively unfamiliar. Peter Hawkes has earned our gratitude for a volume that goes far to reveal the more personal and intellectual dramas of the scientists who created the new technique and brought it to the stage where its future as one of the major tools of modern science became evident.

Like *Fifty Years of X-ray Diffraction*, edited by the late P. P. Ewald, and *Fifty Years of Electron Diffraction*, edited by Peter Goodman, the present volume takes advantage of the fact that many of the originators of the subject are still alive and able to contribute their recollections. In the same way it must be noted with regret that for some the compilation has come too late. The accounts by colleagues or science historians, though valuable for filling some gaps, do not have quite the same flavor. One regrets in particular that Otto Scherzer could not contribute before his death and that health reasons prevented a contribution from Hans Boersch and limited that from R. W. G. Wyckoff.

Perhaps "flavor" is an apt basis for description of the contents of this volume. Each person has contributed in his own style, with his own viewpoint on what is significant. The result is a collection with the widest possible variation of flavorings—enough to provide a rich banquet for the historian and many tasty tidbits for the general scientific reader. There are the careful, systematic records of step-by-step progress through painstaking construction of increasingly complicated instruments. There are the intensely personal reminiscences of the struggle for progress in wartime Europe. There are the gossipy accounts of who was who and how the characters interacted. There are also the unabashed exercises in personal aggrandizement. The variety of styles and of interpretations of the purpose of the compilation is especially entertaining and informative to those of us who have had the pleasure of personal contact with many of the writers.

A notable absence from this book is the personal history of the work of Ernst Ruska, who, more than anyone else, may be regarded as the father of the electron microscope. The absence is explained by the 1980 publication of Ruska's own book, *The Early Development of Electron Lenses and Electron Microscopy*, in the English translation of Thomas Mulvey. In this Ruska has given an excellent and detailed account of how he and his asscciates made their first efforts to produce an electron imaging system, developed the iron-shrouded magnetic coil with pole pieces to concentrate the magnetic field, and achieved the first images having better resolution than could be achieved in an optical microscope. It was Ruska's book that spurred Hawkes into action to collect these contributions from other scientists involved in the early years of electron microscopy. Here Ruska writes only a short preface.

Many fascinating stories emerge, directly or indirectly, from the various chapters. Illuminating accounts are given of the controversial patenting of the electron microscope by Rudenburg, whose contribution to the subject was, at best, conceptual. The war years find the various groups in Germany, France, the Netherlands, and Britain, necessarily in isolation and frequently in danger, struggling with the same problems, which would be crucial for the postwar developments. The stories from England reveal the enormous impact of the six RCA microscopes arriving unannounced from the United States in 1942 under the lend-lease agreement, appearing in chosen laboratories with no instructions, no manuals, and in some cases no one on hand with any knowledge of electron microscopy. There are also accounts of the important contributions of early workers in the United States, Japan, Czechoslovakia, and Venezuela. Unfortunately it was not possible to get contributions from the Soviet Union, but Hawkes does his best to make amends for this deficiency in his careful bibliography and summary chapter.

This book is not a textbook of electron microscopy: for many parts, it is assumed that the readers know the significance for the present-day science of the work described. It is not a history. It is a collection of personal accounts, often overlapping and sometimes contradictory in detail. It is a valuable resource and fascinating reading for all those with an interest in electron microscopy or the history of science.

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A Technological Innovation

The Continuous Wave. Technology and American Radio, 1900–1932. HUGH G. J. AITKEN. Princeton University Press, Princeton, NJ, 1985. xviii, 589 pp., illus. $67.50; paper, $19.95.

As the foundation of some of the 20th century's most significant technological achievements, early radio and the industry associated with it have attracted significant interest from many quarters. For the period 1890 to 1935, technical development and applications, industry infrastructure, patent policy, issues of global communications, the rise of broadcasting, and the role of government have all been analyzed separately. As a result, the general outlines and many details of the development of radio have been known for some time. But Aitken's recounting in *The Continuous Wave* provides an unprecedented cohesiveness, many new details, and a few challenges to older interpretations. During the period covered, business and government were learning which organizational forms and managerial techniques worked best for technological innovation. Because radio makes a revealing case study in this process, this book is important for a wide range of readers.