From the Editor

The Commercial SEM at 50

In 1965 the first commercial scanning electron microscope (SEM), Stereoscan I, was produced by the Cambridge Instrument Company in the UK. Six months later JEOL launched the JSM-1 in Japan. Today the SEM is a versatile tool that can produce surface images with exceptional depth of field or with nanometer-level resolution; it is responsible in part for advances in microelectronics, life sciences, and many other disciplines. While the concept of the SEM was demonstrated in the 1930s, practical realization had to wait for developments in other technologies: electronic image display systems, efficient electron detectors, and improved vacuum systems to minimize specimen contamination.

In the early 1950s, Charles Oately and his students at the Engineering Laboratories of the University of Cambridge built a series of SEMs and solved the problems impeding the development of this microscope. Notably they devised the scintillator-photomultiplier electron detector to detect secondary electrons, an essential component of nearly every SEM built since. By 1958 an instrument with magnetic lenses, stigmator, and tilting specimen stage was completed and sold to the Canadian Pulp and Paper Research Institute.

Several companies were asked to manufacture the SEM. One of the manufacturers of transmission electron microscopes (TEMs) declined because the image resolution was not as good as the TEM (that company also declined to manufacture digital computers saying the market would be too small). In 1962 Cambridge Instruments decided to produce a commercial SEM based on the work of Oately's group. Cambridge Instruments called their first SEM the "Stereoscan" because of the ease with which stunning stereo images could be produced. By the 1970s at least half a dozen companies produced SEMs in the US, Europe, and Japan.

The resolution of early instruments was about 20 nm at 20 keV; however, every few years an important innovation would make the SEM more useful. The field emission electron gun improved image resolution by an order of magnitude, the addition of the energy-dispersive X-ray spectrometer allowed detection of specimen elements, variable-pressure instruments allowed imaging of hydrated specimens, and electron backscattered diffraction attachments provided information about crystal orientation and phase identification. Modern instruments now provide sub-nanometer image resolution at 1 keV.

Some estimates indicate that there are over 50,000 SEMs in the world today. They are the imaging and analysis workhorses in many fields of research. Open the champagne and give a toast to 50 years of commercial SEMs!

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