# SHORT HISTORY OF THE SCANNING ELECTRON MICROSCOPE

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The development of SEMs started with more of a whimper than a bang. From the very beginning of electron microscopy the imaging of solid samples was an important goal, particularly as the methods for producing thin samples were only developed later. The first attempt was made by Ruska (1933) with the sample surface normal to the viewing direction and illumination by an electron beam at grazing incidence to the surface; he obtained images of copper and gold surfaces but at a magnification of only $10^X$. A few years later he has made a second attempt (Ruska and Muller in 1940) with the same geometry and with only marginally better results. Von Borries (1940) was much more successful with his grazing incidence method in the transmission of the electron microscope (TEM) where the sample surface had few degrees both to the viewing direction and to the illuminating beam. Nowadays it is still a very important technique and is widely used.

A breakthrough in the microscopic imaging of surface topography in the TEM was the introduction of replicas by Mahl (1941) and these set the standard for the next 25 years although they were tedious to make and there could be a subject for serious artefacts.

During the 1930s a totally different way of imaging solid samples, scanning electron microscopy was invented by Knoll (1935) for the study of the targets of television camera tubes. Two years later von Ardenne (1938) built an electron microscope with a highly demagnified probe for scanning transmission electron microscopy (STEM) and also tried it as an SEM. And soon afterwards Zworykin et al (1942) developed a dedicated SEM. The beginning of the general use of the (SEM) can be accurately dated to 1965 when the Cambridge Instrument Company in the U.K. marketed their Stereoscan 1 SEM (to be followed about 6 months later by JEOL in Japan). This was thirty years after the initial developments in Germany and the U.S.A., but it was the research project started in 1948 by Oatley at the Cambridge University Engineering Department that led directly to the Stereoscan (Oatley 1982).Working closely with several of his colleagues and graduate students, Oatley was able to demonstrate both the SEM's magnification potential and the astonishing 3-D quality of images it produced.SEMs are routinely used in tasks like inspecting semiconductors for defects or exploring how insects work. It is extremely important nowadays.

The purpose of this article is to trace the development of the SEM up to the sale of the first commercial SEMs in 1965. Incidentally it will be seen that many of the ideas, that were put forward by the early workers, were well ahead of their time, becoming technologically practicable only much later.