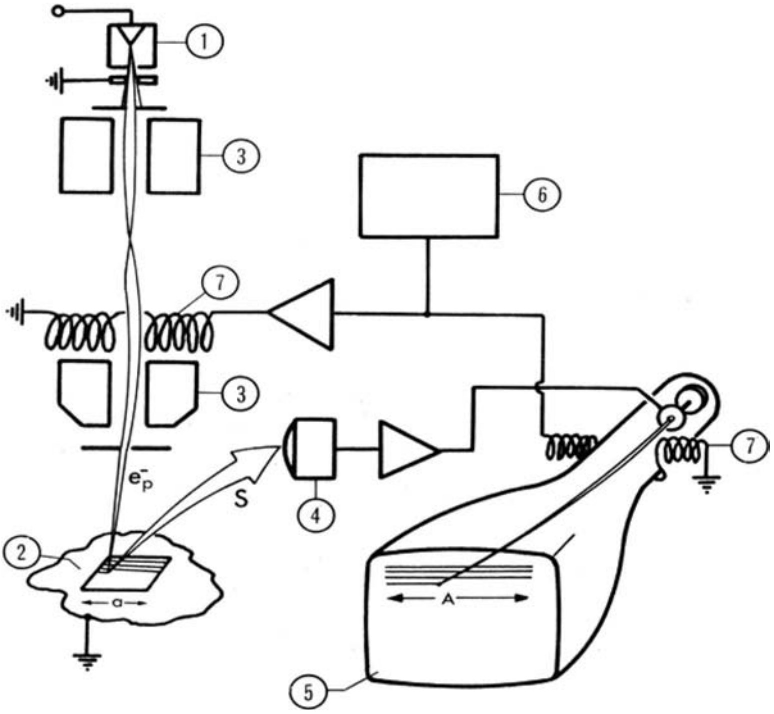

FIGURE 1 Diagram of an SEM. 1, Electron gun; 2, specimen; 3, electromagnetic focusing lenses; 4, signal detector; 5, Screen; 6, Scan generator; 7, scanning coils.

electrons" of that beam with the atoms of the specimen produces various radiations. The resultant image is the transcription on a screen of the intensity of these physical signals scanned at the same rate as the specimen.

The first SEM was developed in 1937 to 1938 by M. von Ardenne (1,2) and the first commercial device was sold in 1965 to DuPont de Nemours by Cambridge Instruments under the name "Stereoscan." These first microscopes had analogical electronics, cathode ray tubes, and rollfilm or Polaroid cameras. Nowadays, the SEMs are fully computerized and digital pictures are stored with full information on mass storage disks that can be directly inserted in reports.

Digital imaging also is an open door for image analysis, computerized 3D presentation, and microrugosimetry.

Basically, an SEM (3,4) is constituted of an electron optical system designed to focalize the electron beam on the sample surface, a scanning system, a signal detector, and amplifier and imaging system (Fig. 1).

Electron optics: The electrons are emitted by a hot tungsten filament or, in modern, top class microscopes, a cold field-emission emitter. The electrons are accelerated by high voltage (typically 5–20 kV) applied between the emitter (cathode) and an anode. The beam is focalized on the sample surface by electromagnetic lenses.

Scanning system: Orthogonal coils produce a crossed magnetic field that deviates electrons in two 90° directions, thus producing a scan on the sample