APPLICATION OF ELECTROGRAPHY
IN ELECTRON MICROSCOPY
AND IN LARGE-SCREEN TELEVISION

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The author describes a new method for fixing the images produced in the electron microscope, which consists in replacing the photographic plate by a thin metal-backed insulating plate, e. g. a sheet of paper coated with paraffin, exposing the picture (for instance with 40kV × 4 sec) and rendering the invisible electric image (produced by the charge of the cathode rays or by the secondary emission) visible by spraying it with a positively charged fine powder, e. g. lycopodium powder. Subsequently, the author describes the antecedents of this experiment: the various methods of the electrographic recording process invented by him in 1928 and 1935, and finally points out the applicability of electrography in the field of television for the production of large screen images.

The micrograms produced in an electron microscope can be observed visually on a fluorescent screen or when fixed photographically onto a photosensitive plate brought into the interior of the microscope, both methods being adapted from the technique of the cold-cathode oscilloscope of Dufour, Gabor, Rogowsky.

In 1928 I invented a new type of cathode ray tube, and a new method for obtaining permanent records of the path of the cathode ray spot in it [1], [2], [3], [4], [5], [6]. The new method — which I have named later electrography — consisted in intercepting the cathode rays by an insulating screen, thus preserving the signals, curves, images etc. in the form of electrostatic charges imparted to the screen in varying density and distribution, and developing the invisible electric record by dusting over it with an electroscopic powder, i. e. with a fine powder, charged oppositely. — I would like to mention that this tube, as described in the patent specification quoted above, must not only be considered as the ancestor of the storage or memory tubes, but it incorporates also many other innovations, for example the utilization of an inner conducting coating (an evaporated layer of metallic magnesium) as an accelerator and deflecting electrode.

The first examples of the tube in question were produced simply of glass bulbs for incandescent lamps, and — as a curious feature — they contained no separate screen at all. The cathode rays hit the inner surface of the glass-

1 Preliminary report, presented to the Hungarian Academy of Science on the Session of the III. Class, December 12th, 1950.
bulb immediately and left their traces in the form of invisible electric curves, which were developed by spraying the outer surface of the bulb with lycopodium powder. Some simple oscillograms were taken with these tubes, and an interesting new type of electric figures (Lichtenberg-figures) produced by the diffusion of the electric charges on the glass surface, were observed (2. and 5.), but I was not given the possibility of developing my invention further than the first experimental stage.

Fortunately in 1936 two Japanese physicists repeated my experiments with a Dufour-oscillograph and they succeeded in obtaining perfect oscillograms up to a frequency of $10^5$ cycle/sec, using ebonite plates as screens and lycopodium powder as developer [7]. Since then I have been convinced that the same method would prove itself successful in fixing the electronic images of the electron microscope too, but I was only given my first opportunity of realizing this idea in December 1950. The Figures 1 and 2 here show the

images obtained in my first experiment, executed with the electron microscope of the Hungarian Academy of Science in the following manner: Sheets of black paper, by immersing in melted paraffin, were coated with same; then pieces of the paper about $4 \times 6$ cm, backed by tin foil, were put into the electron microscope, exposed (about 40 kV, 4 sec), taken out, and developed by spraying with lycopodium powder from a rubber ball. As can be seen, the images are rather sharp and they are positive ones, proving that the lycopodium particles, which by the spraying become positively charged, adhere on the parts shadowed by the wires, where the paraffinated paper was not hit by any electron at all. This, on first sight surprising result can be explained simply as follows: At the voltage of 40 kV the factor of the secondary emission of the paraffin is greater than 1. Therefore the places on the paper bombarded by the cathode rays become positively charged, they influence negative charge in the metallic base (in the tin foil), and the attraction of these negative

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Fig. 1. Electronic image of the preparation holder mesh-screen, fixed by electrical charges on paraffinated paper and developed by lycopodium powder. Magnification about 20x.

Fig. 2. The same as Fig. 1, magnification about 200x.