

Trillat-Fritz: A very early French electron microscope

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The first decade of the electron microscope has been explored in considerable detail but attention has focused above all on Germany (Ruska, Knoll and von Borries; the group at the AEG Research Institute, in particular Mahl, Scherzer, Johansson, Ramsauer and von Ardenne) and to a lesser extent on Belgium, where Marton built his early instruments. There was of course activity in other countries – England, Canada, the USA – but the microscope constructed in France in 1934 by René Fritz and Jean-Jacques Trillat is rarely mentioned.

I have only come across two references to it and both are in French sources (Grivet, 1985; Jouffey, 1996). Early French accounts of the electron microscope such as those of Maréchal (1936)

and Triau (1938) do not mention it. It is evoked in tributes to Trillat, notably on his election to the Académie des Sciences de Paris, and very briefly, in Trillat's own reminiscences. A little more information about it has emerged and is the excuse for this note.

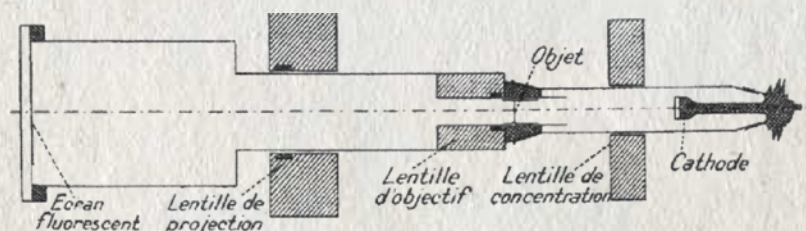


Fig. 1. — Schema de principe d'un microscope électronique magnétique.

Fig. 1. Schematic line drawing of the Besançon microscope (Fritz, 1936).

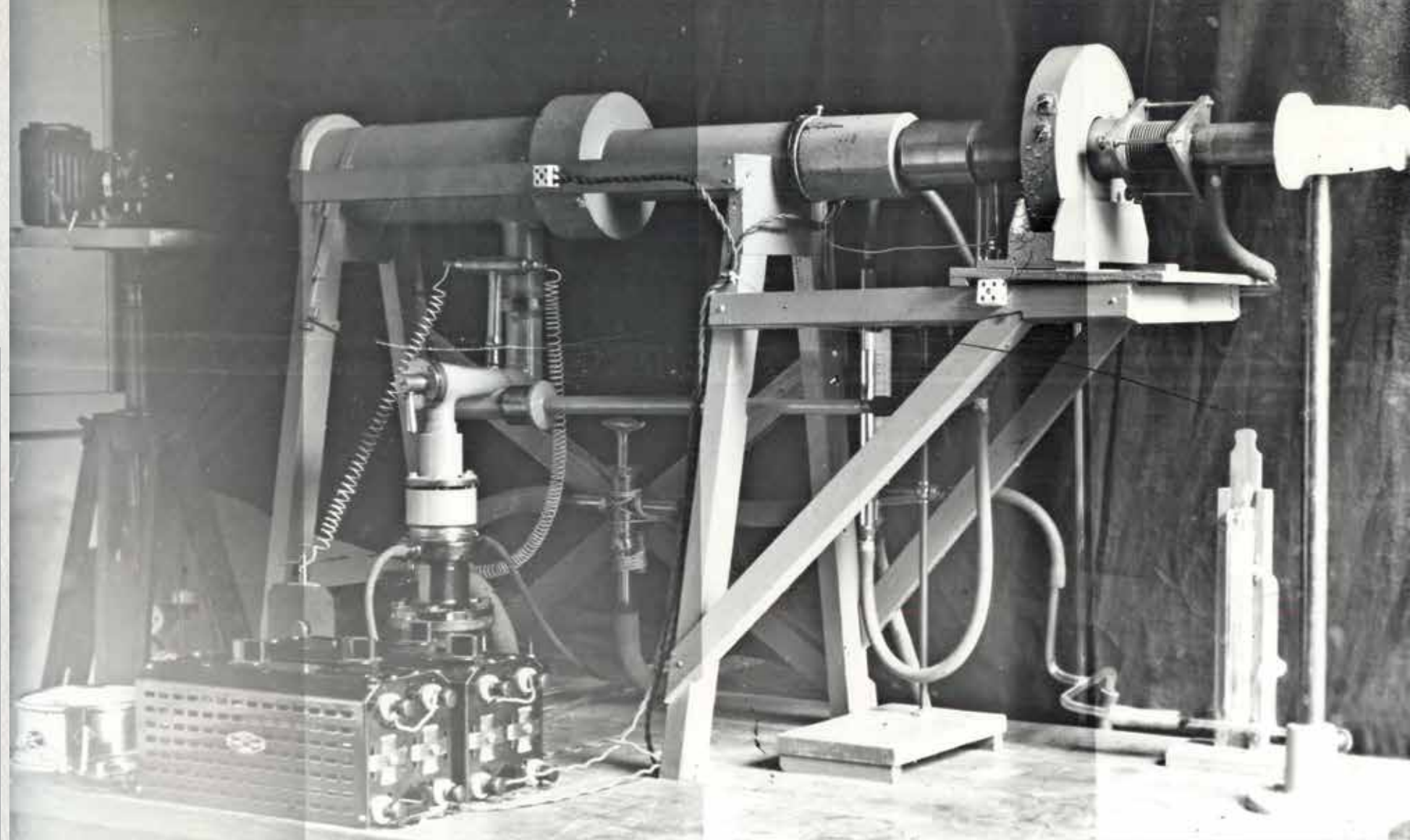


Fig. 2. Photograph of the Besançon microscope. Courtesy of the Académie des Sciences, Institut de France.

Jean-Jacques Trillat (1899–1987) is known as one of the pioneers of electron diffraction studies (Trillat, 1981). He spent eight years (1925–1933) working on x-rays in the laboratory of Maurice de Broglie (brother of Louis de Broglie) and became interested in electron diffraction when the findings of Davisson and Germer and G.P. Thomson confirmed Louis de Broglie's suggestion that a wavelength should be attributed to particles. In 1933 he was appointed Professor of Physics at the Faculty of Sciences in Besançon, where conditions were very primitive: there was little or no equipment and not even a.c. electricity. In two years, with funding from local and national sources, he succeeded in transforming this

into a working laboratory; partly thanks to Maurice de Broglie who allowed him to take the equipment he had been using in Paris to Besançon (Trillat, 1935).

In 1934, with his assistant René Fritz, he constructed a simple electron microscope. Although he tells us that several distinguished scientists of the period (Jean Perrin, F. Joliot, E. Darmais and Maurice de Broglie) came to see it in operation, the only contemporary publication is an article by Fritz (1936), which includes a line diagram of the instrument (Fig. 1) but no micrographs. The only micrographs shown are copied from

the book of Brüche and Scherzer (1934) and a paper by Driest and Müller (1935); Fritz was also aware of an early paper by Marton (1934). Fritz regarded the microscope as a means of studying the structure of the emitter, as in the work of Johansson, which he cites (Johansson and Scherzer, 1933), as well as a device for forming a magnified image of a specimen. At that early date, this is not surprising, for the work of Johansson and others at the AEG Research Institute must have seemed more advanced than that of Knoll, Ruska and von Borries (Fritz cites Ruska, 1934a, 1934b). Although there is no contemporary publication by Trillat, the bulky collection of his papers in the archives of the Académie des Sciences de Paris contains a hitherto unpublished photograph of the microscope (Fig. 2). From this and the line diagram we can see that the instrument has a single condenser lens, an objective and a projector (all the lenses are magnetic). The image is observed on a fluorescent screen.

The fact that this early microscope is so rarely mentioned can probably be attributed to the absence of any publication by Trillat and above all, to the absence of any micrographs and hence any tangible record of the images that it produced and which Fritz and he showed to their distinguished visitors. Fritz later wrote a review article on electron optics (Fritz, 1938), but does not mention the Besançon instrument. Both articles by Fritz are listed in Marton et al. (1950) but neither is present in Cosslett (1950). Trillat described the new Besançon laboratory in the short paper in the *Revue Scientifique* for February 1935 cited above but the electron microscope is not mentioned there. A particularly surprising omission is from the collection of articles edited by Louis de Broglie shortly after the end of WWII (de Broglie, 1946); although de Broglie and Trillat remained friends for many years, there is no chapter by Trillat and none of the contributors mentions his early instrument. Nor is Fritz's article cited in Grivet's two-volume *Optique Electronique* (1955, 1958).

After the war, during which he worked on military scientific projects, Trillat set up the Laboratory of X-ray and Electron Analysis in Bellevue (near Paris) and in 1948, he was appointed Professor of Physics at the Faculty of Sciences of Paris. In 1956, a Chair of Electron Microscopy and Diffraction was created for him. In 1959, he was elected a member of the Académie des Sciences de Paris, of which he became president in 1974.

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Biography

Peter Hawkes, formerly emeritus Research Director in the CNRS, has worked on various aspects of electron optics, notably lens aberrations and image processing methods. The years in the Electron Microscope Section of the Cavendish Laboratory (1959–1975) were initially concerned with the aberrations of quadrupoles and octopoles and related topics and later, with early ideas about image processing. These themes were extended during his years in the Laboratoire d'Optique Electronique (now the CEMES) in Toulouse, where he became interested in image algebra but without abandoning aberrations. He has also contributed in various ways to preserving the history of electron optics and the electron microscope, notably by editing *The Beginnings of Electron Microscopy*, a collection of historical accounts and reminiscences by the pioneers of the subject, by surveying the first 100 years of the electron at EMAG 1997 and by describing the history of aberration correction at a Royal Society meeting on the subject in

2008. The *Beginnings* were followed by *Growth of Electron Microscopy*, edited by Tom Mulvey; both collections were published in Peter Hawkes's series of *Advances*, whole volumes of which have been devoted to the STEM, to aberration-corrected electron microscopy and, as a tribute to Sir Charles Oatley, to the SEM. With Erwin Kasper, he wrote the three-volume *Principles of Electron Optics* (Academic Press, London).

He is a member of the editorial boards of *Journal of Microscopy*, *Ultramicroscopy* and *Microscopy and Analysis* and editor of *Advances in Imaging & Electron Physics*. In 1987, he was director of the Laboratoire d'Optique Electronique. In 1998, he was elected president of the newly-founded European Microscopy Society. He was a founding organiser of the series of Conferences on Charged-particle Optics (CPO) and has served on the organising committee of all subsequent meetings; CPO-3 was held in Toulouse in 1990.