Prof. Elmar Zeitler passed away on December 19, 2020 in Berlin. He was a scientific member and director at the Fritz Haber Institute from 1977 until his retirement in 1995. Elmar was a thoroughbred physicist and always interested in a quantitative and analytical solution to problems. The reduction of a problem to fundamental facts of physics and optics has always been his main concern. At the same time, Elmar was imbued with helping others solve their practical problems with his fundamental contributions. He was an enabler of numerous advances in electron microscopy. He succeeded particularly well in this through his personal way of always putting the matter and never his own person in the foreground.

After receiving his doctorate in Würzburg in 1953 on the subject of "Investigations into the hard secondary radiation of cosmic rays", he worked at Bayer in Leverkusen until 1958 on the knowledge-based perfection of scientific photography. A research stay at the Karolinska Institutet in Stockholm in 1958 sparked his interest in electron microscopy of biological objects, a topic that would accompany him for the rest of his life. After his return to the University of Würzburg, where he habilitated in 1960, he gave the lecture "Physics for Physicians". During this time, he developed a method to perform a local mass determination of a (biological) object by means of quantitative contrast analysis. This method could easily have been realized with modern microscopes, but it was an experimental feat in his time, for which Elmar also created the analytically exact basis.

This was followed by his "American phase" at Walter Reed Hospital in Washington and as a professor at the Department of Physics and Biophysics at Chicago University, where he worked until 1977. During this time, the professor of physics was concerned with the radiation damage to medical preparations and the need for digital reconstruction. In this role, Elmar Zeitler imparted his profound knowledge of optics and the mathematical description of the interaction of electrons and matter to numerous students, who were to adopt his methodology in their own research. Scientifically, he worked on the development of scanning transmission microscopy (STEM) and the necessary point-shaped electron source (field emission method). On the basis of a commercial electron microscope, he realized a self-built field emission source. At the same time, on a central computer, he generated software for image reconstruction based on his work on the analytical description of the 3-dimensional reconstruction of 2-dimensional images. A publication on haemoglobin and sickle cell anemia ("Electron microscopy of fibers and discs of HemoglobinS having sixfold symmetry", Proc. Natl. Acad. Sci. USA, vol 74, (1977) p. 5538) showed the potential of this method. The work is characteristic of the work of Elmar Zeitler, who simultaneously dealt with all aspects of microscopy, from sample preparation and imaging methodology to the development of instrumentation and digital data analysis.

In 1977, Elmar Zeitler was appointed to succeed Ernst Ruska at the Fritz Haber Institute. With the additional experimental possibilities of the department of Ernst Ruska, who remained at the institute for a long time as emeritus, Elmar was able to implement his ideas of a fundamental solution to the radiation damage problem and to develop spectroscopy of energy loss in the microscope with the possibilities of real-space imaging as micro-spectroscopy. The fundamental concern of his work in Berlin was to control and use the interaction of high-energy electrons with matter. Its negative side is the phenomenon of beam damage, which makes the imaging of biologically safe objects very difficult. The positive side is the information about the local electronic structure of the imaged atoms, which the outgoing electron beam carries with it. The answers to this challenge were cryo-electron microscopy and electron energy loss spectroscopy (EELS). The following quote shows how much Elmar was aware of the fundamental importance of his work and how he viewed his science critically: In most cases, the development of a field does not follow logical lines. There are bandwagons which lead wayward; sometimes stumbling blocks are bypassed because a new direction may point to potential success. Problems are glossed over, put in abeyance or simply forgotten, repressed or whatever other psychological terms might be fitting. But as in fashion or psychology, finally they come out of the closet. One such challenge is radiation damage – (E.Z. Ultramicroscopy vol.10, 1982, p. 1)

Elmar Zeitler understood cryomicroscopy as a system of measures to organize the observation of an object in such a way that it became visible in its native state. He realized superconducting objective lenses to use stable magnetic fields (this is now achieved by modern electronics), he developed methods for preparing samples in amorphous ice, and he developed sample holders for low-temperature experiments (both of which are still in use today). The complete 3-D reconstruction of the projection images from the microscope required fundamental considerations of image reconstruction and digital image processing, which Elmar was able to realize in a powerful form and was thus far ahead of his time. In his own way, Elmar facilitated the dissemination of his concepts and ideas through collaborations. Industrial users commercialized his technologies. Scientists carried out pioneering experiments with the hardware and software available in Berlin. This resulted in the key publication for today's highly topical field of bioquent cryomicroscopy, "Model for the Structure of Bacteriorhodopsin based on High-resolution Electron Cryo Microscopy" (J. Mol. Biol. (1990, vol 213, p. 899) by the Henderson group of Cambridge. In this paper, two of Elmar Zeitler's collaborators (F. Zemlin and E. Beckmann) are co-authors, but not Zeitler himself, although he was behind all the machinery and conception that had been built up at that time.

The EELS method was the method of choice for Elmar Zeitler to be able to approach the electronic structure of light atoms (as in biological samples) and to obtain the same information as is easily accessible for heavier atoms by means of X-ray spectroscopy. The lengthy technical realization of a spectrometer with sufficient resolution was again successfully tested in cooperation, this time with Sir John Thomas from Cambridge. However, others at the time were more experimentally successful with a more technically robust solution. On the other hand, the unfolding of the spectra from their subsurface, which is still problematic today, remained a topic of Elmar Zeitler's work until the end of his scientific career.

Elmar Zeitler continued to be intensively involved in the main field of work of the Fritz Haber Institute. The definition of the sample environment of an electron microscope, which was not well solved then as now, was often approached experimentally, but the results were manageable. Much more successful was the combination of UHV surface physics for preparation and manipulation of metal surfaces with subsequent transfer to an electron microscope and imaging of the surface in reflection. This method was perfected by a group of employees of the Zeitler department and conceptually thoroughly studied. Had it not been for the development of scanning probe methods around the same time, this technique, which could still offer numerous advantages today, would not have been forgotten. More successful was the development of a UHV-capable photoelectron emission microscope (PEEM), which, based on previous realizations by others, had excellent functional properties due to its robust design. This instrument enabled numerous works to be carried out in all departments of the Fritz Haber Institute and was commercialized according to the "Zeitler method" through cooperation with a company and thus made accessible to the entire community, which uses it intensively today. And again, the name Zeitler is missing from the corresponding key publication.

His German-American CV and his cooperative nature gave Elmar Zeitler many opportunities to get involved in the electron microscopy community, which he knew both from the methodological and from the point of view of the large subgroup of biological microscopy. Elmar was famous for his many stories from his rich life, which always made it possible to experience the human factor behind rigorous science from his mouth. The founding of a journal "ultramicroscopy" in 1975, which is supported by a number of professional communities, is a lasting achievement – especially in view of the fact that such projects were still quite unusual at that time and required a great deal of personal persuasion.

Elmar Zeitler was an uncompromising scientist. He demanded of himself and his employees the rigorous analysis of problems and the relentless pursuit of a path once taken, regardless of the problems that arise. There were no detours or giving up. At the same time, Elmar Zeitler was very liberal and encouraged the coexistence of working groups in his department that dealt with very different questions, as long as they worked rigorously on them. He nurtured the careers of his collaborators who wanted to develop further, while building a team of permanent electron microscopy experts who formed the methodological backbone of his research. Until the end of his career, he was scientifically active himself and ran a private laboratory in which he experimented with a few employees. Elmar Zeitler has always maintained a cooperative working style with a very wide network of personal relationships. A tradition that goes back to him is the annual New Year's reception for all employees of the Fritz Haber Institute. Even after his retirement in 1995, Elmar Zeitler accompanied the further development of his former department with his advice. Electron microscopy continued to play an important role, but science changed from methodological advancement to further development of its use in the service of catalysis research. Elmar Zeitler has made exemplary use of the Max Planck Society's opportunities to implement his own scientific ideas and an individual working style. His cooperative and outwardly modest manner may have hurt the appreciation of his achievements, but the scientists of electron microscopy and all those who worked with him will preserve his memory.

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