

## MicroscopyPioneers

# Some Personal Memories of Otto Scherzer

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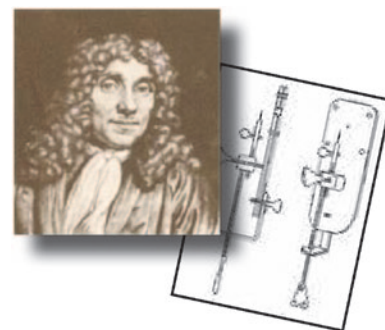
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At last year's M&M meeting, the birth centennial of Otto Scherzer, one of the pioneers of electron optics and particularly the correction of electron-optical lenses, was remembered in a special symposium. His scientific achievements have been extensively described in an article by Marko and Rose (2010). Here we try to recollect some personal memories of Otto Scherzer from the time we spent at the "Institut für theoretische Physik" at the Technische Hochschule Darmstadt (now Technische Universität Darmstadt).

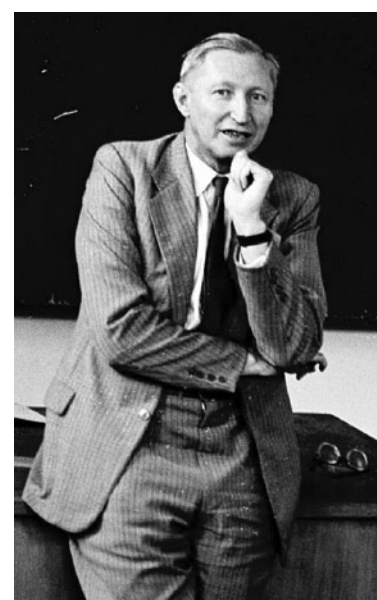
Otto Scherzer was born in Passau in eastern Bavaria on March 9, 1909. He followed a steep career when he was young, getting his PhD at age 22 in the famous institute of Arnold Sommerfeld in Munich. At age 24 he was, together with Ernst Brüche, the author of an important book on geometrical electron optics, and at age 26 he was appointed extraordinary professor in Darmstadt. His time at the Technische Hochschule in Darmstadt was interrupted by the Second World War when he worked on radar at the communications research headquarters of the German Navy. After the war he spent about a year in the United States and then—back in Germany—several years in the Süddeutsche Laboratorien in Mosbach in southwest Germany. In 1954 Scherzer was appointed ordinary professor at the Technische Hochschule Darmstadt. He had accepted the position under the condition that he got a mechanical workshop at his institute, the goal being to do experiments in electron optics. He then persuaded an excellent mechanics engineer (Mechanikermeister), Bruno Bastian, to move with him to Darmstadt. Mr. Bastian had built an electrostatic electron microscope from scratch shortly after the war when almost nothing was available from industry in Germany. He stayed in Scherzer's institute until his retirement and was of eminent help in the development of corrected electron-optical systems.

When we attended Scherzer's lectures on theoretical physics and worked on our diploma and on our PhD theses, he was about fifty years of age and was a well-established German professor. He gave the basic theoretical physics lectures, cycling through electrodynamics, optics, quantum mechanics, and thermodynamics in four semesters. These lectures were accompanied by exercises in solving theoretical physical problems, which were corrected by advanced students, and finally discussed by Scherzer himself in a weekly exercise hour. In addition, Scherzer gave during every

semester a lecture on a special theoretical physics topic such as the quantum theory of chemical bonding, the Dirac equation, theory of nuclear forces, and electron optics. D. Typke, one of the authors of this article, noted, "I liked his lectures very much—more than the experimental physics lectures that I had attended before." Scherzer was not a very eloquent speaker, but whatever he said was well-considered and substantial. Moreover, he had a special ability to teach complicated

matters in a comprehensible way. One of his specialities was to demonstrate with his hands the behavior of coupled pendulums. For many years Scherzer was also the host of the physics colloquium. He was famous for his probing questions and for his ability to clarify matters that seemed to be unclear. In addition he had various activities outside his institute. For instance he was, within the Technische Hochschule Darmstadt, pivotal in establishing the Institute of Nuclear Physics. Two times he was the dean of the faculty of Mathematics and Physics. Outside the Hochschule, he was one of the founding fathers of the heavy ion research center, GSI, near Darmstadt. In 1975 he became an honorary member of the German Electron Microscopical Society, and in 1983 he was awarded posthumously the "Distinguished Scientist Award" of the Electron Microscopy Society of America (EMSA).

Scherzer was a strong, self-willed and self-confident personality—somebody who would not accept anything unless he himself had carefully thought it over. Instead of searching the literature for solutions to some specific problem, he preferred to solve the problem himself. He was well aware



**Figure 1:** Otto Scherzer discussing questions after a lecture on thermodynamics, 1958.

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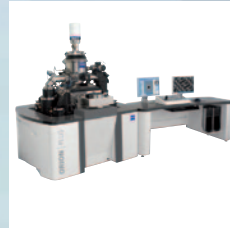
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Figure 2: Otto Scherzer at a conference, 1973.

that he was a first-class physicist, and he had in fact a broad knowledge of theoretical as well as of experimental physics. He was also an excellent mathematician.

Scherzer was not an easygoing person; he was critical of others and demanding of his collaborators, but he was always fair. He was a perfectionist to the point of pedantry. For example, he set a high value on small language details. Already the way the institute's name was written may highlight this personal trait. He insisted that the adjective "theoretische" was to be written in lower case, to emphasize that **physics** was the main subject of his research and teaching. One of our colleagues described the atmosphere by extending the institute's name to: "Institute for theoretical physics, applied pedantry, and practical half education (Halbbildung)." Another example of his attention to language details is the word "stigmator" that he created for his proposed tool to correct the (axial) astigmatism of electron lenses. In contrast to that, people in light optics had termed an objective lens for which the (off-axial) astigmatism had been corrected as "anastigmat." Another example is the paper (1965) in which he proposed a specific terminology for non-spherical electron lenses.

Scherzer was open to new, unconventional ideas. An example of his openmindedness was that he accepted a paper as PhD thesis by an external scientist, Hieronymus Zygan, in which the author assumed the quantization of space. From his assumptions, Zygan had, among other results, derived Sommerfeld's fine structure constant, a basic quantity in atomic theory, to an astonishing accuracy. Scherzer was first skeptical, but when he checked all the mathematical derivations, he did not find an error. Though Scherzer did not accept Zygan's basic assumptions, he decided the paper was worth publishing. By the way, Scherzer's physicist colleagues disagreed with his decision, but he did it anyway, with professor Laugwitz from the Mathematics faculty as the first referee.

Scherzer often lamented the burden of work and his responsibilities. He always had the feeling that he was short of time. When an interesting physical question came up, one of his

sayings was "we should hire a diploma or PhD student to solve this problem—or I should have 10 minutes of time available." However, it also happened that he would ask one of his collaborators to solve a certain problem, and the next day he himself had the solution, normally written on the back of an envelope. He then may have said that he had an appointment at the dentist's office, and while waiting he had time to do the calculation.

Scherzer attracted good students. However, he was not very supportive of their academic careers; he was too critical for that. In fact, quite a number of his diploma or PhD students became professors after having moved to another university. So there was the saying that Scherzer's fugitive pupils were his best.

During the "Third Empire" the Nazi Party promoted what they called "Deutsche Physik" (German Physics). The Deutsche Physik had two famous proponents, the Noble Prize winners Philipp Lenard and Johannes Stark. They wanted to eliminate "Jewish physics," particularly Einstein's relativity theory. So the politicians pressed the professors to teach German Physics. Most physics professors, including Scherzer and his colleagues in Darmstadt, did not yield to the pressure. In his lectures Scherzer cited Einstein. When party officials criticized him because of that, his answer was: "If I mean Einstein, I have to say Einstein." Finally, professor Finkelburg,

one of Scherzer's colleagues in Darmstadt, officially asked for a disputation between the (normal) physicists and exponents of German Physics. This discussion took place in November, 1940, with six physicists, including Scherzer, and the same number of exponents of German Physics in an official building of the party, under the supervision of a medical professor from Munich University and two physics professors that the party had suggested.

The disputation took a course that was disastrous for the exponents of German Physics. After a while they were not able to provide any useful arguments. In a final resolution, quantum theory and special relativity theory were accepted as well-established and indispensable parts of physics. This took some pressure off the physics teachers in their daily work [2].

A strong opinionated character like Scherzer is usually the subject of anecdotes. There were in fact many "Otto" anecdotes around. Below we provide just a few of them.

- a) "Scherzer focus": At an international meeting during the talk of one of the participants, Scherzer was not satisfied with the sharpness of the projector. He got up, went to the projector and adjusted the focus. As he returned to his seat, Albert Crewe said with a low

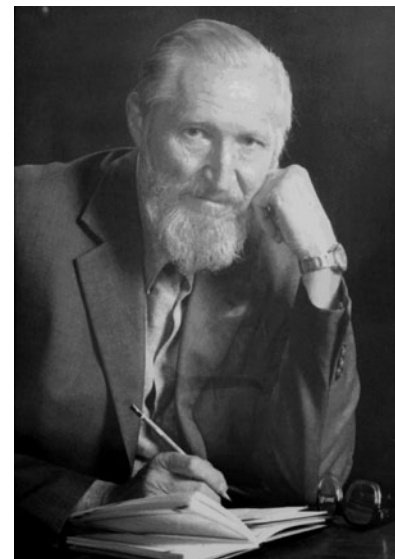


Figure 3: Otto Scherzer at about age 70.



voice but such that everybody could hear: this is now Scherzer focus. (In electron microscopy the Scherzer focus is the defocus used to obtain optimum contrast transfer for an uncorrected objective lens.)

- b) For many years Scherzer drove a Volkswagen Beetle. Once, when driving with his colleagues in his car on a two-way highway, he passed a big truck loaded with logs. When he had finished, one of the colleagues who was obviously scared asked him what he would have done if a car would have come against them. His answer: "I would have pondered what would be the least risk and probably would have moved under the logs."

On another trip with his car, the motor failed at some point. He opened the motor and fiddled around for a short while. Then he started the motor, and it worked again. To his colleagues it appeared a bit like magic, but he knew that the distributor contacts were a weak element in those days, and he fixed the bad contacts by some fiddling.

- c) When some students came late to his lecture, he once remarked: "Academic freedom means that one may come or may not come to a lecture, but it does not mean that one may be late." After that a latecomer only dared enter the small physics lecture hall through the back door and, as silently as possible, took a seat in the most distant row.
- d) At one physics colloquium, H. Lichte talked about electron holography. In his talk he often used the term "Scherzer defocus." After the talk Scherzer, sitting

in the first row, asked, "Mr. Lichte, could you please explain to us what the Scherzer defocus is?"

- e) Before the violation of parity was discovered, the theoretical physicist Friedrich Hund was in Darmstadt at a colloquium. In the discussion after the talk, Scherzer (pro parity violation) offered a bet to Hund (pro preservation of parity), but Hund did not want to bet. Even when Scherzer offered to only bet for a bar of chocolate, he did not accept. Today we know that Scherzer would have won the bet.

When one of the authors (Max Haider) worked in Scherzer's institute as the last operator of the corrected microscope, Scherzer came every morning to ask how far he had gotten with the resolution. One day Scherzer did not come, and Max was informed that he had a light flu. Three days later he had died. Otto Scherzer's untimely death in 1982 at age 73 was unexpected to his friends and his former students. He had always been in good health. If he would have lived another 15 years well into his eighties, he could have had the satisfaction of seeing his dreams of corrected microscopes come true.

### References

- [1] M Marko and H Rose, "The Contributions of Otto Scherzer (1909–1982) to the Development of the Electron Microscope," *Microscopy and Microanalysis* (2010) in press.
- [2] O Scherzer, "Physik im autoritären Staat" in ed. A Flitner, *Deutsches Geistesleben und Nationalsozialismus*, Rainer Wunderlich Verlag, Tübingen, 1965.

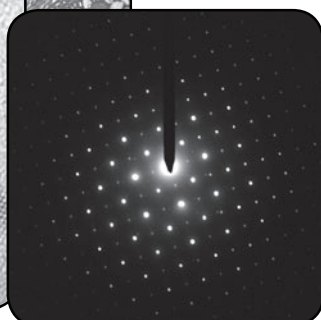
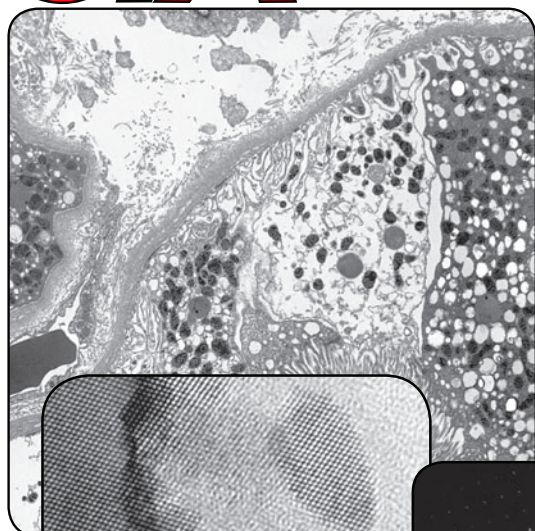
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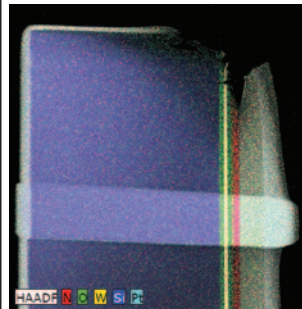
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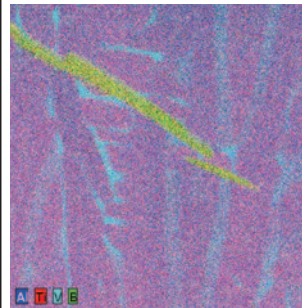
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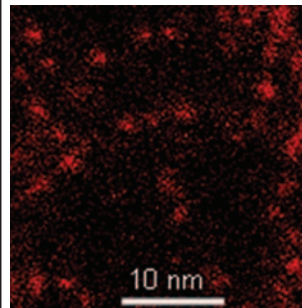
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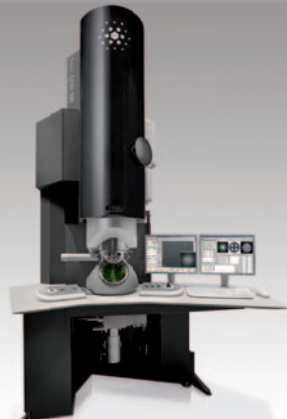
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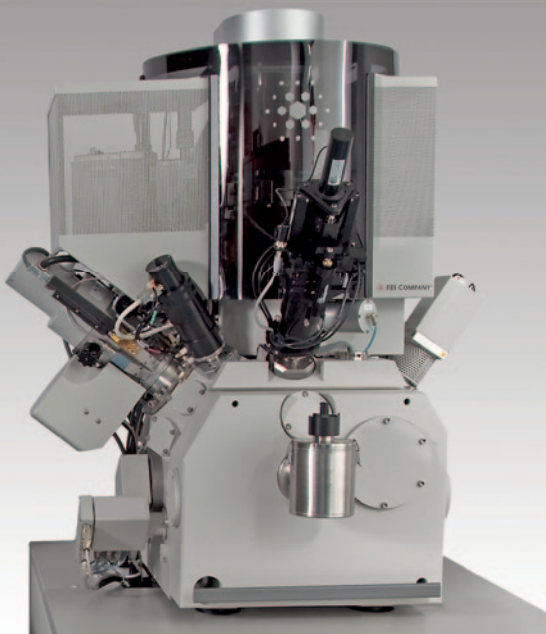
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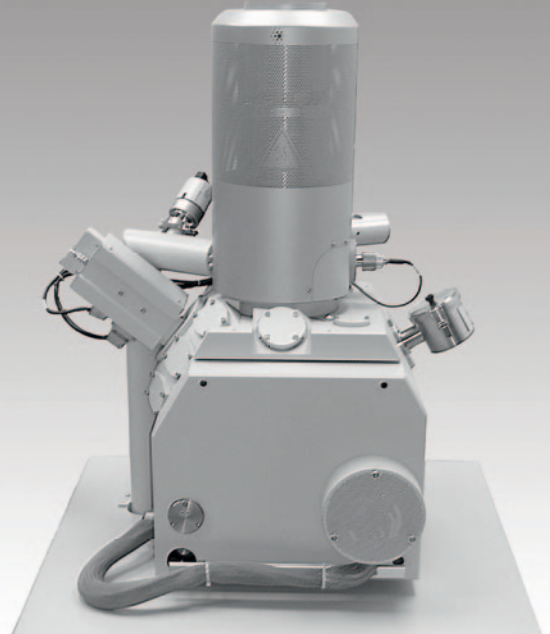
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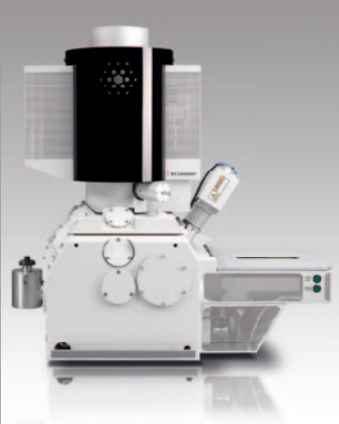
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