Hans Mueller (1900-1965)

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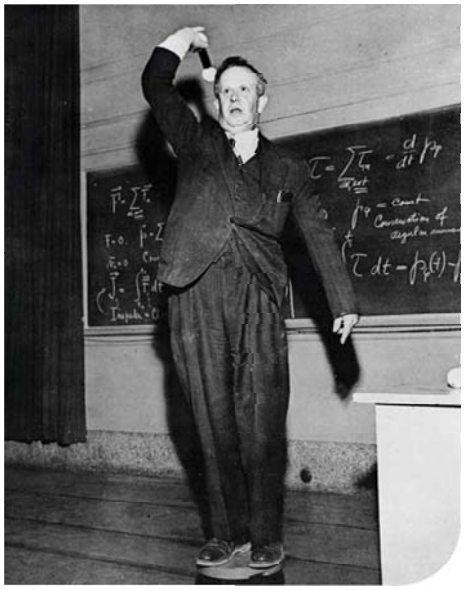
We are happy to offer this contributed biography exploring the life and work of Hans Mueller. It is appropriate to honor the man whose development of the Mueller matrix has become increasingly popular in today's ellipsometry community for measuring anisotropic and partially polarizing materials.

Students of the Stokes-Mueller calculus are confronted with an imbalance: the Stokes vector is named for Sir George Gabriel Stokes, one of the great Victorian polymaths known to most scientists, while the Mueller matrix is named for Hans Mueller, an MIT professor who published sparingly and about whom biographical information is hard to find. Here, we aim to satisfy the curiosity of those who ask, "Who was Hans Mueller?"



Mueller during a physics demonstration. (With permission of MIT Museum.)

Hans Müller* was born in the village of Amriswil in the canton of Thurgau in Switzerland on October 27, 1900. He was the son of Ernst Müller, a farmer, and Mathilde Müller (born Meier). His early years were spent at the primary and secondary schools of Amriswil. In 1916, he began technical studies in the canton capital Frauenfeld and received his high school degree (Reifezeugnis) in the autumn of 1919. His undergraduate and graduate education were conducted at the Eidgenossische Technische Hochschule (ETH) in Zürich where he received a teacher's diploma in science and mathematics in 1923. During the following two years, he worked as a graduate student assisting the Nobel laureate Professor Peter Debye and also Professor Paul Scherrer. In the beginning of 1925, Mueller accompanied Debye on a visit to the Massachusetts Institute of Technology (MIT)[1], but Debye returned to Switzerland alone as Mueller accepted a position as a research associate in the MIT Department of Physics.[2] He completed his ETH dissertation (1928) "Zur Theorie der elektrischen Ladung und der Koagulation der Kolloide" (On the Theory of Electric Charge and Coagulation of Colloids)[3] while working in Cambridge.

The colloidal state of matter was one of the most active areas of physical chemistry in the 1920s.[4] With his doctoral degree, Mueller was promoted to assistant professor, and in 1935 had earned the rank of associate professor.[5] During the academic year 1937–38, he took leave as a Guggenheim Fellow at the Cavendish Laboratory at Cambridge University. In 1942, he was promoted to full professor.[6]

At MIT, Mueller continued his work on colloids,[7-13] but was also beginning to investigate the dielectric and optical properties of crystals and studied the photoelastic effect, a curious foreshadowing of the use of PEMs to deliver Mueller matrix elements.[14-18] Mueller's papers on Rochelle salt, the first ferroelectric crystal, summarized the experimental studies of this substance.[19-23] Apparently, Mueller, in connection with the work on Rochelle salt, coined the term *ferro-electric*,[19] later written *ferroelectric*.[20]

Mueller was one of MITs most popular teachers.[24] He had a major impact on the physics curriculum[25-28] and overhauled one of the Institute's anchor courses, freshman physics.[29] His teaching style included vivid gestures and a loud voice with strong German accent. When Mueller broke his wrist while cranking a Ford automobile, some students assumed it must have happened during a lecture;[30] he was known to flap his arms wildly when animating electromagnetic waves. In all respects, Mueller was highly engaged in the life of MIT, and expressed great concern for the "boys" that were under his charge.[31-35]

* We use his anglicized surname "Mueller" elsewhere, as he did professionally.

As the premier engineering school in the United States, life at MIT was upended by the second world war. Many of the professors and students were drawn into unfamiliar territory. Mueller was involved in standardizing human serum albumin solutions by light scattering, a necessity during the scale up of blood plasma proteins in advance of the invasion of Normandy.[36] His work on light scattering played a role in the development of his eponymous matrix introduced in 1943.

Mueller was motivated to place optics upon a phenomenological foundation, measurements of light intensity, as opposed to the assumption of the wave equation. His matrix formalism was not well documented at the time, but appeared in a now declassified report,[37] and was presented in course 8.262 "Foundations of Optics" at MIT during 1946–1949. The matrices were also presented at the winter meeting of the Optical Society of America 1948[38] and in the thesis of Mueller's student Nathan Grier Parke III, among other doctoral and bachelor of science students.[39] As recalled by his chairman, J. C. Slater, "[Mueller] *has been following a lead which originated from his work on scattering of light during the war. In this study, Mueller developed an interesting mathematical theory of optical instruments and their relation to polarized light. In this theory, an optical instrument is replaced by a linear transformation applied to a vector representing the state of polarization of the light. By extensions of this theory, one can get answers to very complicated problems in the effect of instruments, particularly polarizing instruments, on the state of polarization, problems of great interest to the optical profession. This work, which has not yet been published in an extensive form, is essentially theoretical; Professor Mueller has not been doing experimental work recently, though he hopes to return to it."*[40]

Soon after the end of spring term, on June 10, 1965, Hans Mueller died unexpectedly at his home in Belmont, Massachusetts.[41] He was survived by his wife, Inez, and daughter, Agneta. Mueller was remembered by colleagues as *"a superb teacher and one of the most beloved members of our faculty."* In the "footnotes" section of *The Tech*,[41] a student commemorated Mueller with these words: *"Those of us who were lucky enough to draw recitation sections under 'Hans' will miss him; those who weren't that lucky missed something rare."*

The authors are currently working on a more detailed paper on the life and works of Hans Mueller. Any information on the subject is welcome.

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