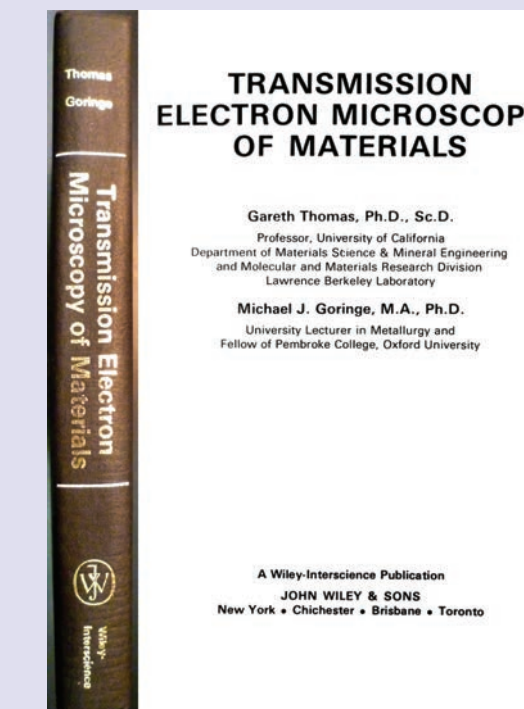


Portrait of Gareth Thomas as MSA President in 1975

Gareth Thomas

1923 - 2013



Transmission Electron Microscopy of Materials [G. Thomas, M.J. Goringe (1981) Wiley, New York]: For decades, the standard textbook in the field.

Brief biography

Gareth Thomas was founder of Berkeley Lab's National Center for Electron Microscopy (NCEM) and was one of the world's foremost experts on electron microscopy.

He was born in Maesteg, South Wales. After a B.Sc. with First Class Honors at Cardiff University in 1952, he went on to a Ph.D. (1955) and an Sc.D. in metallurgy (1969), at Cambridge. He was at Cambridge at the time of the early application of EM in the study of materials, while Peter Hirsch and Archie Howie were working in the Cavendish Laboratory. Throughout his career, he was recognized as the most prominent promoter of electron microscopy for the study of materials; he wrote the leading textbook of its time (above), the first TEM text aimed at the user rather than the theorist.

From 1960, he spent his career at UC Berkeley, where he became full Professor in 1966 and advised and graduated more than 100 UC Berkeley graduate students, and also at LBNL, where was Founder and Director of the National Center for Electron Microscopy, the nation's largest-ever investment in EM facility, from 1982 to 1991. The goal at NCEM, imaging the atomic structure of materials atoms, was realized with NCEM's "Atomic Resolution Microscope". His legacy is represented by the current generation of electron microscopes at NCEM / Molecular Foundry, which are capable of imaging and spectroscopy of individual atoms.

With over 500 publications and 12 patents, Thomas' work covers the following categories:
- Steel and Alloys
- Ceramics
- Magnetic material
- General EM studies of materials (nanostructure, phases)
- Promoting the power of EM in materials research
- Fundamental EM techniques for materials
(He often cited his MSA-meeting abstracts in his full publications)

Techniques he used in his papers on materials research included: HREM, HVEM, Lorenz, EELS, EDX, Image analysis.

From Uli Dahmen, Director of NCEM from 1994 to 2014, and Thomas' former student:
"Thomas' vision and dedication laid the groundwork for the NCEM's many successes, which include surpassing barriers of microscopic resolution, down to the level of half an Ångström, smaller than the diameter of a single hydrogen atom. He put Berkeley on the map and made it a worldwide center for electron microscopy that attracted scientists from all over the world." Dahmen also said: "What set him apart was the fact that he was a microscopist with a big vision, and that's how he was able to convince other people of its importance."

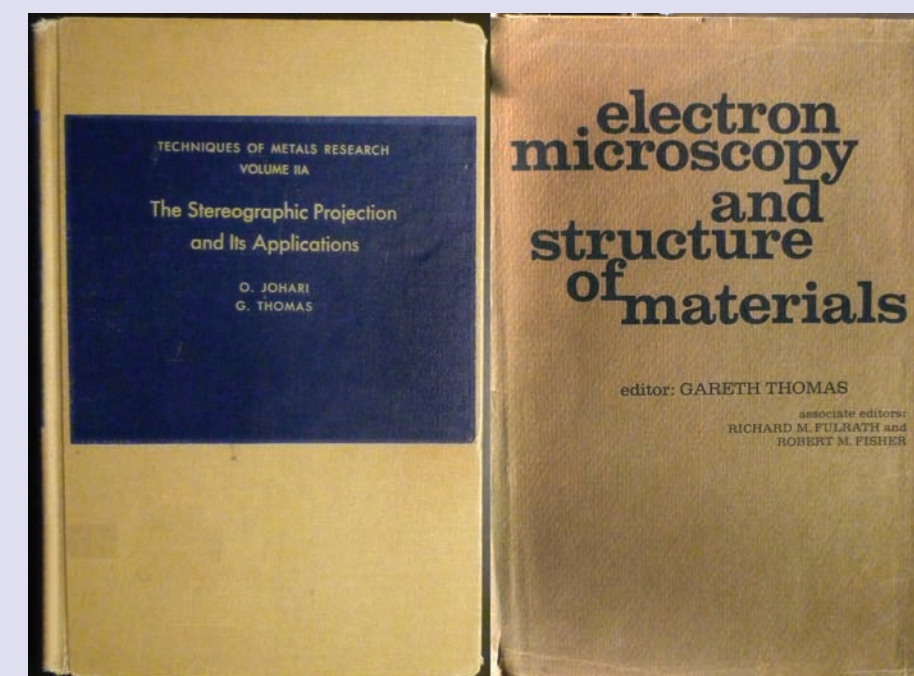
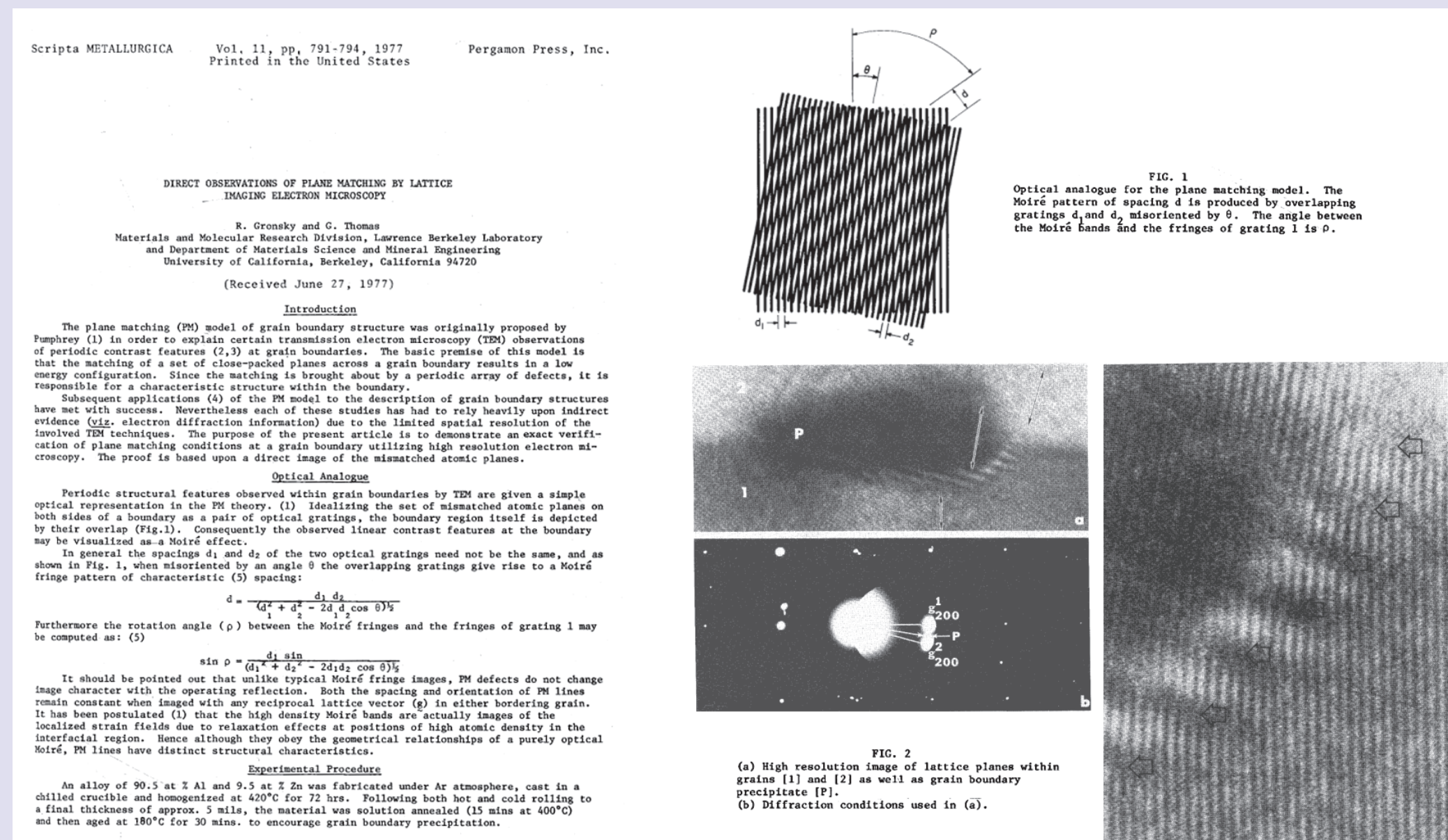
Early Work and Promotion of Electron Microscopy

Interpreting and understanding the ultra-structure of materials was the core of Thomas' scientific career, starting with his Sc.D. / Ph.D work at Cambridge, where Peter Hirsch and Archie Howie were laying the foundations of the analysis of metals using electron microscopy.

Again quoting Uli Dahmen "Gareth did more than anyone to bring atomic resolution to materials science as a tool to help us understand how materials behave. It is hard to imagine how the field of electron microscopy would look today without the influence of Gareth Thomas."

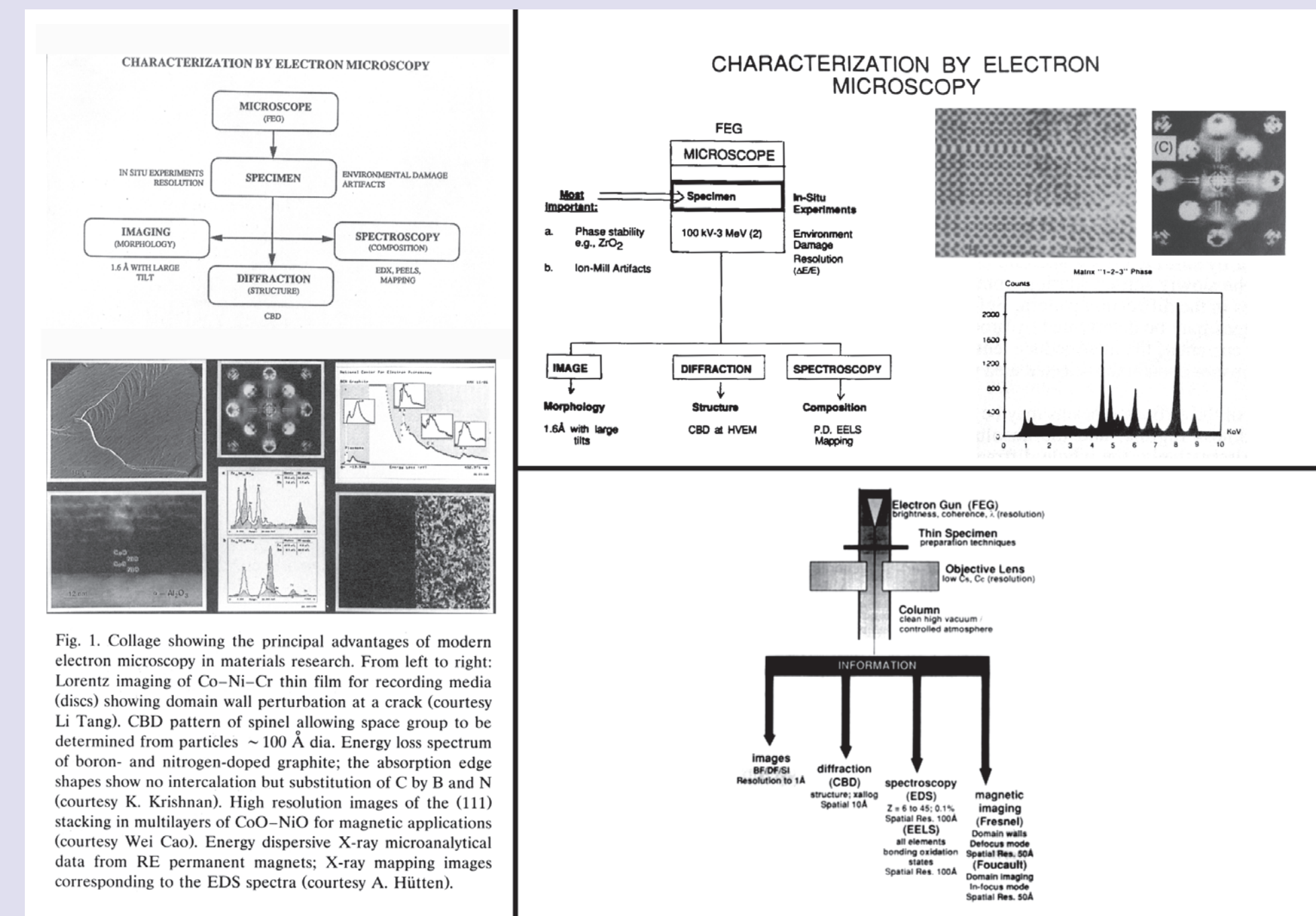
His first book [G. Thomas (1962) Transmission Electron Microscopy of Metals, Wiley, New York.] was the first working handbook on the subject, enthusiastically reviewed in 1962 by V.E. Cosslett, another of the pioneers at the Cavendish laboratory, in the Journal of the International Union of Crystallography.

To the right is an example of early work on understanding contrast effects in lattice imaging at grain boundaries. Another example of this work is: [R. Sinclair and G. Thomas (1978) Determination of Local Composition by Lattice Imaging. Metall. Trans. A, 9A(3): 373-379.]



Some of Thomas' early work on stereographic projections (Johari and Thomas 1969, shown above) and Kikuchi maps (Okamoto, Levine and Thomas (1967) Kikuchi Maps for hcp and bcc Crystals, J. Appl. Phys. 38(1): 289-296.) opened the door to doing real-time crystallography in the TEM.

Early compilations of work, such as [Thomas, Fulrath, Fisher (Eds.), (1972) Electron Microscopy and Structure of Materials University of California Press]— shown above—showed the diversity of applications of TEM, at the 5th International Materials Symposium, held at Berkeley. This and a few other conferences established UC Berkeley and Gareth's lab as the undoubted leader in the application of TEM to solve real materials problems.



Thomas wrote several journal articles promoting the many uses of EM in materials research. The left-hand panel is from [G. Thomas (1994) Microstructural Analyses of Advanced Inorganic Materials, Ultramicroscopy 54(2-4), 145.]. The upper-right panel is from [G. Thomas (1994) Electron Microscopy of Inorganic Materials, Proc. Ann Meet. Microsc. Soc. Am., 558.]. The lower-right panel is from [G. Thomas (1996) Electron Microscopy and Microanalysis of Ceramics, J. Eu. Ceram. Soc. 16:323-338.].

National Center for Electron Microscopy

The beginning of NCEM can be traced to a workshop on electron microscopy held at the LBNL in 1976. Thomas, along with Robert Glaeser and John Cowley, proposed the establishment of a national electron microscopy center that would feature microscopes capable of "seeing" atoms. "We made clear the value, both to organic and inorganic researchers, of such a tool, then we pointed out why it should be built at LBNL," Thomas once explained. "We believed that the quality of the center's work and the caliber of its researchers would prove that the time was right for a microscopy center in the United States."

Building up of the NCEM infrastructure started in 1979, and the Kratos HVEM was installed in 1981, before the official establishment of NCEM. Gareth became the first Director of NCEM at the official establishment on September 30, 1983, which also saw the commissioning of the JEOL JEM-ARM1000 Atomic Resolution Microscope (ARM), the first instrument in the world capable of showing individual atoms in a sample. The ARM remained the world's highest-resolution electron microscope well past the Gareth Thomas' retirement as NCEM Director in 1991.

After Thomas' retirement from the directorship, Ken Westmacott was Interim Director, followed by Uli Dahmen, who became both Managing and General Director from 1993 until 2014. Dahmen oversaw the "TEAM" project, funded by the Department of Energy, which resulted in replacing both of the HVEMs and re-using the "silos" for the world's two most-advanced electron microscopes, capable of 0.05-nm resolution, three times higher than that of the ARM (0.16 nm).



The NCEM facility at Lawrence Berkeley National Laboratory, as it was in Gareth Thomas' time.

The two HVEMs were housed in the blue "silos" (upper left). The Kratos EM-1500 (upper right) was in operation from 1981 to 2003. Used mainly for in-situ work, it slightly pre-dated NCEM itself. It was the special responsibility of Ken Westmacott, who set up the NCEM infrastructure and acted as Managing Director of the NCEM throughout Thomas' directorship.

The JEOL JEM-ARM1000 (lower left), custom-built for NCEM under the direction of Thomas, was configured, installed (in 1982) and managed under the direction of Ron Gronsky. The ARM was inaugurated in 1983 – the sign-off ceremony is shown at the lower right, with Ron Gronsky (left), Gareth Thomas (center) and Kazuo Ito, co-founder and third President of JEOL Ltd. (right). The decommissioning of the ARM took place in January, 2007, the occasion for an international conference.

Microscopy Societies

Gareth Thomas was very involved in microscopy societies. At the time of ICEM-12 in Seattle, which was combined with the MSA meeting, Gareth Thomas was President of IFSEM (he was President of MSA in 1975). He is shown here at Seattle with the executive committee (left) and with the immediate past IFSEM President and HREM pioneer Hatsujiro Hashimoto (right). The Seattle meeting was the second and most recent IFSEM conference held in the US (the first one in the US was in Philadelphia in 1962). Thomas had honorary microscopy society memberships in Japan, India, Korea, Taiwan, and China.

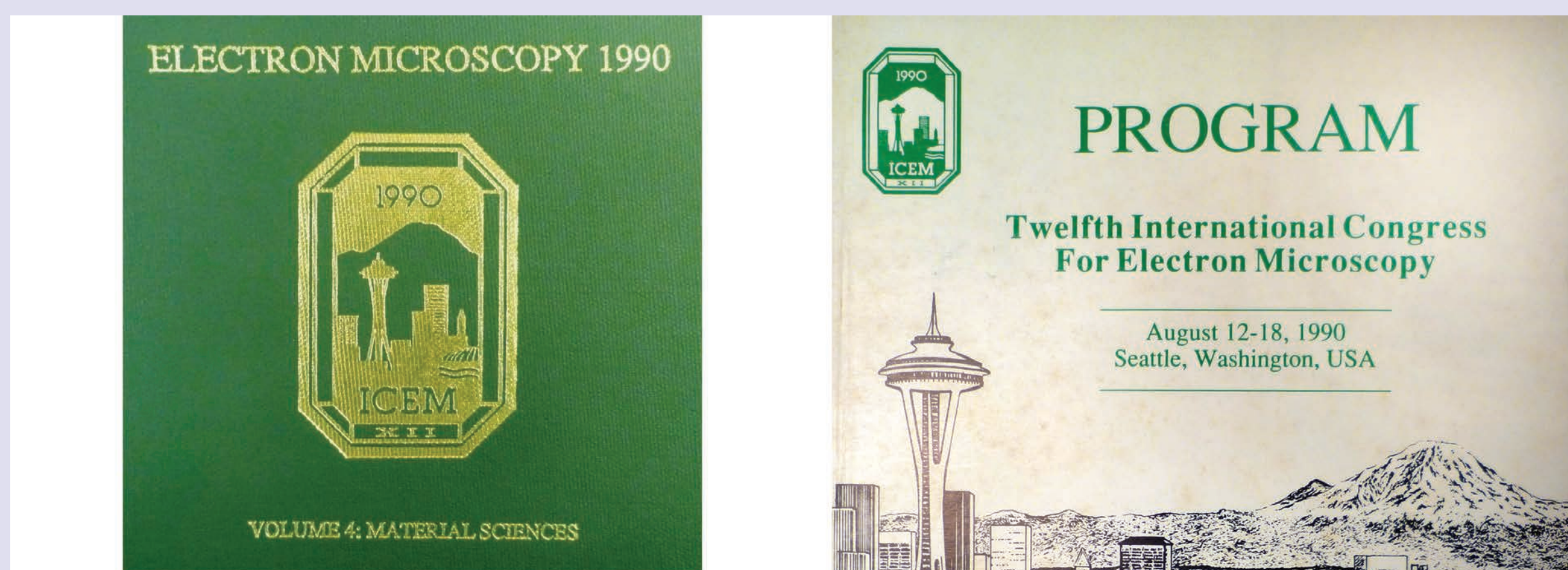


FIGURE 2. Meeting of the IFSEM Executive Committee during ICEM 12 in Seattle, 1990, including newly elected members and guest. Standing (from left): David J. H. Cockayne, Australia (General Secretary from 1995; committee member 1987-1994), Kazuo Ogawa, Japan (committee member 1987-1994), Ernie F. J. van Bruggen, The Netherlands (committee member 1983-1990), K. H. Kuo, Beijing, China (guest, Chairman of Organizing committee for 5th Asia-Pacific Electron Microscopy Conference, 1992), Agnes Csaszdy, Hungary (committee member from 1991), Sitting (from left): Robert M. Fisher, United States (committee member from 1991), Arvid B. Maunbach, Denmark (President from 1995; General Secretary 1987-1994; committee member 1983-1986), Gareth Thomas, United States (President 1987-1990; Vice President 1991-1994; General Secretary 1975-1986), Hatsujiro Hashimoto, Japan (President 1983-1986; Vice President 1987-1990), and Elmar Zeitler, Germany (President 1991-1994; Vice President from 1995; committee member 1983-1990). Not in photo: Archie Howie, U.K. (committee member 1987-1994), Armin Delong, Czechoslovakia (committee member 1987-1990), and Hans Geuze, The Netherlands (committee member from 1991).



Awards and Honors

Among Gareth Thomas' many honors, those of most interest to MSA members are listed here. He is the only electron microscopist ever elected to both the National Academy of Engineering and the National Academy of Sciences.

- 1976 Fellow, Royal Microscopical Society, U.K.
- 1976 Fellow, American Society for Metals
- 1977 The Rosenhain Medal (The Metals Society, U.K.)
- 1978 Ernest O. Lawrence Award (U.S. Department of Energy)
- 1979 Fellow, Metallurgical Society of AIME
- 1980 MSA Distinguished Physical Scientist
- 1981 Alexander von Humboldt Senior Scientist Award, Max Planck Institute, Stuttgart
- 1982 Elected to the National Academy of Engineering
- 1983 Elected to the National Academy of Sciences
- 1987 IMS Sorby award
- 1996 Alexander von Humboldt Senior Scientist Award, IFW, Dresden, Germany
- 2009 MSA Fellow 2009.

Honorary Doctorates: Lehigh University (1996), Krakow, Poland (1999)

Technical Director, Board Member *Acta Materialia* (from 1998)
Editor in Chief, *Acta Materialia* and *Scripta Materialia* (1995-1998)
Founder Member (1992), Editorial Board, *NanoStructured Materials* (Elsevier)
Board Member (1982-1994) and Chairman (1982-1985), *Acta Metallurgica*



Gareth Thomas later in life

Acknowledgements

Appreciation by David B. Williams written for the Microscopy Society of America, March, 2014. Appreciation written by Uli Dahmen, and other content on the Berkeley Lab and NCEM websites. Obituary from the *Daily Californian*, June 28, 2014