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Microscopy AND Microanalysis

Introduction: An International Workshop in Honor of Regents' Professor John Maxwell Cowley on the Occasion of His 80th Birthday

This issue is dedicated to Regents' Professor John Maxwell Cowley, FRS, in recognition of his lifelong contributions to electron microscopy, diffraction, and crystallography. This collection of 22 peer-reviewed articles is based on presentations made at the international workshop entitled "Recent Developments and Applications of Atomic Resolution Electron Microscopy and Spectroscopy—A Silver Jubilee." The workshop was held in the historic Old Main building on the campus of Arizona State University in early January 2003 and was attended by about 150 people. It celebrated the 25th anniversary of the Center for High Resolution Electron Microscopy, which was founded by John Cowley, and also served as an occasion to honor him on his 80th birthday. Keynote speakers included Sumio Iijima, discoverer of the carbon nanotube; Mikail Roco, senior advisor on nanotechnology for the National Science Foundation; and John Cowley himself, whose lecture addressed innovative ideas for achieving sub-Ångstrom resolution without requiring aberration correction.

The articles in this issue, many written by former students, friends, and colleagues of John Cowley, cover a diverse range of topics that reflect the breadth of his scientific interests. Theoretical papers include image interpretation for annular-dark-field scanning transmission electron microscopy (STEM), possibilities for STEM holography, and limits on atomic-resolution imaging and spatially-resolved spectroscopy. Techniques described include *in situ* ultrahigh-vacuum imaging of surfaces and small particles, Lorentz microscopy and electron holography, sub-Ångstrom and aberration-corrected imaging, as well as protein crystallography, novel approaches to electron diffraction and convergent-beam electron diffraction, and multislice simulations. Applications range from nanoclusters, nanobelts, and nanowhiskers to heterogeneous catalysts, nitride semiconductors, and magnetic materials.

We thank all of the participants, especially the invited speakers and session chairs, whose contributions made the workshop into a memorable event. We are also grateful to the authors and manuscript reviewers for their contributions toward publication of this special issue of *Microscopy and Microanalysis*.

Brief Summary of the Contributions of John Maxwell Cowley

Regents' Professor John Maxwell Cowley, FRS, has been an extraordinarily productive scientist over more than five decades. He has made pioneering contributions in the fields of electron microscopy, diffraction, and crystallography that have brought him widespread recognition. He has received the highest awards of the International Union of Crystallography, the Electron Microscopy Society of America, and the American Crystallographic Society, and he has been honored by election to Fellowship of the Australian Academy of Science, The Royal Society of London, and the American Physical Society. His monograph *Diffraction Physics* is THE standard reference in the field.

His early definitive studies on short-range order are remembered by the so-called Cowley-Warren parameters. While employed at CSIRO in Melbourne, Australia, his development (with A.F. Moodie) of the physical optics approach to electron scattering led directly to the multislice formulation, which has become the basis for the standard computer programs that are used worldwide for simulating high-resolution electron micrographs of perfect crystals and defects. At the University of Melbourne, he extended his interests further into X-ray and electron diffraction as applied to structural studies, and he contributed significant insights into electron microscope imaging, especially for the scanning transmission electron microscope.

At Arizona State University, he initially directed his attention toward imaging crystal structures by high-resolution electron microscopy. His theoretical contributions from this period played a significant role in consolidating knowledge and understanding of the high-resolution image formation process. He also turned his attention toward the high-resolution scanning transmission electron microscope, and he helped to establish the microdiffraction technique with a small coherent probe as a viable alternative method for characterizing materials, especially their local disorder. More recently, his efforts have been concentrated mostly on electron-optical techniques for studying small particles, surfaces, and nanotubes, including possibilities for sub-Ångstrom imaging using atomic focusers. Since his nominal retirement in 1994, John Cowley has continued to be highly active, both with novel nanodiffraction experiments and further theoretical developments.

John Cowley founded the electron microscopy facility at Arizona State University that under his leadership came to be recognized as the premier electron microscopy center in the world. The Center has produced numerous doctoral students and attracted many scientists and post-doctoral researchers from around the world. Throughout this period and continuing to the present, John Cowley's ideas, enthusiasm, and basic understanding of electron optics and diffraction phenomena have provided inspiration and leadership to the entire field of electron microscopy.

Resume

Born:	February 18, 1923 in Adelaide, Australia
1945:	M.Sc., University of Adelaide
1949:	Ph.D., Massachusetts Institute of Technology
1945–1962:	Assistant Research Officer, later Senior Principal Research Officer, Chief Research Officer and Head of Crystallography Section, CSIRO Division of Chemical Physics, Melbourne, Australia
1961:	Fellow, Australian Academy of Science
1963–1969:	Chamber of Manufacturers Professor of Physics, University of Melbourne
1970–1994:	Galvin Professor of Physics, Arizona State University

1976:	Bertram Eugene Warren Award, American Crystallographic Society (with Sumio Iijima)
1979:	Fellow, Royal Society
1979:	Distinguished Physical Scientists' Award, Electron Microscopy of America
1983–1990:	Director, NSF National Facility for High Resolution Electron Microscopy
1984:	Fellow, American Physical Society
1987:	Ewald Prize, International Union of Crystallography (with A.F. Moodie)
1988:	Regents' Professor, Arizona State University
1994:	Emeritus Regents' Professor, Arizona State University

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Guest Editor

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