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Norio Kato (1923–2002)

Dr Norio Kato, Professor Emeritus of Nagoya University, 79 years old, passed away very suddenly of a heart attack at his home in the early morning of 5 April 2002. He was a well known scientist, contributing to the IUCr as a member of the Executive Committee (1969–1972), as President (1978–1981) and then Past President (1981–1984). In 1993, at the IUCr Congress and General Assembly held in Beijing, People's Republic of China, he was awarded the third Ewald Prize for his outstanding contribution to the dynamical theory of X-ray diffraction of spherical waves by perfect and nearly perfect crystals, for the experimental exploitation of these theories towards the characterization of the defect structure of single crystals, and for his extraordinary achievements in X-ray diffraction topography.

About one month before his death, Professor Kato visited the X-ray Laboratory of the Department of Applied Physics, Nagoya University, Japan, which was his laboratory before his retirement, and chatted with some members of the X-ray group for more than five hours. He mentioned that it was helpful and useful for him to talk with people in many respects, otherwise he would forget words, because he was living by himself after the death of his wife two years ago. Before he went back home, he registered his present status in the *World Directory of Crystallographers* using e-mail with help from a member of staff. He seemed to be in good health at the time, so it is regrettable to report his death.

He was born on 10 March 1923 in Shanghai, China, and was educated in Tokyo. He graduated from the University of Tokyo with a BSc in physics. He studied the dynamical diffraction effect of electrons on a finite polyhedral crystal under the guidance of the late Professor R. Ueyda at the Graduate School of Nagoya University. This distinctive work in his early years was an extension of Bethe's theory and led to his degree of Doctor of Science awarded by Nagoya University in 1954. He started X-ray diffraction work at Kobayashi Institute of Physical and Chemical Research before he went abroad to study.

Although he was well known for a large number of original research works, the observation of the *Pendellösung* fringe patterns (predicted by P. P. Ewald in 1916) in X-ray topographs of a quartz single crystal, in collaboration with A. R. Lang in 1959 at Harvard University (USA) and the University of Bristol (UK), reminds us of the importance of the technique in characterizing crystal defects. He also pointed out the failure of X-ray dynamical diffraction theory, when it was based on plane waves, as the thickness dependence of the fringe spacing observed in the section topographs cannot be accounted for properly. After returning to Nagoya University as Professor of Applied Physics in 1960, he established an alternative dynamical diffraction theory based on spherical waves for an ideally perfect crystal and confirmed this experimentally by using available silicon single crystals. He also extended the theory to allow its application to slightly distorted crystals by showing the concept of the 'eikonal', which had been widely accepted in the field of light scattering, as being useful for interpreting X-ray topographs.

The series of works presented above was not just limited to building the new theory of X-ray diffraction. It was a key issue in the semiconductor industry at that time to know how perfect the silicon single crystals grown synthetically were and also how to characterize their degree of perfection. The technique of X-ray diffraction topography that he used and also the result that proved the silicon crystal to be very perfect were just what the semiconductor industry wished to have. Accordingly, X-ray diffraction topography was widely accepted as a standard technique in characterizing the quality of synthetic crystals. One other significant theory he developed in diffraction crystallography was the statistical dynamical diffraction theory, by which he made clear physically the meaning and the limitation of the secondary-extinction theory, which has been utilized widely in structure analysis, based on the least-squares refinement of diffraction data.

After he moved to the Department of Crystalline Materials Science in Nagoya University in 1977, he was also positive towards the introduction of new experimental devices. With his leadership, a rotating-anode X-ray generator was introduced at Nagoya University, which was of the highest power in the world, 90 kW, and was completed in collaboration with several Professors of Nagoya University and engineers of Rigaku Corporation in 1978. Remarkable amongst his studies with this facility was an absolute measurement of the structure factor of an Si single crystal on the basis of his dynamical theory with an accuracy of better than 0.05%. This was achieved in collaboration with one of his colleagues. As a result of this study, it became possible to discuss in detail the charge-density distribution of the bonding electrons in Si. He was also involved with the effort to establish the Photon Factory, the first Japanese facility for a synchrotron-radiation source, KEK, at Tsukuba. After retiring from Nagoya University in 1986, he contributed to the education of young people at the Department of Physics of Meijo University, Nagoya, for 10 years.

When solving various problems, not only scientific but also in daily life, Professor Kato's way of thinking was unique and original, which stimulated those who lived with him. He will always be remembered by those people. He had a hobby writing Haiku 'Japanese poems'. The poem he wrote when his wife passed away is as follows: 'Shiro Mokuren chiri te hodo naku tsuchi to naru', which may be translated as 'White magnolia falls and returns to Earth without much time'.

Professor Kato played a leading role in many scientific societies: the Japanese National Committee for Crystallography for 26 years from 1960 and council member of the Crystallographic Society of Japan (CSJ) for 25 years. In particular, he performed an excellent job as President of CSJ in 1982. He was a member of the International Advisory Board of the International Organization of Crystal Growth (1967–1977) and a Co-editor of the *Journal of Crystal Growth* (1967–1977). He contributed to the establishment of the Japanese Association of Crystal Growth. The contributions made by Professor Norio Kato to crystallography were vigorous and worldwide.

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