

MARILYN AND STURGES W. BAILEY DISTINGUISHED MEMBER AWARD 2001

The Marilyn and Sturges W. Bailey Distinguished Member Award of The Clay Minerals Society was made to Dr Keith Norrish, CSIRO Division of Soils, Adelaide, Australia, at the 38th annual meeting of The Clay Minerals Society in Madison, Wisconsin, on June 18, 2001. The following introduction was made on behalf of the recipient.

INTRODUCTION OF KEITH NORRISH

James P. Quirk

It was an honor and a pleasure for me to introduce Dr Keith Norrish as the 2001 recipient of the prestigious Marilyn and Sturges W. Bailey Award of The Clay Minerals Society, in recognition of his many definitive contributions to soil and clay mineralogy. Keith graduated from the University of Western Australia in mathematics and physics and then completed first-class honors and Master's degrees using X-ray diffraction techniques. Later he obtained his Ph.D. degree from the University of London working with D.M.C. MacEwan. In 1948, Keith joined the CSIRO Division of Soils in Adelaide and, over time, obtained the highest rank of Chief Research Scientist. Following his retirement in 1989, he worked full time for the Australian Mineral Mining industry, employing X-ray fluorescence for the analysis of ores.

Keith was not the first person in Adelaide to employ X-ray diffraction in crystallography. William Henry Bragg was appointed in 1886 at the age of 26 by the University of Adelaide as professor of mathematics and physics. He held this post until 1909. When Roentgen discovered X-rays in 1895, Bragg turned his attention to the use of X-rays in crystallography and with his son, William Lawrence Bragg, received the 1915 Nobel Prize for this work.

I want to touch, albeit briefly, on some of Keith's many achievements. His 1954 paper on the extensive crystalline swelling of montmorillonite is truly a classic. To do this work, he had to build a low-angle camera virtually from string and sealing wax. He not only produced a huge set of results but demonstrated a theoretical versatility in interpreting these results in terms of the then recently published *The Theory of the Stability of Lyophobic Colloids* by Verwey and Overbeek. What is especially interesting is that this theory relates to well aligned systems, whereas the bulk of the work on surfaces of colloids, even to the present day, is concerned with flocculation or of suspension stability. Within each of these, alignment is vastly different from that of quasi crystalline montmorillonite. Keith established that calcium montmorillonite did not



expand beyond a d_{001} value of 19 \AA , even in distilled water. The lamellae were held within a potential well. This has been shown to have immense importance in providing insights concerning the physical behavior of soils at the micro-structural level. He carried out an extensive survey of the clay and accessory minerals of the Australian Great Soil Groups. This is a companion piece to J.A. Prescott's 1931 *The Soils of Australia in Relation to Vegetation and Climate*. This work is also important as it formed a template for studies in soil physics and chemistry. Dr Norrish made many contributions, working with various soil minerals; *inter alia* these include his studies on soil phosphates, manganese minerals, the weathering of micas, halloysite, the aluminous goethites, illite, and interstratified minerals. He made novel contributions in the identification of very stable phosphates belonging to the plumbogummite group of minerals. He showed that these minerals can

accommodate a number of heavy metals in their structure and this has an important influence on the immobilization of trace elements as well as phosphate. It could be said that no mineral could retain its secrets once subject to Keith's insightful scrutiny. In the early 1950s, primary X-ray fluorescence being developed commercially, Keith, through theoretical and experimental studies, parleyed the development of X-ray fluorescence for analytical purposes. Over a period of more than 40 y, he further developed and refined the technique and, most importantly, its preparative background. The analyses from his laboratory are held in the highest regard in Australia and internationally.

In 1960, Keith formed a close association with the minerals industry. They asked him to develop appropriate techniques and demonstrate that X-ray fluorescence could be used for their products. Probably the most substantial single application of X-ray fluorescence developed by Norrish was for Mount Isa mines in the early 1980s. At that time, the laboratory had the requirement to analyze a range of elements in Pb, Zn, and Cu ores and their products involving ores, concentrates, tiles, float products, *etc.* This had involved more than 30 separate calibrations for their instruments and Keith developed a method that enabled the laboratory to do everything with a single method and one calibration involving the determination of some 25 elements in 600 samples every day.

Dr Norrish has been heavily involved in the development of standards both within Australia and overseas. He represents the Australian mining industry as a member of the International Technical Committee on Standards. This committee met every two years and agreed on standards which assisted buyers and sellers and thereby provided the basis for international mineral trade. As head of the soil mineralogy section in CSIRO, Keith demonstrated rare qualities of leadership based on

scientific vision and physical insights. He was generous with his ideas and time and had a significant influence in fostering the careers of young scientists in the Division and indeed elsewhere. Not surprisingly, he has received many honors. The award in 1977 of the Birks medal at the University of Denver for his development of the use of X-ray fluorescence was truly a significant occasion. (Birks, you will be aware, pioneered the development of X-ray fluorescence and in particular its application in the American space program). In 1997, he was elected Fellow of the Australian Academy of Science, in competition with the various branches of geology, geomorphology, geochemistry, geophysics, hydrology, oceanography, and astronomy. Dr Norrish is one of the two soil scientists who are Fellows of the Academy. At his retirement, he was appointed an Officer in the Order of Australia. This is equivalent to a British knighthood and is an unusual distinction for someone whose whole career has been as a dedicated laboratory scientist addressing the theoretical and experimental aspects of X-ray diffraction and X-ray fluorescence spectrometry in mineral analysis.

Keith is a devoted family man. He and his wife, Betty, and their three daughters and one son form a very close group together with their 14 grandchildren. I began by mentioning that it was a pleasure to present this introduction of Dr Keith Norrish and I would like to return to that by saying that I, too, have benefited vastly from Keith's scientific vision, perceptive wisdom, and encyclopedic knowledge. He truly merits the distinctive honor of the Marilyn & Sturges W. Bailey Award of The Clay Minerals Society.

Editor's note. Dr Keith Norrish is still only semi-retired, at the age of 85, in Adelaide, South Australia. Professor Jim Quirk, 88, is also only semi-retired in Perth, Western Australia