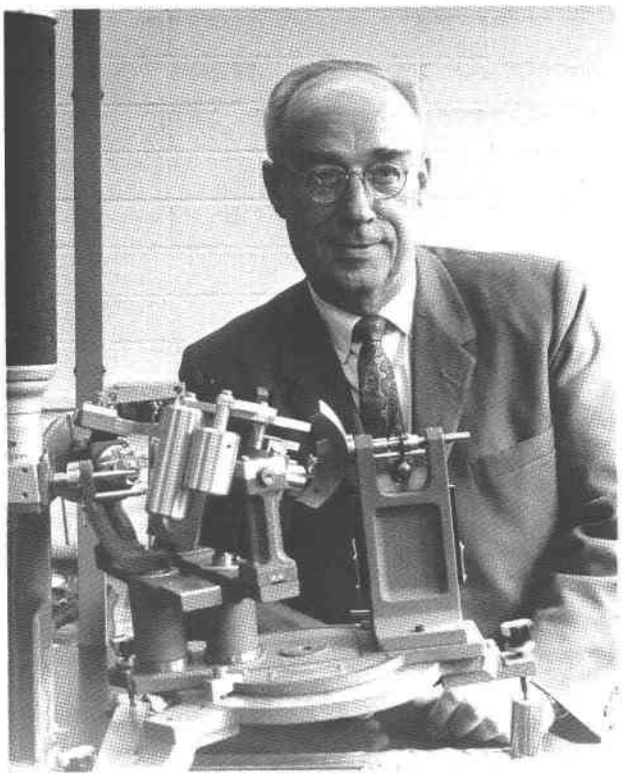
American Mineralogist, Volume 73, pages 1483–1485, 1988

Memorial of Martin Julian Buerger
April 8, 1903–February 26, 1986

CLIFFORD FRONDEL
Department of Earth and Planetary Sciences, Harvard University, Cambridge, Massachusetts 02138, U.S.A.

Martin Julian Buerger, the leading figure in the long history of crystallography in this country, died in his home at Lincoln, Massachusetts, on February 26, 1986, at the age of 83. The cause of death, not early diagnosed, was Alzheimer's disease.

Buerger's scientific contributions, made during a professional association of 50 years with the Massachusetts Institute of Technology, total over 250 publications. These have been listed and categorized elsewhere (Shrock, 1977). They mostly fall into four broad groups: a large body of contributions dealing with the theory of analyzing crystal structures by means of X-ray diffraction; papers and books associated with the design and use of the equi-inclination Weissenberg X-ray camera and the precession X-ray camera (both instruments invented by Buerger); complete crystal structure analyses—forty in all—among them tourmaline, nepheline, and cubanite; and studies contributory to an understanding of polymorphism, phase transitions, twinning, plastic deformation, and exsolution in crystals. His twelve books on crystallography include the widely known *X-ray Crystallography* of 1942.



THE M.I.T. MUSEUM

Martin Buerger, known familiarly as M. J. or Mart, was born in Detroit, Michigan, on April 8, 1903, the older of two sons of Martin John Gottfried Buerger and Julie Emma Rebecca (Weber) Buerger. His brother, Newton Weber Buerger, who survives him, obtained a Ph.D. in crystallography at M.I.T. under Martin in 1939. His father was a grandson of the Rev. Ernst Moritz Buerger, who with religious zeal led a group of Lutheran immigrants from Saxony to Missouri in 1838 and founded the Missouri Synod of the Lutheran Church. Martin arranged the publication in 1953 of a history of the religious activities of his family extending back into the 1700s. Martin was himself a deeply religious person, a habitual church-goer, in his faith a fundamentalist with an unquestioning belief in the inerrancy of the Bible. A believer in providence, and in prayer in dealing with scientific problems (Buerger, 1964), he also recognized that the content of order and its expression by rules that characterizes crystallography as a science were the bases of its appeal to him.

Buerger found a stimulating education at Morris High School in the Bronx, New York, and entered the Massachusetts Institute of Technology in the fall of 1920 as a student in chemical engineering. Dissatisfied with the training offered, he left after two scholastic years to work in industry. He then returned in the fall of 1923 to study mineralogy in the mining and metallurgy option. C. H. Warren, long professor of mineralogy and petrography, had left the year before to become Dean of the Sheffield Scientific School at Yale, and the instruction had fallen to two graduate students, J. L. Gillson and W. H. Newhouse, both assistants to Waldemar Lindgren. They went on to distinguished professional careers in economic geology, initially at M.I.T., and it was primarily through his close association with them that Buerger gained his early interest in ore minerals. Buerger obtained a B.S. degree in mining engineering in 1925, with a thesis on a tin deposit in Bolivia. He then transferred to the Geology Department, where he took a M.A. in 1927 and a Ph.D. in mineralogy in 1929, with a dissertation on translation gliding in crystals of the NaCl type.

In this span of years Buerger also published nine papers, chiefly on the plastic deformation of ore minerals, and from 1927 to 1929 taught the introductory course in mineralogy and petrography. Four summers were spent doing field work, three of them in mining districts, and Buerger might well have gone on to a career as an eco-

0003–004X/88/1112–1483$02.00

nomic geologist had it not been for an important event in 1927. This was an invited series of 32 lectures given by W. L. Bragg in the Physics Department on crystallography and crystal structure analysis by X-rays. It was attended by Buerger together with Bertram E. Warren, George Clark, John T. Norton and others who went on to careers in X-ray crystallography and crystal physics. Buerger lacked X-ray facilities, but in 1930–1931 he readily worked out the crystal structure of marcasite from rotating-crystal and oscillating-crystal photographs obtained on borrowed equipment, applying interpretive techniques he had read about in papers appearing in the *Zeitschrift für Kristallographie.* Later, in commenting about this work, he said he was delighted with the certainty afforded by X-ray analysis as compared with the arguable results obtained by geologists and mineralogists in their fields of study. Very fortunately at this juncture Buerger received a large and unexpected grant of money from the Geology Department in support of his research. It was used for X-ray equipment, and a new career began almost explosively.

During the 1930s alone, following his work on marcasite, Buerger published 40 papers. Among them were descriptions of the crystal structure of loellingite, arsenopyrite, gudmundite, valentinite, and manganite, with unit cell and space group data on five other substances; four contributions to the genesis of polymorphs; papers on lineage structure; the development of a technique and instrumentation for the construction of scaled crystal structure models based on the packing of spheres (an exercise with which most of his students became familiar); a contribution rationalizing the so-called law of complication in morphological crystallography; and, especially, the development in 1934 of the equi-inclination Weissenberg X-ray camera. This instrument was the main factor in first bringing Buerger to international recognition.

Dissatisfied with the unsymmetrical appearance of symmetry on Weissenberg photographs, Buerger devised the precession camera, permitting the undistorted photography of the reciprocal lattice. The first model was described in 1942, an improved model in 1944, and a definitive treatment of the method appeared in 1964 in his book, *The Precession Method.* Buerger's remarkable inventiveness in designing instrumentation also extended to X-ray powder cameras, an instrument for drilling holes in wooden or plastic spheres at specified coordinates, and other devices. In his early years he was greatly aided by two skilled instrument makers in the Department of Geology, Otto von der Heyde and Charles Supper, both of whom went separately into private business and produced Weissenberg, precession, and powder cameras by the hundreds.

Following World War II, during which time his productivity diminished due in part to the diversion of his energy to new and unrelated duties, his research and publications changed somewhat in tenor, with growing emphasis on the theory of interpreting X-ray diffraction data and on the publication of book-length accounts of crystallographic matters. Among the latter were *Elementary Crystallography* of 1956, *Vector Space* of 1959, and *Crystal Structure Analysis* of 1960.

One of Buerger's main contributions, and the source of the deepest satisfaction to him, was his teaching. Twenty doctoral theses were done under his direction, with most of his students going on to professorial posts. This instruction began in the latter 1930s and became accompanied, following World War II, by a long succession of postdoctoral fellows and guests, mostly from foreign countries. His lecturing and teaching activities were further enlarged, as he became known internationally, by numerous invitations to be a visiting professor or guest lecturer by universities in this country and abroad. Buerger's geometrical turn of mind is well illustrated in the manner of derivation of the 230 space groups in his *Elementary Crystallography* and in the descriptive diagrams for the triclinic, monoclinic, orthorhombic, and cubic space groups in the 1983 edition of the *International Tables for Crystallography.* His rigor in exposition was well displayed in his classroom lectures, coupled with an expectancy of high performance on the part of his students.

Buerger's crystallographic and organizational activities outside those centering around his post at M.I.T. also grew rapidly and soon occupied a significant portion of his time. He was closely associated with the International Union of Crystallography, initially as a member of the organizing committee in 1946–1948, then as a member of the Executive Committee from 1948 to 1951, and for over 30 years extending from 1948 as a coeditor of and contributor to the successive editions of the *International Tables for X-Ray Diffraction.* Buerger also served the IUCr as a member of the Commission on Crystallographic Apparatus from 1948 to 1957. He was the organizer in 1939 and first president of the Crystallographic Society of America, a society designed by Buerger to be inclusive of the structural and crystallochemical content of the pure and applied sciences generally. It merged in 1950 with the American Society for X-Ray and Electron Diffraction (of which Buerger also was one of the organizers, and third president in 1943) to form the present American Crystallographic Association. Buerger was a factor in the organization of the International Mineralogical Association in 1958, and served as its American representative in 1968–1970. From 1951 onward he served as a coeditor of the *Zeitschrift für Kristallographie* in which a Festschrift (1968) and a Festband (1973) were dedicated to him, and, finally, a Memorial Volume in 1987.

Notice can be taken here of only a few of the many honors accorded Buerger. He was elected President of the Mineralogical Society of America in 1947 and received the Roebling Medal of the Society in 1958. The Arthur L. Day Medal of the Geological Society of America was awarded to him in 1951. He was elected to the National Academy of Sciences in 1953, and served as the Academy's delegate to a succession of meetings of the International Crystallographic Union. The extent of his rec-

ognition for contributions to crystallography is indicated by his election to honorary membership in eight foreign scientific societies, including the Italian Accademia Nazionale dei Lincei in 1960; the academies of science of Austria, Bavaria, Brazil, and Torino; the German Mineralogical Society; and the Spanish Society of Natural History. In 1958 he was awarded an honorary doctorate by the University of Berne, Switzerland. Appropriately, as he had long investigated the crystal structure of tourmaline, a new sodium–ferric iron member of the tourmaline group was named buergerite in 1965.

Following the completion of his doctorate in June 1929 Buerger was appointed assistant professor of mineralogy and petrography at M.I.T., in 1935 he was made associate professor, and in 1944 he became professor of mineralogy and crystallography. The change from petrography to crystallography in his title came about in 1937 when he relinquished his instruction in optical crystallography and petrography. From that time on his teaching and research were virtually restricted to X-ray crystallography, although his administrative duties at M.I.T. soon broadened. These involved service in 1954–1956 as chairman of the M.I.T. faculty, his appointment to the distinguished rank of institute professor in 1956, and a seven-year period, 1956–1963, as director of the newly organized School for Advanced Study. He was eligible for retirement in 1968, but continued his activities in an appointment at the University of Connecticut until 1973 and then in offices provided by the Department of Geology at Harvard and, later, M.I.T. His writing and research were carried on actively until his terminal illness in 1986.

A most fortunate event in his early career was his marriage in 1938 to Lila Mae MacAskill, whose forebears had early come from Scotland to Cape Breton Island in Nova Scotia to escape religious persecution, and whose parents had migrated from there to Massachusetts in the late nineteenth century. It was a devoted union that created a friendly household to which his graduate students and visiting scholars were welcome. It was in this environment that professional associates and students alike learned what a warm and caring person Buerger was. He is survived by his wife and five of his six daughters.

References Cited

Buerger, M. J. Scientists and God. Christianity Today, vol. 8, 6–8, 1964. See also: Does the Bible conflict with modern science? Christianity Today, vol. 10, 3–6, 1966.

Shrock, R. R. History of the first hundred years of geology at M.I.T., vol. 1, 566–575, 602–604, 607–619, 1977.