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MEMORIAL OF REYNOLDS McCONNELL DENNING

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Reynolds McConnell Denning, Professor of Mineralogy at the University of Michigan, died in Ann Arbor on 1 November 1967. The termination of his life caused profound distress to family, friends, and colleagues the world around. Now, after the initial shock of his abrupt and unexpected death has somewhat abated, we become increasingly aware of the deep personal and professional loss so many of us have suffered by his passing.

Professor Denning was born in Fitchburg, Massachusetts, on 3 September 1916, son of William Wallace and Emma McConnell Denning. From his father, a research electrical engineer, Rey received some of his first technical training—in electricity. His father died in 1932, and his mother then established their new residence with her sister and brother-in-law in Rochester, New York. Rey was already active scientifically in high school, performing experiments in physics with the aid of faculty members at the University of Rochester.

Rey chose to attend the Michigan Technological University at Houghton for his undergraduate college training, and received his B.S. in geology in 1939. His first professional positions as geologist were in the Corps of Engineers, U. S. Army, in Little Rock, Arkansas, in 1939, and the Arkansas Geological Survey, in 1940.

He had a consuming interest in optics, and studied a great deal in this area outside of formal training and the requirements of his work. He came to the attention of Professor Austin F. Rogers of Stanford, who selected him personally for the Austin F. Rogers Teaching Fellowship in Mineralogy for 1941–1942. Rey had thus begun research on his Ph.D., when the nation became involved in World War II.

Rey married Helen Green of Cameron, Texas, who was a graduate fellow in English at Stanford, on 25 June 1942, and shortly thereafter, departed for South America. During the war years, in view of the critical supply situation for tin following the Japanese conquest of the Malay peninsula, he served his country by pursuing geological and mineralogical



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research in a tin-mining district in Bolivia. He was employed by Patino Mines and Enterprises, Consolidated, Inc., in Llallagua, Bolivia. His wife, who became an enthusiastic "sidekick" in mineralogy, followed him, and thereafter throughout their life together they enjoyed far more than usual in mutual interests and shared experiences.

In 1945, he returned to Michigan Technological University, at first as a part-time field geologist with the Michigan Geological Survey, and then as full-time instructor and assistant professor in mineralogy. During this stay in Houghton, he did a research thesis on an Upper Peninsula sandstone, and received his M. S. from MTU in 1949.

Professor Denning came to the University of Michigan as research associate in the Mineralogical Laboratory in summer, 1949. While there, he was encouraged by the mineralogical faculty, chiefly by Professor Chester B. Slawson, to resume his research for a Ph.D. Again in 1950 he returned to Ann Arbor, on leave from MTU, as visiting lecturer in optical crystallography. During his visits to the Michigan campus, he became interested in directional variation of grinding hardness in diamond. He designed and built a precision mechanical device to perform controlled quantitative studies of the phenomenon. This study was continued during 1951-1952, his final year at MTU. In 1952, again with Professor Slawson's urging, Rey became assistant professor of mineralogy at the University of Michigan and during the year concluded and analyzed a large suite of diamond hardness measurements. The results of this research constituted his doctoral thesis, and he was awarded his Ph.D. by the University of Michigan in 1953.

Professor Denning continued his research interest in crystal hardness until his death. From 1952, he served as co-director of the departmental research project in crystal hardness sponsored by the Office of Naval Research, and in 1956 also assumed the role of co-director of an Army Signal Corps research project on infrared optical properties of silicon crystals. He became associate professor in 1956.

In fall and winter, 1958-59, on sabbatical leave, he carried on micro-abrasion hardness research at the Clarendon Laboratory, Oxford, in cooperation with Drs. John and Eileen Wilks.

Shortly after returning to Ann Arbor, Professor Denning became interested in the properties of neutron-irradiated diamond. With a grant from the Atomic Energy Commission, he studied the variations in directional hardness, specific gravity, optical density, cleavage, and electron paramagnetic resonance in diamonds as a function of neutron dose. This work was continued at increasing levels of sophistication until his death. During this period, in 1961, he became Professor of Mineralogy.

Professor Denning's research interests included, besides those noted

above, piezobirefringence in crystals, optical absorption and pleochroism, gemology, crystal growth, and diamond genesis. He engaged in several cooperative projects with medical researchers on inorganic mineral-like deposits in the human body. In the past ten years, he became increasingly eager to incorporate the newest techniques of physics and chemistry into mineralogy and crystallography. And beyond this, he became convinced of the need for interdisciplinary research involving mineralogy, which he felt would be beneficial in both directions. His publication record bears witness to his active support of his beliefs in this regard, and his students have gone forth to success in mineralogy, geology, physics, and chemistry.

Professor Denning's vast store of crystallographic, optical, and mineralogical knowledge amazed all professional colleagues who knew him, and indeed, his expertise could only be properly appreciated by the most knowledgeable of his acquaintances. He was highly esteemed by professionals of all related disciplines, and was elected to fellowship in the Mineralogical Society of America, The American Association for the Advancement of Science, the Geological Society of America, and the Royal Microscopical Society of Great Britain: he was a member of the Mineralogical Association of Canada; the American Crystallographic Association; Sigma Xi; the Michigan Academy of Science, Arts, and Letters; the Mineralogical Society of Great Britain; and the Geochemical Society. He served as acting chairman of the National Academy of Sciences' Panel on Industrial Diamonds in 1957. Professor Denning held numerous consultantships with commercial diamond and mining interests. He is listed in *Who's Who in America*, 35th edition.

Professor Denning's interests graded imperceptibly from his strictly professional concerns to a wide and expanding range of avocational topics. His personal mineral collection was exceptionally fine. He had a passion for optical and mechanical instrumentation. In this area, he collected antique scientific devices, and was a very highly regarded consultant to many researchers in geology, chemistry, physics, and engineering who needed help on diverse experimental apparatus. His love of instrumentation led him to design and construct a number of advanced systems of research apparatus in the Mineralogical Laboratory at the University of Michigan. As a hobby, his love of machinery led to home construction of steam engines and to active participation in several live-steam-buff societies. He was a gifted photographer and expert in cameras, lenses, and all manner of imaging techniques—including holography, the principles of which he demonstrated to us by diffraction techniques years before the laser. Rey was an avid sailor and navigator, and at one time owned a restored 30-foot fishing boat in which he and his family

sailed all over Lake Superior. He loved classical music, and was an attentive listener.

As an educator, Professor Denning was one of perhaps a vanishing breed. He was an ardent perfectionist in all his undertakings, and when he spotted a receptive talent in a student, he was willing to give unlimited time to counsel, and never failed to show a genuine interest in the student's queries and problems. He was rarely if ever heard to criticize people of lesser talent, but was free with praise for those who performed well, in accord with their abilities. He was, in fact, too generous in his appraisals of talent in others; we can recall many occasions of being the object of flattering questions which presumed far greater knowledge for an answer than we possessed. Professor Denning was very enthusiastic in his own research, but invariably preferred to aid or advise students, both his own and others, and faculty colleagues in their research problems. Rey also had an intense dislike for administrative procedures and for political aspects of his profession. These latter factors precluded any aggressive seeking of research empire, but were quite obviously consonant with the high esteem accorded him by all his students. It is ironic that despite Professor Denning's impatience with violent demonstrations by students, he was indeed the very type of professor for which they seem to clamor.

Professor Denning's scientific contributions were of the highest caliber. His work on directional hardness in diamond established the scientific technology of diamond grinding and diamond-tool practice, and removed them forever from the older rule-of-thumb era. By its diffusion of quantitative knowledge, his work has enabled diamond research and diamond-tool development groups to spring forth in several developing nations. His other publications were also held in highest regard in crystallographic, optical, and mineralogical circles. But in later years, Professor Denning expressed occasional concern that he might have chosen the wrong approach to his profession. He speculated about either becoming more single-minded in his research, or perhaps returning to the more emphatically tutorial environment of a smaller school. Those of us who had studied under him raised vigorous protest against either course. We felt that Professor Denning and his educational philosophy were a vital asset in the big university. His ingrained modesty, however, precluded his making a realistic appraisal of his own achievement and stature.

Students will remember Professor Denning exhorting them to X-ray one more crystal or measure one more optical parameter. They will remember warm and pleasant evenings at his home, discussing mineralogy or optics, or steam locomotives, or politics. They will remember a teacher who was quick to help or praise, but reluctant to express an ob-

vious disappointment with half-hearted performance. Reynolds McConnell Denning, Professor of Mineralogy, was a mineralogist for mineralogists, and a professor for students.

Professor Denning is survived by his wife, Helen Green Denning, and his only child, William Charles Denning. He was a member of the First Presbyterian Church in Ann Arbor.

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