Memorial to Raymond Cecil Moore (1892–1974)

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Raymond Cecil Moore, one of the geologic giants of the twentieth century, was born in Roslyn, Washington, on 20 February 1892 and died in Lawrence, Kansas, on 16 April 1974. He was the eldest child of Bernard Harding Moore, a Baptist minister of Irish decent, and Winifred Denney Moore, a homemaker from Elk Falls, Kansas. He had two brothers, Keith and Ralph, and four sisters, Vesta, Lucille, Hazel, and Olive.

He was raised in the Midwest in Kansas, Missouri, Wisconsin, and Illinois and attended high school in Milwaukee and Chicago. He then obtained his A.B. degree Phi Beta Kappa from Denison University in Granville, Ohio, and went on to the University of Chicago, where he received his doctorate in 1916 summa cum laude. His advisor was Stuart Weller and his Ph.D. dissertation was on the stratigraphy of the Mississippian System of Missouri.



He was hired at The University of Kansas (KU) in 1916 as an assistant professor of geology and to succeed William Henry Twenhofel as state geologist and director of the State Geological Survey of Kansas (KGS). In 1920, he replaced Erasmus Haworth as head of the department and was promoted to full professor—from assistant to full professor in just three years! He was head or chairman of the department on three occasions for a total of 23 years and state geologist/director of the KGS for a total of 38 years; for 23 of those years he was head of both organizations.

On arriving in Kansas, Moore turned his attention to refining the Permian-Pennsylvanian stratigraphy of the Midcontinent. His attention to detail allowed him to correlate thin sedimentary units from Nebraska, Iowa, and Missouri southward to Oklahoma; his measured sections are impeccable. From these details he was able to formulate his ideas on genetic stratigraphy, the forerunner of cyclic sedimentation and today's sequence stratigraphy. He was particularly interested in the sequence of depositional environments, and he defined them by their unique fossil assemblages.

His interests spanned stratigraphy and paleontology through oil and gas resources to the Precambrian, and even to the igneous intrusives that occur on the surface in several counties in Kansas. He also made contributions to coal geology, natural gas, soils, and a map of surface features in the state that is relevant and still distributed by the Kansas Geological Survey today.

Many of these studies were the basis for a series of Kansas Geological Society field conferences in the 1930s, a summary publication on the Pennsylvanian of Kansas in 1936, and a revised and updated geological map of Kansas that was published in 1937 with Kenneth Landes as coauthor. Even at this early date, his flair for organization and technicalities was evident as he coerced and cajoled his colleagues into a uniform stratigraphic code for the Midcontinent (he later showed these same abilities as chairman of the U.S. Committee on Stratigraphic Nomenclature and the Committee on Zoological Nomenclature).

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Moore had a mind like a steel trap and never forgot a person, detail, or place. He could identify a person from his past with complete confidence, recall an event, or locate an outcrop measured decades before; he had an uncanny sense of time and place. This thoroughness, which was the result of his legalistic mind, allowed him to outline the stratigraphy of Kansas, and his classification stands today much unchanged from how he proposed it.

His geological publications after World War II (WWII) were mainly summaries concerned with his knowledge of the Kansas stratigraphic section, especially his ideas on cyclic sedimentation, which had been formulating since the symposium on cyclic sedimentation held in Illinois in 1931. His last scientific publications in the late 1960s were on cyclic sedimentation, paleoecological aspects of cyclothems, and crinoids. In all, he authored more than 350 reviews, papers, and books, including his three widely used texts.

Moore envisioned individual "cyclothems" (word coined by J. Marvin Weller in 1932) to be genetically related units, that is, a succession of sediment types deposited in a shallow epicontinental sea by a single advance and retreat of the sea. (These repetitions of beds had been recognized by J.A. Udden as early as 1912.) The transgressive part of the cycle would start at a hiatus with nonmarine clastics grading into marine clastics culminating with a marine carbonate (limestone), and the regressive phase would be a mirror image of the transgression ending with a hiatus. He extended the original concept of Weller's cyclothem to a bundle of related cyclothems (usually four, each represented by the culminating limestone) separated by nonmarine clastics, which he termed a "megacyclothem." A megacyclothem consists of a succession of cyclothems having different peculiarities individually, but nevertheless arranged in a constant sequence.

Moore entered the arena on facies in 1949 with a defining paper titled "Meaning of facies" as an introduction to the Geological Society of America's Memoir 39. He pioneered the use of ecological communities (ecosystems) to help understand cyclothems.

As the stratigraphic and sedimentological framework took form, he turned his attention in the 1940s to invertebrate paleontology. He showed his versatility in the subject by working with corals, crinoids, gastropods, and bryozoans as well as with the flora. With Lowell Laudon he published *Evolution and Classification of Paleozic Crinoids* in 1943, which also was included in the *Index Fossils* volume. His paleontological work to date then was summarized in the classic, and yet-used textbook, *Invertebrate Fossils* (with C.G. Lalicker and A.G. Fischer) published in 1952.

When he first arrived at KU Moore taught a variety of soft rock courses including introductory ones that had been taught by Samuel Williston and William Twenhofel. As the department evolved after WWII, Moore was able to devote his teaching to advanced specialized courses such as "Field Stratigraphy" and "Geologic Development of the World." In 1958, he was appointed a Solen E. Summerfield Distinguished Professor, one of the first four distinguished professors in the university.

He supervised many student theses and dissertations. He guided the research of 22 masters' students between 1921 and 1964, 15 of them on Kansas subjects, and 19 doctoral students between 1931 and 1964 with 8 of them studying Kansas subjects. Many of the doctoral students went on to teach at major universities and others distinguished themselves in industry.

Moore was demanding of students and insisted on excellence. His evaluations were based not only on content but presentations as well, which he required to be in correct English; he was intolerant of shoddy work, but lenient with grades. He assigned readings in other languages, especially French and German, and the students had to scramble to read the assignments. Moore, of course, was conversant in at least six languages!

His paleontological work led to his recognition for the need of a paleontological treatise. After his service as a brevet major in the U.S. Army during World War II, Moore formulated his ideas and got the project funded and housed at KU. It would be supported by KU, the Geological Society of America, and the National Science Foundation. It ultimately was recognized in organization and implementation as the *Treatise on Invertebrate Paleontology*. Moore decided that specialists would write on their area of expertise and provide the manuscripts, which after checking and editing, would be published by the University Press of Kansas. Moore's contribution was mainly in editing, but in addition he made contributions to the *Treatise* in dedications, introductions, definitions of morphologic terms, and other explanations as well as contributing several scientific parts in his specialty areas.

The introduction to Part A of "Fossilization" (1979) contains a dedication to Moore as founder of the *Treatise*, and contains a pen-and-ink sketch of him by former student Roger Williams. Volumes through 1966 were published by the Geological Society of America and the University of Kansas Press; subsequent volumes were published by the Geological Society of America and the University of Kansas.

This gigantic endeavor was an enormous undertaking and continues to this day with volumes published at about one per year, totaling 51 volumes to date. (In 2009, KU's Paleontological Institute became the sole publisher of the series.) This twentieth-century synthesis on the subject rivals in scope Alexander von Humboldt's nineteenth-century *Cosmos*, and Carolus Linnaeus' eighteenth-century *Systema Naturae*, and Count de Buffon's *Natural History*.

Moore was president of the Society of Economic Paleontologists and Mineralogists (1928–1929), the Paleontological Society (1947–1949), the Society of Systematic Zoology (1957–1958), the Geological Society of America (1957–1958), the American Association of State Geologists (1936–1937), and the American Geological Institute (1959–1960). In addition, he served as editor of many journals including the *Bulletin of the American Association of Petroleum Geologists* (1920–1926), the *Journal of Paleontology* (1930–1939), the *Journal of Sedimentary Petrology* (1931–1936), and the Kansas *Paleontogical Contributions*, which he organized and edited for many years.

Thus, his list of service to the Kansas Geological Survey, KU, the State of Kansas, and his chosen profession is almost endless. In recognition of his contributions Moore received many honors and awards during his career. The main KGS building on KU's west campus was named in his honor in 1973, he was one of the first distinguished professors at KU in 1958, and he received the non-alumnus Distinguished Service Citation from KU in 1970. He received an honorary doctorate from his alma mater in 1935; the F.V. Hayden Medal from the Philadelphia Academy of Natural Sciences in 1956; the Sidney Powers Medal from the American Association of Petroleum Geologists in 1956; the first conferred Paleontological Society Medal in 1963; the Prix Paul Fourmarier Gold Medal from the Académie Royale de Belgique in 1966; the Wollaston Medal from the Geological Society of London in 1968; the Mary Clark Thompson Medal of the National Academy of Science in 1970; and the first Twenhofel Medal from SEPM (the Society for Sedimentary Geology) in 1972. The Moore Medal is presented each year by SEPM in his honor for excellence in paleontology.

Moore's military career was checkered. He enlisted in the U.S. Army Reserves in 1929 as a captain and was on active duty for two weeks a year at Fort Riley, Kansas. When WWII broke out, after receiving an exemption for his physical condition (allergies and dentures), he was accepted for limited active duty with a military occupational specialty of petroleum geologist. He went to several army schools and ended up as a geologist in the Development and Rehabilitation Section, Fuels and Lubricants Division, Office of the Quartermaster General, Washington, D.C. For his service as a brevet major during the war, he was awarded the Army Commendation Ribbon. In 1949 he served as an advisor to General Douglas MacArthur for three months as part of a team on coal resources in Japan.

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Moore was married to Georgine Macbeath (or Macbeth) Watters in 1917 in Chicago, Cook County, Illinois, by Moore's father, the Rev. Bernard Harding Moore. One daughter, Marjorie Ann, was born in 1928 of this union; in 1935 Georgine and Moore divorced. (Marjorie Ann passed away 13 March 2012.) After the divorce became final, Lillian (Lilian) Bishop Boggs, who was born in India and the daughter of Canadian missionaries, and Moore were married in July 1936 in St. Louis, Missouri. Lillian stayed in the background and let Moore have the spotlight, took care of his every need, was totally supportive, and was an ideal companion for him.

One of his innovative ideas was the creation of the G-Hawk, the symbol of geology at KU. Ancestor of the G-Hawk was *Jayhawkornis kansasensis*, which Moore illustrated and promoted, especially in the comic strip Pogo, which he made in 1954. In addition, he had a subtle sense of humor that is evident in his writings.

In 1923, Moore was a geologist on an expedition to explore the Grand Canyon when a freak boating accident on the Colorado River caused a premature announcement of his death to the field party. He lived to read his obituary; about the unfortunate loss of a promising young geologist. It is indeed fortunate for the geological profession that he survived to make his many important and lasting contributions.

Raymond Cecil Moore was a dedicated scholar, scientist, field geologist, and technical organizer. In his last few years, he was in poor health and worked at home mostly in bed while editing his beloved *Treatise*. He was survived by his wife Lillian and daughter Marjorie Ann Snave. He is sorely missed by his colleagues, former students, and friends.

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The following parts of the *Treatise on Invertebrate Paleontology* were directed and edited by R.C. Moore; C. Protista 2, I and II (1964); D. Protista 3 (1954); E. Archaeocyatha and Porifera (1955); F. Coelenterata (1956); G. Bryozoa (1953); H. Brachiopoda, I and II (1965); I Mollusca 1 (1960); K. Mollusca 3 (1964); L. Mollusca 4 (1957); N. Mollusca 6, I and II (1969), III (1971); O. Arthropoda 1 (1959); P. Arthropoda 2 (1955); Q, Arthropoda 3 (1961); R. Arthropoda 4 (1969); S. Echinodermata 1 (1967); U. Echinodermata 3, I and II (1966); V. Graptolithina (1955); W. Miscellanea (1962). Part T. Echinodermata 2 (1978) was edited by Moore and Curt Teichert.

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