ROCK STARS

Thomas Chrowder Chamberlin in the 1870s (photo courtesy University of Wisconsin–Madison archive).

Thomas Chrowder Chamberlin (1843–1928)

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Introduction

"Born on a moraine," was how America's pioneer glacial geologist in the late nineteenth century, T.C. Chamberlin, described himself. This was the man who first demonstrated that there had been multiple Pleistocene glaciations in North America and who was the first director of the U.S. Geological Survey's Pleistocene Division (1881–1904). He presented early analyses of moraines, drumlins, eskers, and boulder trains. From these features, he inferred regional glacial flow patterns, differentiated ice lobes, and mapped the outermost limits of the two last glacial advances. He called glacial striations "trails left by the intruder."

Chamberlin went on to seek a theory of climate change and was one of the first to emphasize carbon dioxide as a major regulator of Earth's temperature, thus anticipating modern global warming. TCC, as he was known to associates, is also widely remembered for his 1890 essay about geological reasoning, "The method of multiple working hypotheses" (but he failed to acknowledge that G.K. Gilbert had published on this theme two years earlier).

At the turn of the twentieth century, Chamberlin ventured into cosmology, developing with F.R. Moulton the planetesimal theory for the origin of planets, aspects of which are still influential. Instead of the ruling hypothesis, condensation from a hot nebular cloud, gravitational accretion of cold objects (planetesimals) was proposed. Once formed, Earth was subjected to continuing, but spasmodic, radial gravitational contraction, which had overtones of isostasy. Chamberlin postulated that contractional events caused mountain building due to differential vertical movements of radial earth segments. Another byproduct of the theory was a diastrophic control of global sea level and erosional leveling of continents. This had wide impact upon American stratigraphy and geomorphology; it even anticipated modern sequence stratigraphy. Chamberlin's commitment to vertical tectonics made him an inevitable opponent of continental drift.

In 1899, Chamberlin challenged famous physicist Lord Kelvin's calculation of an age for Earth of only 20–30 million years when geologists were thinking of 100 million. Chamberlin disputed Kelvin's assumption of simple cooling from a molten origin because he was already formulating his own cold, planetesimal origin. He argued that there must be some unknown source of heat energy within Earth that would alter Kelvin's calculations substantially. Without realizing it, Chamberlin had anticipated heat from radioactive decay, which had just been recognized but was not yet widely understood.

The Young Chamberlin

Chamberlin was born on that moraine in southeastern Illinois, but his family moved north to settle near Beloit in southern Wisconsin. Young Chamberlin helped his father, a Methodist circuit minister and farmer, and four brothers haul limestone slabs to build their farmhouse. He was fascinated and puzzled by the many fossils in that Ordovician stone. Education was prized in the family, and at the early age of eight, he announced that he "wanted to teach in the best school in the state." With his brothers, he attended a preparatory academy and then Beloit College. Professor H.B. Nason inspired in him a deep interest in natural science. Geology had a particularly strong appeal in spite of apparent conflicts with his strong Methodist background. Chamberlin directed the church choir while attending Beloit College, where he was also an outstanding student, athlete, and debater. He learned early the art of framing a sound argument, which he practiced frequently in later life.

Chamberlin worked on the farm and taught in country schools to finance his education. Upon graduation in 1866, he became a teacher and later principal in a high school near Beloit. He gave popular evening lectures and led field trips about natural science. In 1867, he married Alma Wilson; they had one son, Rollin, who also pursued geology. In 1868–1869, Chamberlin spent a year at the University of Michigan to strengthen his overall science background and thereafter became very critical of the classical curriculum in colleges. He next taught natural science at the Whitewater, Wisconsin, Normal School, and joined the Beloit faculty in 1873, where he was professor of geology, zoology, and botany. Dana's *Manual of Geology* was the guiding textbook, and Chamberlin introduced microscopic petrography to Beloit. He was a tall, commanding figure and a popular teacher, who always projected "moral and ethical rectitude."

On the Way Up

In 1873, together with several other geologists from around the state, Chamberlin was recruited to work part time on a comprehensive geological survey of Wisconsin. He was assigned the southeastern region, where bedrock is only scantily exposed. It was here that his career in glacial geology began. In 1876, the survey was reorganized, and Chamberlin was appointed chief geologist. During the next six years, with an able group of assistants, he supervised the completion of the survey and the publication of four large volumes that rivaled in quality the best survey publications in the world. Chamberlin wrote sections of most of the volumes, including material on Paleozoic and Precambrian geology, lead-zinc deposits, artesian wells, and soils, as well as glacial deposits. The results brought national attention and appointment as head of the glacial division of the national survey in 1881.

Recognizing his outstanding organizational and administrative skills, the board of regents of the University of Wisconsin in Madison invited Chamberlin to be president. Somewhat reluctantly, he left his U.S. Geological Survey (USGS) research post to serve as president from 1887 to 1892. Chamberlin introduced many reforms, including strengthening the science curriculum and recruiting outstanding faculty members. He also began the extension program, which brought new knowledge to the grass roots, especially to farmers. He introduced the seminar method of teaching and inaugurated formal post-graduate study with a Ph.D. program that gave new emphasis to research. Chamberlin tightened discipline and outlawed hazing; his moral rectitude and authoritarian demeanor rubbed some regents the wrong way and irritated students even more. Yet, when rumors circulated that he was being courted by the University of Chicago, the students petitioned him to stay.

The Chicago Throne

Chamberlin was tiring of administration and missed research, so in 1892 he accepted the offer to organize a department of geology at the new University of Chicago, where he remained until retiring in 1918. Chamberlin created one of the nation's premier departments with a distinguished faculty and a strong research program. He also founded the *Journal of Geology* and acted as its editor for many years. Like James D. Dana had done as long-time editor of the *American Journal of Science* at Yale, Chamberlin used his *Journal* as a podium for editorializing on many aspects of geology as well as an outlet for many of his own articles. One of his innovations was a series of "Studies for Students," in which an authority provided a valuable summary of a specialized topic.

Chamberlin on a Pleistocene geology field trip near Peoria, Illinois, 1898. Left to right: S.W. Beyer (Iowa), J.A. Udden (Illinois), Chamberlin with hair now all white, S. Calvin (Iowa), and F. Leverett (Michigan). Leverett in particular extended Chamberlin's pioneering work in glacial geology (photo courtesy University of Iowa archive).

It was at Chicago that Chamberlin fully matured as a leading scholar. He soon collaborated with Moulton to develop the planetesimal hypothesis and coauthored with Rollin Salisbury *Geology* (1904–1906), probably the most influential textbook of geology in the United States prior to World War II, imitating the precedent of Dana's nineteenth century *Manual of Geology*. Although less true today with many competing books available, a single comprehensive introductory textbook then had a profound influence upon a field. The last book of similar stature was probably Arthur Holmes' *Principles of Physical Geology*, first published in 1944.

Chamberlin's offices and honors seem countless. He was president of the Geological Society of America (1894–1895), president of the Wisconsin (1885–1886), Chicago (1897–1915), and Illinois (1907) Academies of Science, president of the American Association for the Advancement of Science (1908–1909), member of the National Academy of Sciences (1903), and the first Penrose Medalist of both the Society of Economic Geologists (1924) and Geological Society of America (1927). He was a member of the American Philosophical Society and the American Academy of Arts and Sciences and received six honorary degrees. In 1909, he spent five months traveling as a member of a commission to determine how the Rockefeller Foundation could best aid China. Chamberlin was still actively writing when he died in 1928.

That Moral Rectitude

T.C. Chamberlin had a commanding personality and a great physical and intellectual presence, which made him an able administrator and an inspiring, though authoritarian, teacher. He had an exceptionally keen, inquiring mind and an unusual ability to present an argument. Moral rectitude characterized his entire career; he even viewed science as a moral activity. Rectitude also could make him very aggressive when challenged by others. Because of his vigorous attacks upon the views and motives of his adversaries, his USGS appointment was terminated in 1904. Although his "Method of multiple working hypotheses" seemed the ideal recommendation for reasoning in a complex science with limited available evidence so as to maintain objectivity, he did not always practice what he preached. The longer he worked on his planetesimal hypothesis, the more dogmatic he became, excluding all competing hypotheses from consideration so that it became just the kind of ruling hypothesis that he had railed against in 1890. The great T.C. Chamberlin was human after all.

Further Reading

Chamberlin, T.C., 1882, Preliminary paper on the terminal moraine of the second glacial epoch: Third Annual Report of the United States Geological Survey, p. 291–402.

Chamberlin, T.C., 1890, The method of multiple working hypotheses: Science, v. 15, p. 92–96.

Chamberlin, T.C. and Moulton F.R., 1909, The development of the planetesimal hypothesis: Science, v. 30, p. 642–645.