Francis J. Pettijohn

1904–1999

BIOGRAPHICAL *Memoirs*

A Biographical Memoir by
Steven M. Stanley

NATIONAL ACADEMY OF SCIENCES

FRANCIS J. **PETTIJOHN**

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By Steven M. Stanley

Francis Pettijohn was the consummate gentleman and scholar, a giant in his field but always gracious, tactful, and courtly in his demeanor. He was also a master of lucid explanation, able to synthesize material with great clarity and economy of words. Thus, although his research was widely acclaimed, he was best known for his textbook, *Sedimentary Rocks*, which was first published in 1949. This book amounted to a sedimentary bible of its day. One Johns Hopkins University colleague of Pettijohn's who visited India in the 1970s discovered the second edition of this book in a store there and suddenly felt right at home. Obviously, it was no accident that Pettijohn had been elected to fellowship in the Geological Society of India.

Born in 1904, Pettijohn was the oldest of six children. His parents were teachers and they moved about a great deal, so that his early schooling was spread among Wisconsin, North Dakota, Indiana (during two spans of time), and Washington, DC. In a one-room schoolhouse in North Dakota, he was the only student slated for the fourth grade, so he was elevated to the fifth grade and lost the chance to learn long division. Later, as a boy in Bloomington, Indiana, where limestone and fossils were everywhere, he explored his surroundings and collected geological specimens, receiving support from Clyde Melott, a next-door neighbor who was a graduate student and then a faculty member at Indiana University. Before entering college, Pettijohn knew that geology would be his major. He entered the University of Minnesota in 1921 and graduated in three years.

Stemming from his experiences at the University of Minnesota, where he remained for a masters degree, Pettijohn's first love was for Precambrian rocks and fieldwork in the Lake Superior region. He attributed this attachment to Frank Grout, an inspirational professor at the university for whom he served as field assistant in 1924. Over the years, Pettijohn

made dozens of traverses across the southern Canadian Shield, logging thousands of miles on foot and in a canoe.

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Although Pettijohn viewed himself first and foremost as a field geologist, he was famous as a pioneer in what became known as sedimentary petrography: the microscopic interpretation of transparent slices of sedimentary rock that are attached to glass slides and known as "thin sections." When Pettijohn was a student in the 1920s, such optical studies were the purview of geologists who studied igneous and metamorphic rocks. He had become well versed in such work and took up a mentor's suggestion that he fruitfully apply what he knew about it to sedimentary rocks.

After receiving his masters degree, Pettijohn spent two years teaching geology at Oberlin College in Ohio, where he met violinist Dorothy Bracken and soon married her. Eventually they had three children, Norma, Clare, and Loren. (Dorothy passed away in 1989, and in 1996, Pettijohn married Virginia Romberger, who unfortunately also predeceased him.)

After departing from Oberlin, Pettijohn returned to graduate school, spending a year at the University of California, Berkeley, before heading back to the University of Minnesota, where he completed his doctorate. The year at Berkeley was inspirational, primarily because of the presence of Andrew Lawson, an eminent student of Precambrian geology. There, Pettijohn also expanded his knowledge of igneous and metamorphic petrography.

Pettijohn took a faculty position at the University of Chicago in 1929, completing his dissertation during his first year there. This situation placed him in proximity to William C. Krumbein, a young faculty member at the university who was better versed in quantitative methods than Pettijohn. In 1938 their collaboration produced a classic book, *Manual of Sedimentary Petrography*, which Pettijohn later mused probably led to his almost immediate promotion to associate professor.

Pettijohn's most important contribution as a young researcher was certainly his 1943 paper published in the *Geological Society of America Bulletin* with the simple title, "Archean Sedimentation." The Archean Era produced the oldest rocks known on Earth,

and at the time of Pettijohn's initial evaluation of sedimentary rocks representing this ancient interval—work upon which he elaborated in subsequent publications—many geologists were of the opinion that Archean rocks and the processes that formed them were very different from those of more recent intervals. Pettijohn proved them wrong. He discovered Archean turbidite deposits, for example. Turbidites in younger rocks had only recently been recognized as having formed by turbidity currents that flowed down submarine slopes at alarming speeds, depositing sediment as they slowed in deep water, with the coarsest grains settling out first and the finer material ending up on top. Pettijohn also identified the oldest glacial deposits ever known. Their layers alternated between very thin ones deposited when the body of water in which they formed was covered by winter ice, and thicker layers deposited in warmer weather, when more sediment washed in from the land. These "varves," Pettijohn recognized, were remarkably similar to those laid down in lakes positioned in front of glaciers during the most recent advance of ice sheets over North America. He also discovered among the ancient varves what are termed "dropstones," isolated pieces of rock that could only have been released far from shore by melting bodies of floating ice. Actually, the age for the ancient varves is now considered to be about 2.3 billion years, and the Archean/Proterozoic boundary is arbitrarily placed at 2.5 billion years ago, so the varves are early Proterozoic in age. They are still positioned far back in the Precambrian, however, and Pettijohn concluded that fundamentally, the world then was not unlike the world we live in now.

Francis Pettijohn with a hand on a portion of the 2.3-billion-year-old Gowganda Tillite in Ontario, Canada—a unit that early in his career he showed to consist of annual varves deposited in a glacial lake.
(Photo courtesy of the author.)

Pettijohn did recognize that one conspicuous group of Precambrian rocks—banded iron formations—were unknown from the much younger geologic record. These striking rocks often consisted of layers of sparkly silver hematite (ferric oxide) alternating with layers of chert (cryptocrystalline quartz) of a bright reddish hue. Pettijohn became fascinated with these banded iron formations, and during World War II he assisted miners of iron ore on Michigan's Upper Peninsula with magnetometer surveys, core logging, and stratigraphy. Later in life he learned, primarily from the work of Preston Cloud, that banded iron formations came into being at a time when Earth's atmosphere contained little oxygen, so that dissolved ferrous iron was abundant in the ocean. Also, back then, sponges, radiolarians, and diatoms were not robbing the ocean of silica. Pettijohn was right that the basic, natural processes operating on our planet back in the Precambrian were the same ones operating on it today, but the chemical compositions of the shallow Earth and its oceans and atmosphere were different.

Pettijohn became disillusioned with his department at the University of Chicago, as his colleagues increasingly came to view field geology as old-fashioned. It was not that he had a negative view of laboratory work, but he recognized that "ground truth" must guide theoretical and laboratory analyses and that this can only be obtained through insightful observations of nature. In his autobiography, *Memoirs of an Unrepentant Field Geologist*, Pettijohn bemoaned the fact that, several years after he took his position at the University of Chicago, almost all of his colleagues, throughout the year, were donning white lab coats each morning and never taking them off until leaving for home. He wanted a more balanced approach to his work. This he found at Johns Hopkins University, to which the eminent structural geologist Ernst Cloos lured him in 1952. By the 1960s, most of Pettijohn's colleagues at Johns Hopkins were conducting both field work and theoretical or laboratory work, approaches that were mutually beneficial.

Cloos and Pettijohn each chaired the Department of Geology at Johns Hopkins for several years, and they remained in emeritus status for many years, during which the high principles they espoused and the wisdom they shared benefited a host of younger faculty members.

During his tenure at Johns Hopkins, many of Pettijohn's contributions entailed the interpretation of Paleozoic sedimentary rocks in the Appalachians, mostly by way of his twenty-six doctoral students, a large number of whom went on to attain prominence in their profession. His most important research effort at this time—again in a pioneering role—was on the analysis of paleocurrents, which revealed transport directions, and

hence source areas, for sediments. Paul E. Potter, his postdoctoral fellow, played a major role in this work, which was reviewed in their classic book of 1964, *Paleocurrents and Basin Analysis*, a volume widely utilized by petroleum geologists as well as academics. Pettijohn and Potter produced two additional classic, widely cited books: *Atlas and Glossary of Primary Sedimentary Structures,* and, with Raymond Siever of Harvard, *Sand and Sandstone.*

Beyond academia, Pettijohn was long active in the Unitarian Church, serving on the board of trustees of the First Unitarian Church of Chicago, and subsequently becoming one of the founders of the Towson Unitarian Church in Maryland, for which he served on the board and eventually became president.

He also demonstrated the value of writing books in an era when short scientific papers were becoming increasingly fashionable. Pettijohn's number of published papers was relatively small, but he lived in a time when professors of geology seldom attached their names to students' publications. Furthermore, his impact was enormous. He received many honors, in addition to election to the National Academy of Sciences in 1966: among them, receipt of an honorary Doctor of Science degree from the University of Minnesota, the Twenhofel Medal of the Society for Sedimentary Geology, the Penrose Medal of the Geological Society of America, and the Sorby Medal of the International Association of Sedimentologists. His life, which ended in 1999, spanned almost the entire twentieth century, and it was a happy, principled, productive, and highly influential one.

Pettijohn left a sizeable imprint on the field of geology. Some have dubbed him the Father of Sedimentology.

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