

k11 Subdivisions of Precambrian time < Great Lakes formations >

... ignorance more frequently begets confidence than does knowledge. —Darwin.¹

The time has come to liberate Precambrian geology from the tyranny of a telescoped classification. —Holmes.²

Rocks older than the Cambrian are not widely exposed in Europe where the geologic column was devised. There, Precambrian rocks either are apparently unfossiliferous sedimentary strata called *Eocambrian* or, where they underlie fossiliferous strata nonconformably, are schists and gneisses, much fold-contorted and widely intruded by granites, called the *Fundamental Complex* or *basement*.

In the New World, Precambrian rocks are found to be exposed throughout vast reaches of the Canadian Shield. Early prospectors of these ancient rocks were initially drawn to sites long worked for native copper by Ontario Indians who had found they could hammer the malleable stone into tools and ornaments. Pioneer geologists who visited these areas were not able to make ready sense, in terms of their Wernerian thinking, of the geologic formations that they found.³ To rectify this, the Geological Surveys of United States and Canada appointed a committee in 1902 of their ablest geologists to report on the eastern and western Great Lakes areas. By 1904, Charles Richard Van Hise (1857-1918), Julius Morgan Clements (1869-19??), Charles Kenneth Leith (1875-1956), and xenophobe⁴ William Shirley Bayley (1861-1943), had each published on the formations of the Lake Superior western region relevant to prospection of the vast iron-ore deposits that had been found by then. The Precambrian rocks in Minnesota can be ordered by superposition into four time-stratigraphic formations (**Figure k11.1**). The enormous stratigraphic thickness of these formations⁵ posed a problem for those craven to Kelvin's claim (instigated, beginning 1862, and refuted by others, beginning 1905) that geologic time was short overall. To allow as much time as possible for uniformitarian processes and evolution since Cambrian beginnings, Chamberlin and Salisbury in their *Geology*, 1904, compressed to a few decades of million years the duration of the Precambrian.⁶

The mapped Keweenaw and older Huronian strata are not everywhere folded. The relatively uneventful era during which these accumulated was named in 1888 by Samuel Franklin Emmons (1841-1911) the "Proterozoic" (which means "before life") for the apparent lack of fossils in them.

The mapped Keewatin and the Laurentian strata are everywhere highly deformed and extensively granite intruded. The "turbulent era" of the cooling early-Earth during which these had accumulated and bear evidence of, was named in 1872 by James Dana (1813-1895) the "Archaozoic" (Archaean or Archean refer to that time; Gk. *Archaios* means *ancient*).

In North America, a great unconformity separates the Proterozoic strata from the Archean. Van Hise held it to be universal. This was a reasonable inference *if* geologic time recorded Precambrian formations is brief. Radiometric dating that in 1907 had begun to reveal the wrongness of that tacit assumption⁷ could be overlooked until, in the late 1940s, the method began to yield undeniably reliable dates.⁸ In the interim, geological reasoning on such matters was foggy at best. As J. A. Jacobs, R. D. Russell and J. Tuzo Wilson summarize in *Physics and Geology*, 1959: "Wherever stratified rocks have been investigated to sufficient depth, they are found to rest with profound unconformity upon a basement of altered rocks, but in the case of younger rocks no one supposes that the sequence is everywhere of the same age. For example the overlap of Cretaceous strata upon metamorphosed Paleozoics in the Appalachian region cannot possibly be equated to the overlap of Paleozoic strata upon the Canadian shield. Around the Great Lakes, if all Precambrian time is divided only into Proterozoic and Archean eras, all such unconformities are lumped together without regard for the fact that they can differ widely in age, as is shown by radioactive age determinations."⁹



*Figure k11.1*¹⁰

Generalized stratigraphic succession in southwestern Ontario and northern Minnesota.

The Keweenaw series and Animikie group, both little deformed, are separated by a regional angular unconformity. They are the original stratotypes for the Proterozoic Era.

Animikie lithological correlatives east of Lake Superior in Southern Ontario are strata of the Huronian series. Together they rest on a well defined nonconformity that cuts across a complex of gneissic granites and infolded formations of Knife Lake “sediments” and Keewatin “volcanics” or “greenstones.”

The Knife Lake and Keewatin formations, both much deformed, are separated by a regional angular unconformity. They are the original stratotypes for the Archean Era.

The simplicity of this geologic column masks the reality. In the Lake Superior region pioneer geologists had soon described and mapped some hundred Precambrian formations that organized locally by succession and then correlated by gross lithology and shaky unconformity matching (as for Animikie and Huronian), gave this column a total thickness of more than 150,000 feet (46 kilometers)!

N. MINNESOTA & S.W. ONTARIO

