

Yet, notwithstanding these sources of change, no good evidence in all Paleozoic time, except near or at its end, has been found in the fossils or the rocks, of zones in the earth's climates or of variations in temperature. North America shows in its large coal formation, as compared with that of Europe, that it had then, as it has now, the moister climate; and therefore that the system of winds was the same as in Recent time, and hence that the system of oceanic currents was the same. Some difference must have existed, and more in the atmosphere than in the waters; but it was not enough to modify, as far as has been ascertained, the marine fauna of the globe. Uniformity in climate in the northern hemisphere is favored by unobstructed oceanic currents.

In the later part of the Permian, or at its close, a cold epoch occurred (page 737). At the same time happened one of the earth's most general exterminations of life. But large continental areas were then rising, and the Antarctic Continent was elevated and greatly extended; so that the elevations may have been the cause of the cold.

After the close of Paleozoic time, zones become apparent (page 791). But even in the earlier part of the Cretaceous period, Cycads abounded in the northern polar regions, showing only a small decline in mean temperature since the Cambrian. After the Middle Cretaceous, a more rapid decline began (page 872); but, concordantly, large continental elevations were in progress. The increasing elevations during the later Tertiary culminated in the Glacial period of the Quaternary.

Thus, throughout the earth's history since life began, the only cold epochs of which proof has been found occurred near or at the close of the Permian, at the close of the Triassic, and during the Glacial period. At the close of the Cretaceous, another epoch is suspected to have occurred, but without direct evidence.

The post-Permian and Glacial cold occurred at times when the Antarctic Continent had great extent, and therefore when the earth's polar diameter had unusual elongation. Since the Glacial period, the polar lands have again become submerged; but, inasmuch as Greenland affords evidence of continued subsidence, it may be questioned whether a time of minimum for the polar diameter is yet reached.

This review of the extremely slow decline of temperature in the earth's climates during its lifetime, — be it 10 millions of years or 600 times this, — with traces of only three or four epochs of cold in the course of the millions, is calculated to give the impression that the eccentricity cycle in the earth's orbit is a very ineffectual epoch-making agency.

#### THE EARTH'S DEVELOPMENT.

The evolution of the earth's continents and their surface features is one of the two great subjects in the science of Geology. The idea — Continents always Continents — announced by the author first in 1846, has been affirmed