

including vast moraines, on the slopes of Charchani in southern Peru. Glaciers existed in the Cordillera of Columbia about the peak of Cocui, 9,000 feet high, and in the Sierra Nevada de Santa Marta, 15,400 feet in height. In this region the decrease in temperature with altitude is now about 1° F. in 330 feet.

In New Zealand, glaciers descended along the so-called Alps on the west side of the southern island, probably to the sea level. They were properly local glaciers. Captain Hutton states that in New Zealand the mountains were 3000 to 4000 feet higher than now. There were glaciers also in the Australian Alps about Mount Kosciusko in southeastern Australia, as reported by Von Lendenfeld in 1885, and in 1893 by R. Helms, and in western Tasmania.

CAUSE OF THE CLIMATE OF THE GLACIAL PERIOD.

A. *The cold climate.* — 1. The elevation of the land over the globe, and especially in the higher latitudes, if a fact, as appears to be proved, is a sufficient reason for a large increase of cold, and thereby of frigid winds; and alone it goes far toward explaining the extension of a polar climate over the lower lands to latitudes where now the July temperature is 65° to 70° F.

2. This elevation would have made dry land, or a very shallow belt of water, across the North Atlantic from Scandinavia to Greenland and thus the Arctic regions would have been deprived of the large supply of heat they now derive from the Gulf Stream.

3. The confinement of the circuit of the Gulf Stream to the middle portions of the North Atlantic would concentrate thus its heat, make a much warmer ocean, and produce abundant precipitation.

4. With abundant vapors for precipitation thus produced, and the continents largely under a frigid climate, the snows which would have descended abundantly, would have been distributed over different regions with some reference proportionally to the ratio of precipitation; and this ratio would have been the modern ratio, modified by the topographic and oceanic conditions then existing.

The cold of the Glacial period has been attributed to the loss of the Gulf Stream by the Atlantic through the deep submergence of the Isthmus of Panama. But such a submergence is not sustained by evidence in the region. Moreover, there is proof that the Gulf Stream had the same effect on European climate in the Glacial period as now, in the fact that the relation of the isotherms of the two continents was unchanged.

Croll's theory, which makes the occurrence of a cold period dependent on the eccentricity of the earth's orbit, is explained on page 254. It is objected to by American geologists on the ground that the Glacial period closed, according to American geological facts, not more than 10,000, or at the most 15,000, years ago (page 255), instead of 150,000, or at the least 80,000, as the eccentricity hypothesis requires. According to this theory, the cold epochs of the northern and southern hemispheres occurred 11,500 years apart, or half the length of the precession cycle. J. Geikie, who recognizes six epochs of glaciation during the Quaternary, adopts the theory mentioned, and refers the times of the six