

those that had before occurred in Reptiles. It was progress downward almost indefinitely, but without loss of the essential characteristics of a Mammal.

The above examples and explanations may serve to illustrate some of the methods by which the modifications of species are supposed to have taken place without the aid of physical catastrophe.

The great diversity in the characters of Eocene Mammals, wrought out, it is believed, in such quiet times, teach this plainly — that the first period of the Tertiary was exceedingly long, whatever may be gathered to the contrary from some persistent Cretaceous plants.

OROGENIC AND EPEIROGENIC MOVEMENTS.

In the opening of the Tertiary era geological history reaches the time when, as mentioned under Dynamical Geology, besides the making of great mountain ranges, nearly all the mountain chains of the world received additions of many thousands of feet to their heights and hundreds of thousands of square miles to their areas; and also when igneous eruptions took place of extraordinary extent.

1. *Orogenic movements at the close of the Nummulitic epoch of the Eocene.* — In Europe, the elevation of the Pyrenees, and of some other heights in eastern Europe, occurred after the marine Nummulitic beds of the Eocene had been deposited. The mean direction of the Pyrenees is about N. 80° W. There are large flexures and steep slopes on the side toward France, but less upturning and gentler slopes toward Spain.

2. *Orogenic movements at the close of the Miocene.* — In North America an upturning took place at this epoch along the coast region of California and Oregon, tilting and, in some cases, flexing the Miocene, Eocene, and Cretaceous formations, 5000 feet or more in thickness, as is proved by Miocene fossils in the upturned beds (J. D. Whitney). The earlier Jurassic strata are believed to have been earlier upturned and metamorphosed, being of cotemporaneous origin with the Sierra Nevada.

At this epoch also the great upturning of the Alps and Juras occurred briefly described on page 367. It gave to the mountains the bold flexures of the Mesozoic formations with the overlying Eocene and Miocene, which are a remarkable feature of many of the lofty summits. The Apennines, according to Stefani, passed through a crisis of upturning and flexures at the close of the Nummulitic Eocene, like the Pyrenees, and also at the close of the Miocene, with the Alps.

The Himalayas were, to a large extent, beneath the sea during the Nummulitic epoch, and at least 20,000 feet lower than now (page 368). Either directly after this epoch, or before the close of the Miocene, there was an upturning and flexing of the Nummulitic and underlying Cretaceous beds (down to the top of the Carboniferous) and the commencement of the final elevation of the mountain chain. According to the Geological Survey