

drainage area in about 6000 years. The rate usually taken is one foot in 3000 to 7000 years. The rate 1 to 3000 was deduced by S. Haughton (1880) from the rate of sedimentation of the following rivers: the Mississippi, 6000 years; Ganges, 2358; Hoang Ho, 1464; Yang-tse-Kiang, 2700; Rhone, 1526; Danube, 6846; Po, 729 years; the mean of which is 3090 years. He adds that since the sea bottoms are to the land surfaces as 145 to 52, the rate at which the sea bottoms are becoming silted up, that is to say the present rate of formation of strata, is one foot in 8616 years. Thence, supposing the rate the same as now for all past time from the Archæan onward, the whole duration of geological time is 200,000,000 years. But Haughton included in the thickness of the terranes, 60,750 feet of Archæan, or over one third of his total (177,200 feet). Deducting for the Archæan, the length of the rest of geological time would be about 130,000,000 years.

Mellard Reade makes the time since the Archæan, on the same kind of basis (taking the mean area of denudation as one third the entire land area, and the rate of denudation one foot in 3000 years), 95,000,000 years (1893).

C. D. Walcott deduces, for the elapsed time, 70,000,000 years (1893); H. H. Hutchinson, 600,000,000 years (1892); M'Gee, including in his basis the rate of denudation at Niagara, and giving credit to the extreme estimates of thickness of the early Paleozoic formations, 6,000,000,000 years (1893).

All these estimates proceed on the solid basis of existing facts. Yet in deriving them the extreme difference between the existing earth and that of the geological past was not taken into account. Going back in geological time, the rock-making portion becomes more and more widely marine, and rivers have correspondingly diminished size and drainage areas. But, at the same time, climates become warmer and precipitation therefore increasingly abundant; and through Paleozoic to earlier time the eroding carbonic acid and oxygen of the atmosphere are increased in amount, and corrosion thereby was proportionately greater. Even as late as the Middle Cretaceous, the western half of North America was an open sea with its large and small islands. In the Paleozoic, and still more in the Archæan, the whole continent was in a like condition; and the Continental seas had only little streams and drainage areas to supply sediment for the thick formations, so that the sea did much more than half the work in its slow way. Further, changing climates have occasioned changing rates of erosion and sedimentary deposition; and have made, over large continental areas, times of great precipitation to alternate with times of prevailing drought, and times of full lakes and of large hard-working rivers, with times of dwindled or feeble waters. In addition, the deposits of one period have often been largely denuded to make those of the following; and the chief sources of all sediments are Archæan. Attempts therefore to find, in the results of aqueous action, a definite measure of any part of the geological past necessarily lead to very doubtful results.

*Length of geological time on evidence from terrestrial physics.*—Kelvin pointed out in 1862 that a limit to the earth's age is fixed by the known