

fracture-planes thousands of feet in displacement in the mountain ranges of the Great Basin, the High Plateaus of Utah, the Wasatch Mountains, and the Sierra Nevada.

Through a study of the river systems of the Sierra Nevada, it has been proved by LeConte (1886) that a great elevation of the Sierra took place at or near the close of the Pliocene. The drainage of the Sierra is chiefly to the westward, the eastern front being very steep. Whitney describes in his Report (1865) the facts respecting an early system of valleys having been covered up and obliterated by basaltic eruptions, and the new and much deeper system of subsequent time (page 300). He illustrates also, by a plate in his work on the *Auriferous Gravels* (1880), the difference in the depth of erosion of the two systems, the earlier that occupied all Cretaceous and Tertiary time, and the later, of subsequent time after the eruptions. In view of these and related facts, LeConte urges that the deeper erosion by the existing streams, although their time of work was short compared with that of the earlier system which existed through the Cretaceous and Tertiary, proves that a great elevation of the Sierra Nevada, increasing the fluvial denuding power, took place soon after the Pliocene; and that this was accomplished by a rise along a fault-plane having the course of the steep *eastern front* of the range. It is to be remarked that the Glacial period followed the Pliocene; and its glaciers and abundant precipitation would account for part of the profound denudation of the later rivers. But this fact does not invalidate seriously the conclusions. It is sustained through additional facts by other geologists, including Lindgren and Diller.

The eastern border of the continent underwent only small changes. At the close of the Eocene some modification of the surface occurred within the Mexican Gulf which put an end to the deposition of true marine beds along its northern beds west of Florida. The only Miocene beds recognized are of fresh-water or brackish-water origin. With the close of the Tertiary, and probably before the Pliocene had fully passed, elevatory movements occurred which raised the Tertiary of the Atlantic border about 100 feet, and that of the Gulf border not much more, except along a region in Georgia, and the border of Alabama in a line with the Peninsula of Florida, where the height is 300 to 400 feet above sea level. A Florida axis of elevation is indicated by it. On Long Island, Martha's Vineyard, and other islands south of New England, occur upturned beds of the Cretaceous or Cretaceous and Tertiary, indicating orogenic movements before the Quaternary. See further, page 1021.

The elevation of the Atlantic border may have been part of a greater change which affected also the whole of the Appalachian region; but no positive evidence of this is yet obtained.

What was the total gain in mass through the great Tertiary elevation of the North American continent? On this point little is known with regard to its eastern half, but the western affords available facts.

With the opening of the Tertiary the larger part of the western half of the United States was at the water's level from the eastern foot of the Sierra Nevada