

universal, for in some regions the sands from shells and corals were made into hard limestones, as they are now, and over areas of great extent. Moreover, firm shales and sandstones occur that are like those of early time. Besides, there are thick beds of *greensand*, like those of the Cretaceous formation in constitution, and equally valuable as a fertilizer. There are also beds of coal or lignite associated with some of the deposits.

Beds of siliceous organisms, Diatoms, Radiolarians, and Sponge spicules, have sometimes much thickness, and are occasionally partly consolidated into opal.

The rocks of the lacustrine and terrestrial deposits are generally fine-grained, and either feebly indurated sandstones, soft straticulate clays passing into shales, or soft fragile limestones of fine grain; but these soft kinds graduate into harder and sometimes into coarser varieties. They have derived their great thickness in the usual way; that is, through a gradual subsidence attending the deposition from waters of the region. On the coast of Florida, some beds have been converted partially into phosphates (or phosphatized), by water filtrating through overlying guano deposits. In the Rocky Mountain region and over the Pacific slope occur deposits, sometimes hundreds or thousands of feet thick, made of volcanic ashes. There are also coarse volcanic conglomerates or breccia. The volcanic beds sometimes cover the stumps of many successive growths of forests (page 135); and the finer kinds occasionally contain remains of the Beetles, Butterflies, and other Insects of the period.

Lignite beds also occur locally over the country. One of the most noted of them is that of Brandon, Vt., which is probably of Eocene origin. It is associated with a bed of limonite.

Denudation was universal over the exposed continental surface, as in all past time, dissecting and degrading mountains, and making fluvial deposits as well as lacustrine. The *Auriferous gravels* of the western slope of the Sierra Nevada are largely fluvial deposits of Tertiary origin, as shown by J. D. Whitney in his *Geological Report on California* (1865), and much more fully in his *Auriferous Gravels of the Sierra Nevada* (1880). The plants found in the gravel beds indicate, according to Lesquereux, a Miocene and Pliocene age; but Whitney regards the formation as representing the whole of the Tertiary. It probably began in the Cretaceous period. As Le Conte states, the detritus of the old gravels is in general exceptionally coarse, showing strong currents.

### 1. *Sea-border Areas.*

I. **Eocene.** — Along the Atlantic and Gulf borders (see map, page 881), the Tertiary belt is very narrow and interrupted through New Jersey; it is broader in Maryland and Virginia, and still broader in South Carolina. But the formation is best displayed on the Gulf border. The inner limit, or that against the Cretaceous in the Carolinas and the Gulf region, is over 100 miles