

**Volcanic Tuff.**—This general term may be made to include all the finer kinds of volcanic detritus, ranging, on the one hand, through coarse gravelly deposits into conglomerates, and on the other, into exceedingly compact fine-grained rocks, formed of the finest and most impalpable kind of volcanic dust. Some modern tuffs are full of microlites, derived from the lava which was blown into dust. Others are formed of small rounded or angular grains of different lavas, with fragments of various rocks through which the volcanic funnels have been drilled. The tuffs of earlier geological periods have often been so much altered, that it is difficult to state what may have been their original condition. The absence of microlites and glass in them is no proof that they are not true tuffs; for the presence of these bodies depends upon the nature of the lavas. If the latter were not vitreous and microlitic, neither would be the tuffs derived from them. In the Carboniferous volcanic area of Central Scotland, the tuffs are made up of débris and blocks of the basaltic lavas, and, like these, are not microlitic, though in some places they abound in fragments of the basic glass called palagonite. (Fig. 23, and *infra*, p. 242.)



Fig. 23.—Microscopic Structure of Carboniferous Palagonite Tuff from Burntisland, Fife.

Tuffs have consolidated sometimes under water, sometimes on dry land. As a rule, they are distinctly stratified. Near the original vents of eruption they commonly present rapid alternations of finer and coarser detritus, indicative of successive phases of volcanic activity. They necessarily shade off into the sedimentary formations with which they were contemporaneous. Thus, we have tuffs passing gradually into shale, limestone, sandstone, etc. The intermediate varieties have been called *ashy shale*, *tuffaceous shale*, or *shaly tuff*, etc. From the circumstances of their formation, tuffs frequently preserve the remains of plants and animals, both terrestrial and aquatic. Those of Monte Somma contain fragments of land-plants and shells. Some of those of Carboniferous age in Central Scotland have yielded crinoids, brachiopods, and other marine organisms. Like the other fragmentary volcanic rocks, the tuffs may be subdivided according to the nature of the lava from the