

in thickness, and has been made use of both as fuel, and in the manufacture of lead-pencils. At the distance of 30 miles from the plumbago, there occurs, on the borders of Rhode Island, an impure anthracite in slates, containing impressions of coal-plants of the genera *Pecopteris*, *Neuropteris*, *Calamites*, &c. This anthracite is intermediate in character between that of Pennsylvania and the plumbago of Worcester, in which last the gaseous or volatile matter (hydrogen, oxygen, and nitrogen) is to the carbon only in the proportion of 3 per cent. After traversing the country in various directions, I came to the conclusion that the carboniferous shales or slates with anthracite and plants, which in Rhode Island often pass into mica-schist, have at Worcester assumed a perfectly crystalline and metamorphic texture; the anthracite having been nearly transmuted into that state of pure carbon which is called plumbago or graphlite.*

It has been remarked by M. Delesse that the minerals developed in hypogene limestone vary according to the degree of metamorphism which the rock has undergone. Thus, for example, where the structure is but slightly crystalline, talc, chlorite, serpentine, andalusite, and kyanite are commonly present; where it is more highly crystallized, garnet, hornblende, Wollastonite, dipyre, Couzeranite, and some others appear; and, lastly, where the crystallization is complete, there are found, in addition to many of the above minerals, felspar, especially those kinds which are richest in alkali, together with mica. The same author observes that, as calcareous deposits usually contain some aluminous clay, so we may naturally expect to meet with silicates of alumina in crystalline limestone; such silicates, accordingly, are frequent, and occasionally even pure alumina crystallized in the form of corundum.†

Mr. Dana has suggested that the phosphoric acid of phosphate of lime and the fluor of fluor-spar, so often met with in crystalline limestones, may have been derived from the remains of mollusca and other animals; also that graphite (which is pure carbon in a crystalline form, with or without admixture of alumina, lime, or iron) may have been derived from vegetable remains imbedded in the original matrix.

The total absence of any trace of fossils has inclined many geologists to attribute the origin of the crystalline strata to a period antecedent to the existence of organic beings. Admitting, they say, the obliteration, in some cases, of fossils by plutonic action, we might still expect that traces of them would oftener occur in certain ancient systems of slate, in which, as in Cumberland, some conglomerates occur. But in urging this argument, it seems to have been forgotten that there are stratified formations of enormous thickness, and of various ages, and some of them very modern, all formed after the earth had become the abode of living creatures, which are, nevertheless, in certain districts, entirely destitute of all vestiges of organic bodies. In some, the traces of fossils may have been effaced by water and acids, at many successive periods; and it is clear,

* See Lyell, Quart. Geol. Journ. vol. i. p. 199.

† Delesse, Bulletin Soc. Géol. France, 2d série, tom. 9, p. 126. 1851.