

Supposing, now, that Lycopods (*Lepidodendroids*, etc.) afforded one half the material of the coal-beds, and the other plants the rest, and that the silica and alumina of the former averaged 40 per cent, and of the latter only 27 per cent, this being all silica, then the amount of these ingredients afforded by the vegetation would be 1.66 per cent of the whole weight when dried. This would make the amount of silica and alumina, in the bituminous coal made from such plants (supposing three fifths of the material of the wood lost in making the coal, as estimated on page 713), 4 per cent; and the whole amount of ash about 4.75 per cent. At the same time, the ratio of silica to alumina would be nearly 3 to 2.

Now many analyses of bituminous coal have obtained not over 3 per cent of ash, or impurity, although the general average, excluding obviously impure kinds, reaches 4.5 to 6 per cent; being, for the coals of the northern half of Ohio, 5.12, and for the southern half, 4.72.

It hence follows that (1) the whole of the impurity in the best coals may have been derived from the plants; (2) the amount of ash in the plants was less than the average in modern species of the same tribes; (3) the winds and waters for long periods contributed almost no dust or detritus to the marshes; and (4) the ash, or else the detritus, was greatest in amount toward the borders of each marsh-region. In that era of moist climate and universal forests, there was almost no chance for the winds to gather dust or sand for transportation.

In rare cases, an occasional boulder or rounded stone has been found in a coal-bed, as well as in other layers of the Coal-measures. E. B. Andrews describes one of quartzite, lying half buried in the top of the Nelsonville coal-bed, at Zaleski, Ohio, which was 12 and 17 inches in its two diameters. F. H. Bradley reports one, also of quartzite, about four by six inches, found in the middle of the coal-bed mined at Coal Creek, East Tennessee. These may have been dropped from the roots of floating trees, as has happened to masses of basaltic rocks occasionally found upon the coral atolls of the Pacific.

Sulphur also occurs, in some coal-beds, as a constituent of a resinous substance; and Wormley suggested that part of the sulphur in the Ohio coals is in some analogous state.

The mineral oil and gas of western Pennsylvania come wholly, or nearly so, from Chemung beds of the Devonian — not from the Carboniferous (page 606).

2. Iron Ores.—The ore-bearing layers of the Subcarboniferous and Carboniferous series occur in connection usually with the beds either of limestone or of shale, but sometimes with the sandstone and coal-beds. As these ores are more or less impure from mixture with clay, they are called *clay-ironstone*. The limestones often contain *iron carbonate* (siderite)—a gray ore, stone-like in aspect, of specific gravity 3.7 to 3.8. It occurs either in solid beds, from a few inches to two or three feet in thickness, or in nodules, or “ball ore,” more or less united into a layer. The same limestone often contains also nodules of another valuable ore, *limonite* (page 71), the ore which affords a brownish yellow powder, though often brownish black to black in outside color. This limonite has frequently been made by the oxidation of the siderite. The Ferriferous limestone, just below the Kittanning coal-bed, contains both of the ores mentioned. The limonite in nodules, or as a “ball