Selected Articles.

THE ORIGIN OF COAL.

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Before we can enter on the question of the origin of coal, it is necessary to state how we determine it to be of vegetable origin.

It has been said, by some microscopic observers, that a true ligneous structure can be detected in coal; this is, however, denied by our most eminent botanists. Plants, in great abundance, are found preserved in the coal measures; but these are not in the state of coal. However, the chemical constitution of coal clearly indicates it to have originated from plants. The vegetable world consists, essentially, of carbon, combined with the two gaseous bodies which form water—hydrogen and oxygen; and coal is formed of the same elements, differing only in the proportions in which they are combined. The progress of the change, from a living tree growing in the sunshine, to a dead lump of coal lying deep in the earth, is indicated to us, if not exactly determined.

Every one must have observed decayed wood. Whether the decay goes on by the process of *dry* or *wet* rot, it is still a case of slow combustion. The carbon is attacked by the oxygen—that, in every way wonderful gas, which is at once the supporter of life and light, and the destroyer of all things. By this combination a gaseous acid—carbonic acid—is formed and expelled, leaving, relatively, an increased quantity of carbon behind. Thus we have dark and dusty rotten wood in the works of art, and we have *brown coal* or lignite, in which the woody structure is preserved, in the products of nature. Chemistry shows us the kind of change which takes place; and although it does not explain to us the conditions under which the change occurs, it gives us an intelligible result:

	Carbon.	Hydrogen.	Oxygen.
Wood contains.....	49.0	6.0	45.0
Lignite "	60.0	5.9	31.4
Coal "	80.0	5.3	14.7

With this chemical evidence in support of the hppothesis that coal is altered vegetable matter, let us proceed to the examination of the physical conditions under which it was formed.

Geological research indicates a period in the history of our own land when the sea washed around an extensive group of low islands, formed of the older granitic and slaty rocks, from the waste of which the old red sandstone rocks were forming. In the course of ages these almost land-locked seas became shallower, and the deposited matter arose around the margins, towards the surface of the waters. Myriads of strange and beautiful fish sported in the waves which glowed with the reflection of a sun tropical in the intensity of its light and heat. On the slopes of the shores the coral animals were working in those days, as they are now laboring in the Pacific Ocean, forming their calcareous cells, so beautifully preserved in the limestones of Derbyshire and Devonshire.

Thus, by the wearing down of the land, and by the active agencies at work in the waters, vast tracts of low, swampy lands were formed.

These vast morasses, and the shallow waters of widely spread lagoons, became the abodes of a wild, a strange, vegetation. Tree ferns rose high into air and spread their fronds so thickly that deep shadow reigned forever in the groves. Hosts of smaller ferns almost infinite in variety, luxuriated in those shades—succulent plants, like the sigillaria and club mosses abounded; and other mosses and fungi covered the damp ground. Vegetable life was abundant—to a degree which we can scarcely realize. Amongst these teeming organisms, one of the most remarkable is the plant known as the *Siggilaria*. "They are generally," says Dr. Hooker, "but a few feet high, though sometimes two yards broad at their expanded bases; they are truncated at the top. * * * So common are they, that I have, in many South Wales and other collieries, counted five or six in the space of a few fathoms, always suggesting the idea of the erect stumps of trees in a forest." *Stigmaria*—long, serpent-like roots, shooting off from a centre into the mud in which they grew—were once thought to be a peculiar, a distinct, form of vegetable growth. They are now ascertained to be the roots of the *Sigillaria*.

These plants appear to have been of a very lax fibre. They grew, in all probability, to an enormous size with great rapidity, and as speedily decayed—forming and adding to the mass of *humus* which fed the mighty grasses, ferns and mosses, clustered and matted round the larger trees.

Vast swampy plains like those were thickly spread with the *Sigillaria*, sending their vast roots far over the mud, to absorb speedily the water required for their rapid growth. Graceful *Lepidodendrons* grew in abundance—these were gigantic arborescent club mosses, bearing, at the ends of their graceful leaves, their cone-like fruit.

There, again, were vast spaces covered with huge "horse-tails"—the *Esquisetum;* and on the soft, marshy silt of the river's edge and estuary, grew forests of reeds—*Calamites*. Ferns and mosses combined with these, and formed a mat of vegetation wich rapidly filled the shallow water. Floating in the deeper parts were found the *Asterophylites*. There were numerous varieties of this plant, all of them remarkable for their graceful forms, and apparently all growing in water sufficiently deep to float their branches and leaves. Under the influence of strong solar excitation, the vital powers of vegetable nature were stimulated to the highest. This was also quickened by a high terrestial temperature. We have evidences proving to us "that, in the ancient world," to quote the worlds of Humboldt, "exhalations of heat, issuing forth through the many openings of the deeply-fissured crust of the globe, may have favored, perhaps for centuries, the growth of palms and tree ferns, and the existence of animals requiring a high temperature, over entire countries where now a very different climate prevails." There is little doubt that such were the conditions when a teeming vegetable world drew its carbon from the atmosphere, in which it existed in the form of carbonic acid. That, under those conditions—life being at its maximum of power—these plants decomposed the carbonic acid; and, giving back the oxygen to the air, built up with rapidity their woody structures with the carbon thus obtained. These plants died, and decomposed—through the same agencies—as rapidly as they grew, forming dense beds of black matter, which were slowly re-