

*Coal, how formed—Erect trees.*—I shall now consider the manner in which the above-mentioned plants are imbedded in the strata, and how they may have contributed to produce coal. Professor Göppert, after examining the fossil vegetables of the coal-fields of Germany, has detected, in beds of pure coal, remains of plants of every family hitherto known to occur fossil in the coal. Many seams, he remarks, are rich in *Sigillaria*, *Lepidodendra*, and *Stigmaria*, the latter in such abundance, as to appear to form the bulk of the coal. In some places, almost all the plants were calamities, in others ferns.\* “Some of the plants of our coal,” says Dr. Buckland, “grew on the identical banks of sand, silt, and mud, which, being now indurated to stone and shale, form the strata that accompany the coal; whilst other portions of these plants have been drifted to various distances from the swamps, savannahs, and forests that gave them birth, particularly those that are dispersed through the sandstones, or mixed with fishes in the shale beds.” “At Balgray, three miles north of Glasgow,” says the same author, “I saw in the year 1824, as there still may be seen, an unequivocal example of the stumps of several stems of large trees, standing close together in their native place, in a quarry of sandstone of the coal formation.”†

Between the years 1837 and 1840, six fossil trees were discovered in the coal-field of Lancashire, where it is intersected by the Bolton railway. They were all in a vertical position, with respect to the plane of the bed, which dips about  $15^{\circ}$  to the south. The distance between the first and the last was more than 100 feet, and the roots of all were imbedded in a soft argillaceous shale. In the same plane with the roots is a bed of coal, eight or ten inches thick, which has been ascertained to extend across the railway, or to the distance of at least ten yards. Just above the covering of the roots, yet beneath the coal seam, so large a quantity of the *Lepidostrobis variabilis* was discovered inclosed in nodules of hard clay, that more than a bushel was collected from the small openings around the base of the trees (see figure of this genus, p. 363). The exterior trunk of each was marked by a coating of friable coal, varying from one-quarter to three-quarters of an inch in thickness; but it crumbled away on removing the matrix. The dimensions of one of the trees is  $15\frac{1}{2}$  feet in circumference at the base,  $7\frac{1}{2}$  feet at the top, its height being 11 feet. All the trees have large spreading roots, solid and strong, sometimes branching, and traced to a distance of several feet, and presumed to extend much farther. Mr. Hawkshaw, who has described these fossils, thinks that, although they were hollow when submerged, they may have consisted originally of hard wood throughout; for solid dicotyledonous trees, when prostrated in tropical forests, as in Venezuela, on the shore of the Caribbean Sea, were observed by him to be destroyed in the interior, so that little more is left than an outer shell, consisting chiefly of the bark. This decay, he says, goes on

\* Quart. Geol. Journ., vol. v., Mem., p. 17.

† Anniv. Address to Geol. Soc., 1840.