

present period, thermal waters and hot vapors burst out from the earth during earthquakes, and these would not fail to promote the disengagement of volatile matter from the carboniferous rocks.

*Continuity of seams of coal.*—As single seams of coal are continuous over very wide areas, it has been asked, how forests could have prevailed uninterruptedly over such wide spaces. In reply, it may be said that swamp-forests in one delta may extend for 25, 50, or 100 miles, while in a contiguous delta, as on the borders of the Gulf of Mexico, another of precisely the same character may be growing; and these may in after ages appear to geologists to have been continuous, although in fact they were simply contemporaneous. Denudation may easily be imagined in such cases as the cause of interruptions, which were, in fact, original. But as in all the American coal-fields there are numerous root-beds without any superincumbent coal, we may presume that frequently layers of vegetable matter were removed by floods; and in other cases, where the *stigmariæ*-clays are for a certain space covered with coal, and then prolonged without any such covering, the inference of partial denudation is still more obvious.

In the Forest of Dean, ancient river-channels are found, which pass through beds of coal, and in which rounded pebbles of coal occur. They are of older date than the overlying and undisturbed coal-measures. The late Mr. Buddle, who described them to me, told me he had seen similar phenomena in the Newcastle coal-field. Nevertheless, instances of these channels are much more rare than we might have anticipated, especially when we remember how often the roots of trees (*Stigmariæ*) have been torn up, and drifted in broken fragments into the grits and sandstones. The prevalence of a downward movement is, no doubt, the principal cause which has saved so many extensive seams of coal from destruction by fluvial action.

*Climate of Coal Period.*—So long as the bonanist taught that a tropical climate was implied by the carboniferous flora, geologists might well be at a loss to reconcile the preservation of so much vegetable matter with a high temperature; for heat hastens the decomposition of fallen leaves and trunks of trees, whether in the atmosphere or in water. It is well known that peat, so abundant in the bogs of high latitudes, ceases to grow in the swamps of warmer regions. It seems, however, to have become a more and more received opinion, that the coal-plants do not, on the whole, indicate a climate resembling that now enjoyed in the equatorial zone. Tree-ferns range as far south as the southern part of New Zealand, and Araucarian pines occur in Norfolk Island. A great predominance of ferns and lycopodiums indicates moisture, equability of temperature, and freedom from frost, rather than intense heat; and we know too little of the *sigillariæ*, calamites, *asterophyllites*, and other peculiar forms of the carboniferous period, to be able to speculate with confidence on the kind of climate they may have required.

The same may be said of the corals and cephalopoda of the Mountain Limestone,—they belong to families of whose climatal habits we know