

geographical conditions. It shows that the deeper and clearer water of the Carboniferous sea spread over the site of Yorkshire, Derbyshire, and Lancashire; that land lay to the north, and that, while the whole area was undergoing subsidence, the maximum movement took place over the area of deeper water. The sediment derived from the north, during the time of the Carboniferous Limestone, seems to have sunk to the bottom before it could reach the great basin in which foraminifers, corals, crinoids, and mollusks were building up the thick calcareous deposit. Yet the thin limestone bands, which run so persistently among the Lower Carboniferous rocks in Scotland, prove that there were occasional episodes during which sediment ceased to arrive, and when the same species of shells, corals, and crinoids spread northward toward the land, forming for a time, over the seabottom, a continuous sheet of calcareous ooze, like that of the deeper water further south. These intervals of limestone-growth no doubt point to times of more rapid submergence, perhaps also to other geographical changes, whereby the sediment was for a time prevented from spreading so far. It is further deserving of remark that the fossils in these thin upper limestones in Scotland, though specifically identical with those in the thick lower limestones and in the massive Carboniferous Limestone of central and southwestern England, are often dwarfed forms, as if the conditions of life were much less favorable than where the thicker sheets of calcareous material were accumulated. The corals, for instance, are generally few in number and small in size, and the large *Productus* (*P. giganteus*) is reduced to a half or third of the dimensions it attains in its best development.

Viewed as a whole, the Carboniferous Limestone series of the northern part of the British area contains the records of a long-continued but intermittent process of subsidence. The numerous coal-seams, with their under-clays, may be regarded as surfaces of vegetation that grew in luxuriance on wide marine mud-flats. They mark pauses in the subsidence. Perhaps we may infer the relative length of these pauses from the comparative thicknesses of the coal-seams. The overlying and intervening sandstones and shales indicate a renewal of the downward movement, and the gradual infilling of the depressed area with sediment, until the water once more shoaled, and the vegetation from adjacent swamps spread over the muddy flats as before. The occasional limestones serve to mark epochs of more prolonged or more rapid subsidence, when marine life was enabled to flourish over the