

and at a latitude of 82° N. in the Arctic.¹ The surface temperature of the sea could not well have been less than about 70° F., and the same temperature and the same marine fauna prevailed from equator to poles, the temperature not being higher at the equator. Flowering plants did not exist in the coal period. Flowers with vivid and brilliant tints only appeared in Mesozoic ages when for the first time the sun pierced the envelope of dense clouds that surrounded the whole earth. The atmosphere was less agitated then than now. In early Mesozoic times cooling at the poles and differentiation into zones of climate appear to have commenced, and temperature conditions did not afterwards admit of coral reefs in the polar area. But the colder and hence denser water that in consequence descended to the greater depths of the ocean carried with it a large supply of oxygen, and life in the deep sea became possible for the first time. There have been many speculations as to how a nearly uniform temperature could have been brought about in sea-water over the whole surface of the earth in early geological ages, as well as to how sufficient light could have been present at the poles to permit of the luxuriant vegetation that once flourished in these regions. The explanation that appears to me the most satisfactory is the one which attributes these conditions to the very much greater size of the sun in the early stages of the earth's history—an idea first introduced into geological speculations by Blandet,² who likewise discussed the relations of Arctic and Antarctic faunas—together with the greater amount of aqueous vapour in the atmosphere and the greater mass of the atmosphere.

The pelagic Algæ, Radiolaria, and Foraminifera above referred to are probably the but slightly modified descendants of a very ancient universal pelagic fauna and flora. Life in its simplest form most likely first appeared in Pre-Cambrian times in the detrital matters laid down about the mud-line, when the mud-line was generally not so deep, and the land-surfaces were more extensive than at the present time. From these simple forms, which would occasionally be carried into the superincumbent waters, the pelagic Protophyta and Protozoa, which peopled the surface-waters of the Pre-Cambrian ocean, were most probably derived. Radiolaria, and possibly also pelagic Foraminifera, have been discovered in Pre-Cambrian rocks.³ From their remains being preserved in these rocks we may suppose that the Radiolaria were then even more abundant than in modern seas, and their skeletons appear likewise to have been more massive. Radiolaria and other silica-secreting organisms are much more abundant in those parts of the present ocean where there is a low salinity and where the surface is frequently affected by fresh water bearing the finest clayey matter in suspension. We have thus then a hint that the waters of the Pre-Cambrian ocean were probably not so

TEMPERATURE
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PELAGIC FAUNA
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¹ Lapparent, *Traité de Géologie*, ed. 3, Paris, 1893, p. 884.

² *Bull. Soc. Geol. de France*, ser. 2, t. 25, p. 777, 1867-8.

³ L. Cayeux, Sur la présence de restes de Foraminifères dans les terrains précambrian de Bretagne, *Comptes Rendus*, tom. cxviii., p. 1433, 1894.