

The climatic variations during former periods of the earth were discussed by Lyell in considerable detail. He opposed the opinion that climatic changes had been due to the gradual cooling of the earth from an originally molten state, but admitted that during the Tertiary and Diluvial epochs there had been a warmer climate in Europe. During the Secondary epochs reef-corals had inhabited the temperate zones, and in the Carboniferous epoch tree-ferns and other plants indicative of a moist and warm climate had flourished as far north as 75° N. latitude. Lyell traced climatic variations to the varying distribution of land and water, to the influence of ocean currents, to icebergs, and the accumulation of glacier-ice in the polar districts and in the high mountain-chains. He pointed out the geological phenomena characteristic of the Carboniferous epoch—the wide distribution of submarine volcanic products and pelagic limestones, the basin-shaped occurrence of the sedimentary rocks, the absence of large terrestrial and fresh-water vertebrates, the absence of purely fresh-water deposits, and the insular character of the flora. From all these characteristics, Lyell concluded that the northern hemisphere had been covered during the Carboniferous epoch by an island-studded ocean. He then depicted the later epochs, showing that during the Secondary epochs large continents arose in the temperate regions and produced a change of climate; during the Tertiary time the continents in the northern hemisphere became more extensive in the direction of the North Pole, while the Alps, Apennines, and Pyrenees rose as massive mountain-chains, and promoted the gradual approach of the present climatic conditions.

Lyell, in the earlier editions of the *Principles*, attributed little importance to the influence of astronomical causes upon terrestrial variations of climate; afterwards he thought these more worthy of consideration. More especially the changes in the eccentricity of the earth's orbit and in the precession of the equinoxes were treated as important climatic factors, and turned to account in the explanation of the Ice Age.

Having opposed the "Catastrophal Theory" in the first volume of the *Principles*, Lyell tried to establish the uniformity of all natural agencies in past epochs and in the present, and both in the organic and inorganic world.

The subject-matter of the second volume covers the same ground as Von Hoff's work, but while the German geologist