

4. It has been supposed that the earth may have at different times traversed more or less heated zones of space, giving alternations of warm and cold temperature. No such differences in space are, however, known, nor does there seem any good ground for imagining their existence.

5. The heat of the sun is known to be variable, and the eleven years' period of sun-spots has recently attracted much attention as producing appreciable effects on the seasons. There may possibly be longer cycles of solar energy, or the sun may be liable, like some variable stars, to paroxysms of increased energy. Such changes are possible, and may fairly be taken into the account, provided that we fail to find known causes sufficient to account for the phenomena.

Of well-known causes there seem to be but three. These are: First, that urged by Lyell—viz., the varying distribution of land and water along with that of marine currents; secondly, the varying eccentricity of the earth's orbit, along with the precession of the equinoxes, and the effects of this on oceanic circulation, as illustrated by Croll; thirdly, the different conditions of the earth's atmosphere with reference to radiation, as argued by Tyndall and Hunt. As these causes are all founded on known facts, and not exclusive of each other, we may consider them together. I shall take the Lyellian theory first, regarding it as the most important, and the best supported by geological facts.

We know that the present distribution of land and water greatly influences climate, more especially by affecting that of the ocean currents and of the winds, and by the different action of land as compared with water in the reception and radiation of heat. The present distribution of land gives a large predominance to the arctic and sub-arctic regions, as compared with the equatorial and with the antarctic; and we might readily imagine