the earth's history, though not making it the sole cause of glacial conditions, or holding that such conditions would necessarily ensue. The heat received during the summer and winter intervals being as 5 to 3, and the winter interval 199 days long in an extreme case, the severe and prolonged cold of the winters might, other things favoring, accumulate more snow than the short summers could melt. This theory makes the Glacial period of the northern hemisphere follow or precede that of the southern by 10,500 years; that is, by half of a revolution of the seasons (21,000 years). Moreover, the condition of maximum eccentricity is so slow in passing that, according to this theory, two or more glacial periods might occur in the course of one maximum.

This subject and Croll's theory have been ably discussed in a volume of 180 pages, entitled *The Cause of an Ice-Age*, by the Astronomer Royal of Ireland, Sir Robert Ball, 1891. The conclusion is reached that the conditions of a period of maximum eccentricity are fully adequate to cause glacial periods in geological history. See also a notice of the work by G. H. Darwin in *Nature* for January 28, 1892.

Geology has no evidence in favor of the idea that the latest of Glacial periods occurred in the southern hemisphere 10,500 years after, or before, the northern, and it has probable evidence that the time of *the* Glacial period was not over 10,000 years since, and therefore not nearly as far back as the maximum of 210,000 years since, or that of 100,000. Further, it has discovered no satisfactory traces of a second Glacial period, corresponding to the extreme maximum 850,000 years since; for it has good proof that none occurred between *the* Glacial period and the epoch closing the Cretaceous period, some millions of years since. It is admitted, however, that the calculation of the time to the extreme maximum (850,000 years) is not wholly trustworthy.

4. *Progressing diminution in the sun's heat.* — Since the sun has been radiating heat through all past ages, the earth must receive less heat now than in Archæan time; and the greater heat of the early geological ages may have this as a chief cause.

5. *Changes in the condition of the sun's surface.* — The changes from maximum to minimum in the spots on the sun's surface have a cycle of about 11 years, the minimum occurring in the year 1 of the century, and the year 1889 being therefore at the minimum. How far this cycle is one of changing temperature to the earth is not known. Other cyclical changes are possible, and are conveniently assumed at times, though not proved.

6. *Changes in the position of the earth's axis of rotation.* — Mathematical investigations by Lord Kelvin (Sir William Thomson), S. Haughton, G. H. Darwin, and others, have shown this hypothesis to be of no geological value. Darwin has demonstrated that a displacement of the pole of merely 1° 46′ would require that a twentieth of the whole earth's surface should be elevated to a height of 10,000 feet, with a corresponding subsidence in another quadrant; and for one of 3° 17′, that double the surface should have undergone these great changes. Kelvin concludes from his discussion of the subject that "there is no evidence in geological climate throughout those parts of the world which geological investigation has reached to give any indication of the poles having been anywhere but where they are, at any period of geological time."