epochs to as many precession cycles, during one period of maximum eccentricity, thus putting several thousand years between the till deposits of successive epochs in the northern and also in the southern hemisphere. There is no evidence yet reported that the Glacial periods of the two hemispheres were not essentially simultaneous in their epochs. For a full appreciation of the views of Geikie, reference should be made to the recent edition of his *Ice Age* (1894), in which the arguments bearing on the question and on the views of others are fully presented. Moreover, he gives a later map of the Baltic glacier than that he published in 1892.

The merits of Croll's theory have been discussed mathematically and physically by G. F. Becker (*Am. Jour. Sc.*, August, 1894), with adverse conclusions, as follows: —

"The summer of the eccentric period in the hemisphere of rigorous climate will be the hottest possible, nearly 20° F. hotter, it would seem, than that of the present time in temperate latitudes. The evaporation would of course be immense. The heat gradient toward the pole is also considerably greater than it now is, or than it would be at the time of zero eccentricity. Hence the summer would be wet as well as hot. It seems to me, then, that the period of greatest eccentricity would be most unfavorable to glaciation, the snowfall being the smallest, and the summer rainfall the largest which can occur with the present obliquity. It seems much less favorable than the period of zero eccentricity when the winter cold is great enough to preclude much rain in the higher portion of the Temperate Zone, while the temperature in the tropics is great enough to produce active evaporation. It would be manifestly absurd to suppose equality of seasons sufficient to produce an ice age; but I am forced to the conclusion that, so far as eccentricity is concerned in the matter at all, the smaller the eccentricity the more favorable are the conditions for glaciation." Considering the influence of the variation in the obliquity of the ecliptic, he states, as a further result of his investigation, "that the combination of *low eccentricity and high obliquity* will promote the accumulation of glacial ice in high latitudes more than any other set of circumstances pertaining to the earth's orbit. It seems to me that the Glacial period may be due to these conditions in combination with a favorable disposition of land and water. . . . All the indications seem to point to the conclusion that within 30,000 or 40,000 years conditions have occurred, and have persisted for a considerable number of thousand years, which would have favored glaciation on the theory of this paper."

With reference to the return of the warmer climate which determined the departure of the ice, the theory suggests that when the period of combined low eccentricity and high obliquity of the apparent ecliptic was passed, the area of evaporation during the summer of the glaciated hemisphere must have increased, and, at the same time, the temperature gradient toward the pole must have become steeper. Both causes would have led to relatively heavy, warm summer rains in high temperate latitudes. Such rains would rapidly melt the ice-fields, making flooded streams.

The amount to which the mean temperature of the globe was lowered to bring on the conditions of the Glacial period was probably small. The existing mean temperature has been thought by some to be sufficiently low for the result, provided the summers were cool, and excessively wet through an increase of precipitation. This view is presented by J. D. Whitney, in his *Climatic Changes of Later Geological Time* (1882). But it appears to be more difficult to find a cause for such excessive precipitation than for greater cold. E. Brückner, in a recent discussion of the subject, concludes that a change in mean temperature of 8° F. to 10° F. would be sufficient. The lowering of the snow-line in Europe required would be not over 3000 to 4000 feet. (Penck's *Geogr. Abhandl.*, 1890.)