

owing to change in the ellipticity of the orbit, the earth is 14,368,200 miles nearer the sun than when at its greatest possible distance. These maxima and minima of distance occur at vast intervals of time.¹⁵ The last considerable eccentricity took place about 200,000 years ago, and the previous one more than half a million years earlier. Since the amount of heat received by the earth from the sun is inversely as the square of the distance, eccentricity may have had in past time much effect upon the climate of the earth, as will be pointed out further on (§ 8).

§ 3. **Precession of the Equinoxes.**—If the axis of the earth were perpendicular to the plane of its orbit, there would be equal day and night all the year round. But it is really inclined from that position at an angle of $23^{\circ} 27' 21''$. Hence our hemisphere is alternately presented to and turned away from the sun, and, in this way, brings the familiar alternation of the seasons. Again, were the earth a perfect sphere, of uniform density throughout, the position of its axis of rotation would not be changed by attractions of external bodies. But owing to the protuberance along the equatorial regions, the attraction chiefly of the moon and sun tends to pull the axis aside, or to make it describe a conical movement, like that of the axis of a top, round the vertical. Hence each pole points successively to different stars. This movement, called the precession of the equinoxes, in combination with another smaller movement, due to the attraction of the moon (called *nutation*), completes its cycle in 21,000 years, the annual total advance of the equinox amounting to $62''$. At present the winter in the northern hemisphere coincides with the earth's nearest

¹⁵ See Croll's "Climate and Time," chaps. iv. xix.