

ASTRONOMICAL PARAMETERS OF THE EARTH AND THE SUN

The Earth:

The Earth is considered approximately spherical in shape. But actually it is very approximately an oblate spheroid. Oblate spheroid is the figure formed by revolving an ellipse about its minor axis. The earth is flattened at poles – its diameter along the polar axis being lesser than its diameter at the equator. The equatorial radius a of the earth, according to Hayford's spheroid is 6378.388 km and the polar radius b of the earth is 6356.912 km. The ellipticity is expressed by the ratio $\frac{a-b}{a}$, which reduces to $\frac{1}{297}$. For the Survey of India; Everest's first constants were used as follows:

$a = 20,922,932$ ft and $b = 20,853,642$ ft, the ellipticity being $\frac{1}{311.04}$.

The earth revolves about its minor or shorter axis (i.e. polar axis), on an average, once in twenty-four hours, from West to East. If the earth is considered stationary, the whole celestial sphere along with its celestial bodies like the stars, sun, moon etc. appear to revolve round the earth from East to West. The axis of rotation of earth is known as the polar axis, and the points at which it intersects the surface of earth are termed the North and South Geographical or Terrestrial Poles. In addition to the motion of rotation about its own polar axis, the earth has a motion of rotation relative to the sun, in a plane inclined at an angle of $23^{\circ} 27'$ to the plane of the equator. The time of a complete revolution round the sun is one year. The apparent path of the sun in the heavens is the result of both the diurnal and annual real motions of the earth.

The earth has been divided into certain zones depending upon the parallels of latitude of certain value above and below the equator. The zone between the parallels of latitude $23^{\circ} 27 \frac{1}{2}'$ N and $23^{\circ} 27 \frac{1}{2}'$ S is known as the torrid zone (see Fig. 1.12). This is the hottest portion of the earth's surface. The belt included between $23^{\circ} 27 \frac{1}{2}'$ N and $66^{\circ} 32 \frac{1}{2}'$ N of equator is called the north temperate zone. Similarly, the belt included between $23^{\circ} 27 \frac{1}{2}'$ S and $66^{\circ} 32 \frac{1}{2}'$ S is called south temperate zone. The belt between $66^{\circ} 32 \frac{1}{2}'$ N and the north pole is called the north frigid zone and the belt between $66^{\circ} 32 \frac{1}{2}'$ S and the south pole is called south frigid zone.

The sun:

The sun is at a distance of 93,005,000 miles from the earth. The distance is only about $\frac{1}{250,000}$ of that of the nearest star. The diameter of the sun is about 109 times the diameter of the earth, and subtends an angle of $31' 59''$ at the centre of the earth. The mass of the sun is about 332,000 times that of the earth. The temperature at the centre of the sun is computed to be about 20 million degrees.

The sun has two apparent motions, one with respect to the earth from east to west, and the other with respect to the fixed stars in the celestial sphere. The former apparent path of the sun is in the plane which passes through the centre of the celestial sphere and intersects it in a great circle called the ecliptic. The apparent motion of the sun is along this great circle. The angle between the plane of equator and the ecliptic is called the Obliquity of Ecliptic, its value being $23^{\circ} 27'$. The obliquity of ecliptic changes with a mean annual diminution of $0'.47$.

The points of the intersection of the ecliptic with the equator are called the equinoctial points, the declination of the sun being zero at these points. The Vernal Equinox or the First point of Aries (Υ) is the point in which the sun's declination changes from south to north. Autumnal Equinox or the First point of Libra (Ω) is the point in which the sun's declination changes from north to south. The points at which sun's declinations are a maximum are called solstices. The point at which the north declination of sun is maximum is called the summer solstice, while the point at which the south declination of the sun is maximum is known as the winter solstice.

The earth moves eastward around the sun once in a year in a path that is very nearly a huge circle with a radius of about 93 millions of miles. More accurately, the path is described as an ellipse, one focus of the ellipse being occupied by the sun.