Jayant Narlikar and Thanu Padmanabhan

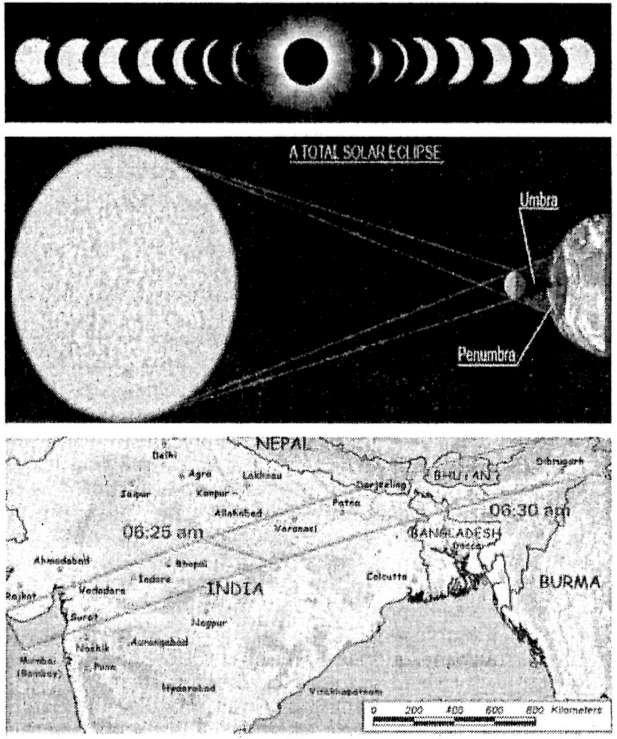
TOTAL SOLAR ECLIPSE

In an earlier instalment, we mentioned the curious fact that both the Sun and the Moon subtend the same angle (about half a degree) on Earth. This is a coincidence which does not occur for any other satellite in solar system. It is as though nature designed it to make the phenomena of solar eclipses - one of which is going to occur soon, on 22 July 09 - a treat to watch for earthlings.



The total solar eclipse occurs when the Sun, Moon and Earth come in a precise straight line so that the (so called) umbral shadow of the Moon falls on a region of the Earth. (See the figure which describes the difference between umbral and penumbral shadows.) Obviously, this has to take place on a New Moon day but we will not have a solar eclipse on all New Moon days. This is because the Moon's orbit is slightly inclined to the Earth's orbital plane around the Sun and the precise alignment casting the shadow on Earth cannot occur on all New Moon days. Even when the alignment does occur, we could sometimes be in the penumbral shadow of the Moon that will lead to a partial solar eclipse, which is a much less spectacular phenomenon.

Next week, on Wednesday, a total solar eclipse will be visible from within a narrow belt that goes across half of Earth. The path followed by the Moon's umbral shadow across the Earth is called the Path of Totality It is typically 10,000 miles long and about 100 miles wide covering less than 1% of Earth's entire surface area. This path of Moon's umbral shadow enters India at about 06:15 hrs IST and crosses over to Nepal, Bangladesh, Bhutan to China. After leaving mainland Asia, the path crosses Japan's Ryukyu islands. The duration of total solar eclipse is never too long and the shadow moves fairly fast across the ground. This time, the duration of totality of the eclipse visible in India varies between about 3.5 to 4.5 minutes. The maximum time for which the totality lasts is about 6 minutes and 39 seconds but you need to be on a ship to catch it since it occurs over the Pacific Ocean.



From top: Phases of a total solar eclipse, schematic of a total solar eclipse, the zone where it will be visible.

In spite of its short duration, the total solar eclipse is considered to be one of the most awe inspiring spectacles of nature. As the moon covers the sun, one sees surrounding the Moon, a beautiful halo. This arises from the solar corona, which is a superheated plasma at two million degrees of temperature. Just before totality, the thin crescent Sun fragments into a series of brilliant beads and short arcs which dwindle and vanish in rapid succession leaving behind only one bead, set like a single dazzling diamond in a ring.

There are several important Indian cities within the path of the Moon's shadow including Surat, Vadodara, Indore, Bhopal, Jabalpur, Allahabad, Varanasi, Patna, Bhagalpur, Siliguri, and Guwahati. Nearby regions which are not fortunate to see the total solar eclipse get the consolation prize of partial solar eclipse in the penumbral shadow of Moon. This includes most parts of the rest of India, eastern Asia and Indonesia.

Needless to say, the superstitions associated with total solar eclipse have no scientific basis whatsoever. It is perfectly safe to be out watching the eclipse without any harm coming to you. The important precaution needed is the use of specially made goggles to watch the Sun and not to observe it directly. Do not let some old wives' tale prevent you from watching a beautiful cosmic spectacle if you have the chance.

Next week: The giant leap for mankind

Astrophysicist Jayant Narlikar and theoretical physicist Thanu Padmanabhan will contribute to DNA's special series through 2009, designated the International Year of Astronomy.