# Total Solar Eclipse

## Shedding Light on a Dark Phenomenon

By J. V. NARLIKAR

A YEAR ago I wrote (TOI, October 22, 1994) about the scare and superstitions that prevented a large body of people even in a modern city like Bombay from witnessing the unique phenomenon of solar eclipse in 1980. I had concluded: "A test will be a year from now. On October 24, 1995, there will be another total solar eclipse visible from some parts of India. It is a sight not to be missed even when the eclipse is partial where you are located ... If Bombay continues to stay indoors with blinds drawn and windows closed, then my hopes (of winning a battle against superstitions) are misplaced ..."

As the date draws near, astronomers, amateurs as well as professionals, are gearing up to witness this rare event when the shining disc of the sun is covered by the much paler one of the moon. The purpose of this article is to invite the celebrated "man in the street" to come out on the street and do the same...

### Inclined Orbits

The British astronomer W.H. McCrea once wrote an article with the above title, highlighting the fortuitous circumstance that although the sun and the moon are vastly different in size, they happen to be located at such relative distances that viewed from the earth the moon's disc can just about block out the sun's. Further, the orbits of the sun and the moon are not exactly in the same plane but are inclined at a small angle of about five degrees. All this makes the total solar eclipse possible yet rare.

The forthcoming eclipse so far as India is concerned will be visible from a narrow belt stretching from north Rajasthan through southern U.P. to southern Bengal. Its speciality is that it encompasses thickly populated urban areas and as such a large number of people can witness the event without having to make special trips. Elsewhere the eclipse will be partial but still well worth witnessing. The duration of the total eclipse is, however, not very long, hardly a minute or so. But even in that period a lot can be seen.

These details are given in a booklet, entitled *Nightfall on a Sunny Morning* by Nilesh Vayada, Samir Gandhi and Narayan Chandra Rana, brought out by the Confederation of Indian Amateur Astronomers. Another useful information booklet has recently been issued by the India Meteorological Department.

Long before the period of totality begins there is the partial phase which is seen all over India in varying degrees, where the sun takes on the crescent shape with the progressive shrinking of its visible limb. The intensity of daylight declines and one can see the light crescents on the ground beneath trees where the sunlight has penetrated through the leaves, a natural demonstration of the pinhole camera effect. The reverse happens when the eclipse is ending with the crescent getting progressively fuller. The entire phase may last two to three hours.

Totality, however, brings its own peculiar effects. There is a fall in temperature as well as light. The birds, confused by the changes, flutter to their nests and in natural habitats there is noticeable silence. As the sun disappears completely, its outer part, the corona which is normally outshone by the bright skylight, now begins to glow. Just before and after the totality phase you could possibly see the shadow bands which are bands of the approaching shadow, whose wavy pattern is caused by atmospheric fluctuations. Another way of seeing these bands is to plant a vertical stick and to observe its shadow on a white sheet.

Of course, when the entire disc is covered and totality of the phase has begun, look out for the stars and planets and see how many you can count. If you have a pair of binoculars watch for prominences at the edge of the moon. These are orange red flames on the sun's turbulent surface which might be visible when the main solar disc is covered.

### Bright Spots

Then there are the so-called Bailey's beads which are bright but tiny bead-like spots on the dark solar disc. These are caused by sunlight showing through the chinks of craters and valleys in the not-so-smooth lunar disc covering the sun. But more dramatic is the diamond ring which appears only momentarily when the totality phase is over and the sun begins to peep out from behind the moon. The bit first showing through is like a bright diamond and the inner part of the now faded corona is the round ring. If you are lucky you may be able to photograph this dramatic event.

But, as we stand poised to march into the 21st century,we still have to tackle the basic question: "To watch or not to watch?" If you are still guided by the age-old superstitions then this article is not for you. You better hide yourself in the innermost part of your house and come out and have a bath when you are told that the "evil period" is over. This article is also not for you if you are guided by modern superstitions which tell you that dangerous invisible rays come out of the sun when it is eclipsed and it is better not to venture out.

Let us look at facts. The sun emits, besides the visible light, other types of radiation in varying quantities to which our eyes do not respond but our instruments do. For example, beyond the seven rainbow colours that make up sunlight, the sun also emits infrared and ultraviolet rays which we cannot "see". These would, however, damage our eyes if we were unwise enough to stare at the sun. When the sun is shining brightly in the sky we do not stare at it simply because we can't. But at the time of the eclipse the situation is different.

### Radiation Reduced

First, when the sun is partially covered, all its radiation, visible or otherwise, is reduced. Thus, contrary to the popular misconception, the harmful component of solar radiation is reduced rather than increased at the time of the eclipse, dropping to near zero at totality. The real danger to our eyes arises, however, from our temptation to stare at the considerably mellowed sun during a partial eclipse. So do not look at the partially eclipsed sun with your naked eyes.

You can, however, shield your eyes with specially prepared solar filters like those made of aluminised mylar sheets that block the harmful radiation, or the dark welder's glasses of shade number 14. If you are using mylar filters please ensure that they are certified for their absorption properties by reputed scientific organisations. Do not use ordinary sun glasses or glass darkened on flames. They are not safe. And even with adequate filters glance only occasionally at the partially eclipsed sun ... avoid staring continuously.

If you want to watch the partially eclipsed sun continuously then use the pin-hole camera technique. Make a tiny hole in a cardboard and hold it against the sun; you can project its image on a white sheet of paper, or on a wall, on the other side of the cardboard. Or use a small mirror covered with a piece of black paper with a one to two centmetre hole in the centre to form a reflected image on the wall.

Concerned with the misinformation produced at an eclipse, Professor Jay Pasachoff, chairman of the working group on astronomy of the international astronomical union, has in a recently issued press release advised on how to observe the eclipse, giving similar do's and don'ts. And now the most important: "Don't; Don't miss watching this important event even though you are not in the zone of totality!"