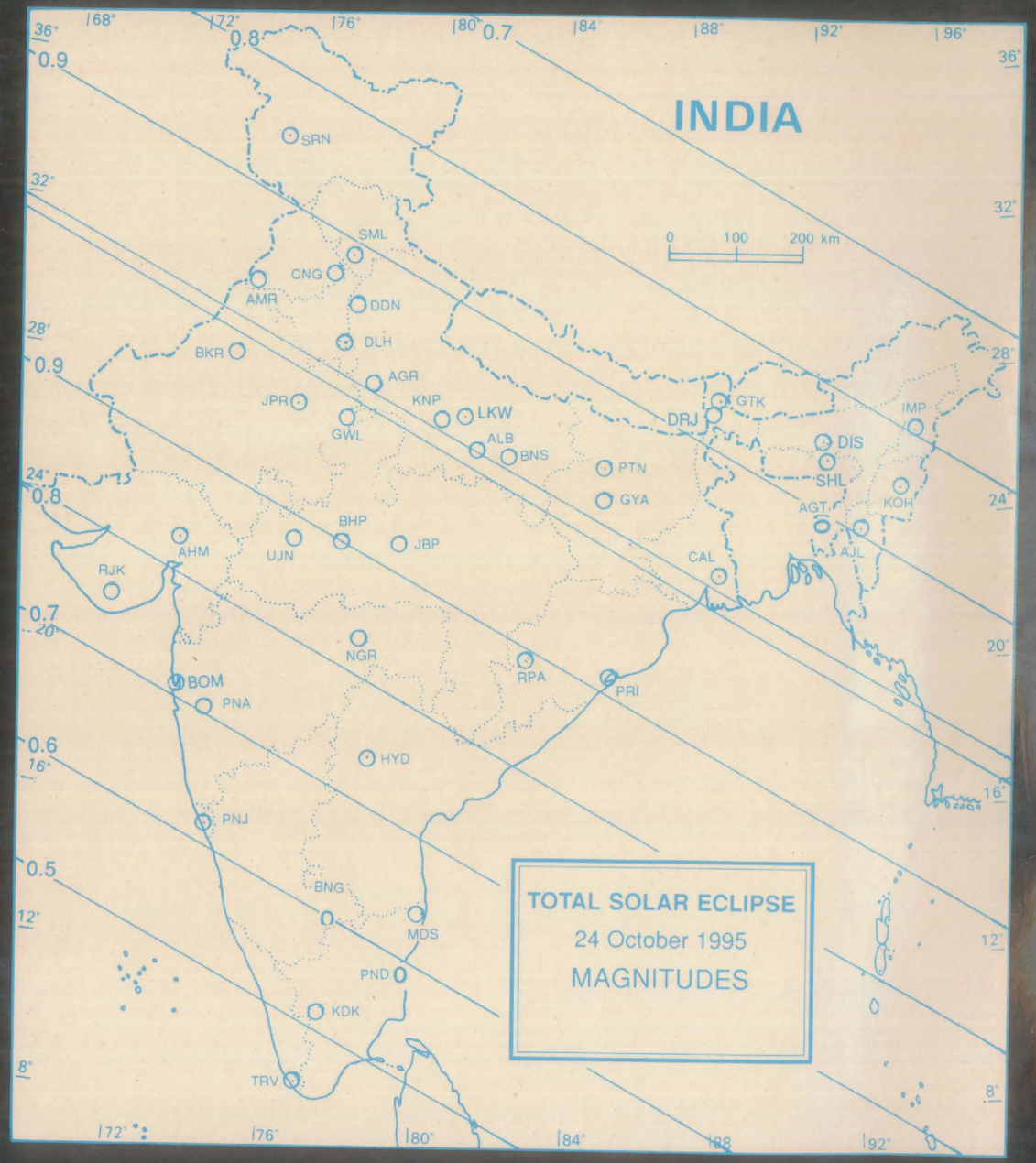

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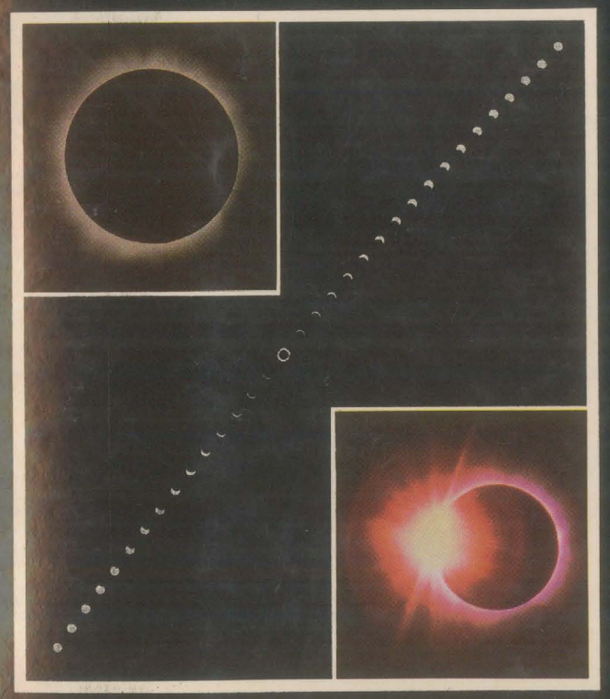
Nightfall on A Sunny Morning



HANDBOOK ON INDIAN CIRCUMSTANCES

FOR

TOTAL SOLAR ECLIPSE

OCTOBER 24, 1995

NILESH VAYADA SAMIR GANDHI

N. C. RANA

CONFEDARATION OF INDIAN AMATEUR ASTRONOMERS'

CAUTION

"The Total Solar Eclipse may be a glorious sight,
But we still have to return to the starry night,
So be careful, ever so careful, my delicate eyes,
To keep wandering through the beautiful skies."

DO NOT ...

Look at the sun without appropriate solar filters which cuts down all UV, Infrared and Rainbow colours by no less than about a hundred thousandth part.

NEVER ...

Look at the sun through optical aids without tested filters, you will permanently damage your eye.

ALWAYS ...

Watch the Total Solar Eclipse with due caution; the sun does not emit dangerous radiations only during an eclipse but all the time. These radiations are blocked by the opaque body of the moon during the total phase by a factor of 100,000. Watching the total phase without any opticial aid is a must for you to get the *"TOTAL"* experience.

REMEMBER ...

Seeing the diamond ring or Baily's beads could be harmful to the naked eyes. Use at least one superimposed negative which has been totally exposed (Black) before developing, during the last one minute before totality and the first one minute after the totality.

Nightfall on A Sunny Morning

HANDBOOK ON INDIAN CIRCUMSTANCES FOR TOTAL SOLAR ECLIPSE OCTOBER 24, 1995

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NIGHTFALL ON A SUNNY MORNING

Handbook on Indian Circumstances for Total Solar Eclipse October 24, 1995

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PREFACE

Since a total solar eclipse is not an astronomers' special privilege but for everybody who loves the beauty of nature, this booklet is targeted to a wide audience including amateur astronomers, students, laypersons and businessmen. Those of you who have witnessed this rare event before, surely know how impressionable a few seconds of memories are! Spanning over a very narrow belt and cutting across the globe stretching from south of Teheran and through parts of Rajasthan, Uttar Pradesh, Bihar and West Bengal (in India), the moon's shadow will sweep past these places in the early hours of the forthcoming Deepavali at a fantastic speed of no less than 5000 kms/hour. No wonder that it will take only 20 minutes to traverse the entire breadth of the country. Since the shadow's width and breadth are approximately 45x75kms, anyone located on the central track of the shadow will witness it merely for a minute or so.

Notwithstanding the geometrical description of this event, the richness in visual terms is so dramatic that anyone who has witnessed it once in life has failed to compare it with any other grand spectacles that she/he has ever witnessed on earth. Here comes another Great Eclipse Chase! This booklet is going to provide you with all the basic and scientifically correct information regarding choice of camping sites (for witnessing the CELESTIAL FIREWORKS during this Diwali!) **The data which are calculated by the authors takes account of weather conditions, duration of totality, tips for observation and photography. However, the accuracy of the number in the listed tables is subject to further revisions in the light of the possible time corrections, (which remains unpredictable till the minute of the actual event) and therefore the last significant digits can be ignored.** For example, the physical state of the storming atmosphere of the Sun cannot be predicted and the phenomena such as Diamond Ring, Bailey's beads and Shadow bands cannot be predicted with certainty.

We sincerely wish that everyone should take this rare opportunity of witnessing all these phenomena associated with the total solar eclipse. The experience is not just visual but intensely emotional. As the Sun goes almost black (figuratively speaking!) it creates an awesome eeriness due to its suddenness. The flora and fauna get thoroughly confused during this temporary nightfall between evening and morning twilight effects in a rapid sequence. Just before and after totality, due to atmospheric diffraction of sunlight, thin shadow bands travel across the landscape as if some snake like creatures were ripping past. All these wizard sequences of apparitions at such a breath-taking pace perplex even the most civilized and educated humans. Scientists have been known to fumble with their solar instruments not knowing whether to keep recording or just enjoy the event ! With such an impact it is no wonder that the weak minded often spread false rumors on the "harmful effects" of watching an eclipse. We should endeavor to stem superstitions on the basis of scientifically proven explanations. Thousands of foreigners have already made their airline bookings a year in advance. Luckily the path of this totality is embracing a number of thickly crowded cities and populated villages unlike many times when it is in the middle of an ocean or a desert! Useful tables and detailed charts and maps are appended to help you plan YOUR trip.

Please read this book carefully for all its suggestions and precautionary measures to be taken during the viewing of the Eclipse. Wish you all a happy-going Eclipse Expedition. Should you require any further information please contact your local amateur or professional astonomical organizations, failing which we shall remain at your service.

We thank all the persons/organizations who have helped in preparation of this booklet with special thanks to Mr. Satish Nagarajan and Mr. Ajay Talwar for helping in computing the tables, and Ms. Mridula Chandola for converting the text and the tables into camera ready LATEX Version. Also Mr. Asis Mukherji & Mr. Suresh Sali for their contineous help and support in bringing out this publication.

- Authors

15th December, 1994.

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1. INTRODUCTION

Ever since man has been observing the grand celestial sphere through day and night, nothing has captured his imagination more than an eclipse. Although there are more astronomical events which are equally profound in their manifestations, they are not as predictable and frequent as an eclipse. Also consider the fact that an eclipse literally conjures up images of Gods playing around with the mighty Sun.

An eclipse is essentially the foreshadowing of the surface of an astronomical body by the presence of another body between it and a bright source. Specifically, it is either the Moon or the Earth which falls within the shadow of the other as a consequence of the linear alignment of the Sun, Earth and the Moon. Most of you know that lunar eclipses seem to be more frequent than a solar eclipse. However, the same is not true. This is because the lunar eclipse is visible through the entire hemisphere facing the Moon whereas the solar eclipse is visible only where the shadow of the Moon falls on the Earth.

The first recorded solar eclipse seems to be that of 2136 BC (22 October) seen in China during the reign of Emperor Chung K'ang. The Chinese believed that eclipses were due to an attack on the Sun by a hungry dragon, and they endeavored to scare the dragon away by making as much noise as possible. (It always worked!) The first known prediction of an eclipse was made by Greek philosopher Thales who forecast the eclipse of 25th May 585 BC. This occurred near sunset in the Mediterranean area, and is said to have put an end to a battle between the forces of King Alyattes of the Lydians and King Cyaxares of the Medes; the combatants were so alarmed by the sudden darkness that they concluded a hasty peace.

1.1 Our Solar System

Life on Earth is so used to the regularity of the rising and setting of the Sun that their biological clocks are set by this recurring event. There are more such events like the waxing and waning of the Moon or the predictable paths of the planets. For ages man has known that certain bodies in the sky are much closer to us than the "cold distant" stars. Today, any school going child will tell you the number of planets and their satellites (more likely their correct number and not what the 'old textbook' says) and where the asteroid belt lies.

Yet things could have been entirely different. It is extremely difficult to comprehend that the Sun may not rise one day. Or that the Moon will always hang at the same place in the sky. Or that the night sky will never vary through the ages. Or even that one day, we may have two Suns' thereby creating irregular days and nights. But we know why none of the above happens. School geography tells us the reasons in terms of the movements of various planets, the moon and the rotation and tilt of the Earth's axis.

In the clockwork precision of the mechanics of the solar system, we do observe something out of the ordinary from time to time, like the apparent intrusion of comets or the eclipses. These seem inexplicable at first but with some logical thinking do not tax our brains much. Of course, with expeditions to the planets (such as the Voyager, Pioneer, and Mariner) we keep learning more and more about the nature and origin of our solar system. With projects like the Hubble Space Telescope, the day is not far away when we may start learning about the

existence and nature of other solar systems. Candidates like the Barnard system are already under observation.

1.2 Observations of Total Solar Eclipse over Indian Subcontinent

The last total solar eclipse had occurred on 16th February 1980. Cricket buffs may recall that a test series between England and India was going on during this period and to prevent people from observing the eclipse during the match, this day was declared a rest day! Before 1980, the previous total solar eclipse visible from India occurred only in 1898 except for a very brief touch of umbral shadow cone in 1955 near the southern tip of the Indian peninsula. In the future, India will experience such an eclipse on 11th August 1999, but due to the prevailing monsoon in August the event will in all probability end up in a total frustration.

1.3 Eclipses — Types and Causes

From elementary geography, we know that there are partial, total and annular eclipses, the frequency of which reduces in the same order. We also know that there are lunar eclipses. We may wonder as to why an eclipse should occur in the first place and if it does (undoubtedly!) why it should appear the way it does. It is indeed remarkable that the Moon nearly seems the same size as the Sun, giving rise to the kind of eclipses that we are used to observe. The Moon's diameter is 400 times lesser than that of the Sun but it is almost 400 times closer to Earth, giving rise to this coincidence.

Before we attempt to understand the reasons for the types and causes of eclipses, we will understand a bit of Eclipse geometry. We know that an eclipse can occur only when all these three bodies are more or less in a straight line. Extending this logic, we should have a solar eclipse on some part of the Earth every month with unfailing regularity. However, eclipse geometry gets complicated due to the elliptical orbit of the Earth around the Sun as also the Moon around the Earth. As a result, there is an obvious change in the apparent diameter of the Sun and the Moon through the time period marking the end of one revolution in each case. Of course, the extreme variations would occur when the distance of the bodies involved are either at their largest or the smallest separation. The variation of the Moon's apparent diameter is 11% which is 3% in case of the Sun.

Due to the elliptical orbits it may happen sometimes that the shadow of the Moon may fall within the distance to the Earth and yet not create an eclipse .Moreover, the planes of these orbits are tilted at an angle with respect to those of others. This makes the likelihood of an eclipse at every crossing of the node even less probable. Yet, these parameters at their extremes still ensure two solar eclipses a year on some part of the Earth. Were all three bodies revolving in a single plane with circular orbits, a solar eclipse would be a normal occurrence (every month) through the ages and may not have evoked a feeling of wonder and astonishment every time it occurred.

Use a little imagination and it becomes clear that when the ratio of Moon to Sun diameter is more than one, some part of the Earth will experience a total absence of sunlight for a few minutes when the whole of the Sun is hidden behind the Moon. This, of course, is our Total Solar Eclipse. Conversely, when this ratio is less than one, the Moon only occults the central portion of the Sun, leaving behind a solar ring. This kind of eclipse is aptly named an Annular Solar Eclipse (annulus means 'ring' in Latin).

From elementary geography, we know how the interplay of shadows around a sphere causes umbral and penumbral cones. If a part of the surface of the Earth lies within the umbra, it experiences totality whereas a larger coverage of the penumbral cone ensures wider experience of partial eclipse at the same instant. Depending on the ratio of the apparent diameters of the Moon and the Sun, the duration of totality at a given place will vary. The larger this ratio, the longer is the duration when the Sun remains hidden behind the Moon. As per current observations, the maximum deviations of ellipticity of the orbits of the bodies involved ensures that no total eclipse will last for more than seven and a half minutes.

1.4 Saros Cycles

It is interesting to note that all the solar eclipses form part of a cycle which more or less repeats after 18 years and 10 days (if there are five leap years) or 11 days (four leap years). This is known as 'Saros' cycle of the eclipse, noticed by the Babylonians sometime between 1800 and 700 BC. Specifically, an eclipse which occurs today will repeat itself under the same circumstances after every 18 years and 10/11 days. A different eclipse which would occur six months hence will similarly repeat itself after about eighteen and a half years from today. Such a cycle may last 13 centuries producing eclipses which share similar geometrical characteristics. Since there are about 3 solar eclipses every year, in the block of 18 years there could be about 65 eclipses, and therefore nearly 100 individual series of such cycles would be running simultaneously for any given century.

The explanation to this seemingly bizarre occurrence is really very simple. The repetition of a cycle can only be said to have taken place when the alignment of the Sun, Moon and Earth is almost the same (thereby producing a similar eclipse as before). With the extension of our understanding of eclipse geometry, this fact stares us in the face. To find a periodicity in the mechanics of the solar eclipses, we must search for a commensurability between the synodic month (the time taken by the Moon to attain subsequent conjunction with the Sun) and an eclipse year (comprising two eclipse seasons - when the three bodies are in a position to create an eclipse). Fortunately, 19 eclipse years match 223 synodic months to within 11 hours. This is what is known as Saros cycle and is 18 years, 11 days and 8 hours long. Since the duration of this cycle does not fit in an integral number of days (instead it is divisible by 8 hours or 1/3 day), the next eclipse of that cycle will occur 120° away from its last occurrence on the surface of the Earth. Obviously, after 3 Saros cycles, the same geographical longitude on Earth experiences that eclipse, but by that time the mean geographical latitude of the occurrences shifts considerably. In other words, every fourth eclipse of the same saros series will not occur at the same place but either above or below it progressively.

The forthcoming eclipse belongs to the Saros cycle number 143, as catalogued by von Oppolzer in his magnum opus *Canon der Finsternisse*.

2. TOTAL SOLAR ECLIPSE OF 24 OCTOBER 1995 (2 KARTIKA 1917 SAKA ERA)

The most peculiar thing about this eclipse is that it will be visible in thickly populated regions of North India. Usually, the rarer the event, the lesser the probability that it will be visible from populated areas.

2.1 General Circumstances

Seen over the entire Earth, the eclipse of 24th October 1995 begins at 7h 22m IST and ends at 12h 42m IST. General elements and circumstances for the eclipse are shown in the accompanying charts. Maps have been provided to select areas from where the totality is observable. The partial phases can be seen within longitude 36°E and 173°W as well as latitude 70°N and 30°S. This covers North East Africa, Central South and Eastern Asia (except extreme north east), Indian Ocean, northern half of Australia and Western Pacific Ocean. The umbral cone travels over a reasonably narrow portion of the Earth's surface for varying durations. It first makes its appearance at local Sunrise near Teheran at about 8h 23m IST. The path of totality is about 16 km at this point and the duration is less than 16 seconds.

The central line will reach the north west portion of India in about 7 minutes after having crossed Iran, Afghanistan and Pakistan. At this point the totality path will be 37 km wide with a duration of 44 seconds. The central path then crosses into Bay of Bengal after passing over southern Bangladesh. It then traverses Myanmar, Thailand, South China sea, northern tip of Borneo, Celebes Sea and the Pacific Ocean. The maximum duration of totality occurs at this end at about 10h 06m and is roughly 129 seconds. The width of totality here is 78 Km.. The central eclipse ends at 11h 42m IST in the Pacific Ocean at local Sunset.

2.2 Circumstances Related to India

The partial phase is visible throughout India although the totality is observable from a narrow band which passes through the northern states of Rajasthan, extreme north of Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal. The times of beginning and ending along with other relevant data for various places in this band and major cities for the partial phase are provided elsewhere in this book. It is important to note that the position angle of contact is measured from the north point of the solar disc eastwards (counter clockwise). The magnitude of partial phase at the greatest obscuration decreases with the distance from the path of the total phase. The path of the total phase is provided for quick reference.

An interesting thing is that Allahabad, a major city, will lie just on the edge of the path of totality thereby providing a graze totality for the northern residents while the southern residents can expect to observe totality while in case of Ranchi it will be the other way. Cities which lie close to the path of totality are Agra, Mathura, Gwalior, Kanpur, Varanasi and Calcutta. The duration of totality for a place depends on its distance from the central line within the path of the total phase. Along the central line in India, it varies from about 44 seconds in the west to about 79 seconds in the east.

3. TIPS FOR THE OBSERVERS

3.1 What To Watch For During The Eclipse

The total solar eclipse is beyond doubt one of the most awesome sights in nature. It almost slinks on you unheeded, and before you have realized, the western edge of the Sun starts being "eaten away" by the Moon. As the minutes pass by, the brighter portion of the Sun becomes smaller and smaller. Just before totality, the sky darkens noticeably, and an ominous silence settles over the ground. Birds flutter to their nests, animals slink home, the temperature dips.

Then, after a last thinning crescent, the sun abruptly disappears completely behind the Moon, and a pearly corona glows softly in the sky around a black disc. A few stars come out, night birds wheel in the air, and night insects begin to chirp. Everything else is still, and there is an eerie orange glow at the horizon. In quick succession, we see some of the most awesome sights that accompany a total solar eclipse. The essential phenomena are described briefly here below.

3.1.1 Contact points

These are the points where the Sun and the Moon seem to meet and leave as seen from the Earth. A total solar eclipse shows four distinct contact points. Just as the limb of the Moon touches that of the Sun marking the beginning of the eclipse gives us the first contact point. The second point is obtained just when totality begins. The third is obtained just as totality ends. The fourth, of course when the limbs of the Moon and the Sun seem to detach. It is important to time these contact points because the results may show a slight discrepancy between recorded and predicted times and this may possibly be due to an alteration of the solar diameter - a highly controversial issue, ever since Eddy proposed the idea of the shrinking Sun. Timing may also help to identify perturbations of the lunar orbit and irregularities of the Earth's rotation.

3.1.2 Shadow bands

These are wavy lines seen across terrestrial features before and after totality. They are caused due to the Earth's atmosphere and were first observed by H. Goldschmidt in 1820.. Of course, you need to have a clear horizon to really appreciate the beauty of this spectacle. Note the width, speed and direction of shadow bands. Alternately, you can also lay out a white sheet on the ground with sticks propped vertically in the center. The passage and direction of shadow bands can be noted from observing the shadow of the stick through a period of time.

3.1.3 Bailey's beads

Caused due to the shining of the Sun's rays through the valleys on the lunar limb immediately before and after totality, this brilliant bead-like effect gives the impression of watching a necklace. This observation was first noted by Halley in 1715. Francis Bailey, an English astronomer, explained this phenomenon when he observed this effect during the annular eclipse of 15th May 1836. C.F.Hines and members of the Philadelphia Photographic Corps. first photographed this beautiful sight during the eclipse of 7th August 1869 from Iowa. Count the number of beads visible just before and just after totality.

3.1.4 Diamond ring

As the first speck of the Sun returns to view immediately after totality, irradiation makes this spot seem larger than it actually is. The resultant effect is the famous formation of the Diamond ring, with the speck of the Sun as the diamond and the inner corona as the ring. Of course, by this time the outer corona is already blotted out. Savor the delight of watching this brief but magnificent sight, for there are no details to memorize and jot down.

3.1.5 Stars and planets

Planets and the brighter stars have been seen even during partial eclipses. Count the number of visible stars and planets and mark constellations if possible.

3.1.6 Prominences

Just after totality begins, watch the edge of the Moon through binoculars. You will see red and orange jets of flaming fire lacing into the inner corona. These are the prominences which fade suddenly as totality ends. They have been known to travel at amazing speeds to heights of a million miles above the solar surface. Note the number, shape, colour and position of the prominences.

3.1.7 Corona

The exact nature of the Corona remains a mystery. It is obviously the Sun's outer atmosphere consisting mainly of hydrogen and extends into several diameters of the Sun. It is so tenuous that comets have been known to pass through it without slowing down. It seems irregular in shape if the sun-spots are at their minimum and almost spherical otherwise. Two distinct Coronas can be made out at different times - the inner and the outer Corona. Its streamers may reach out millions of miles into space. If you watch the portion of the Sun just beyond its north and south poles, you will see intensified lines of light which are the polar brushes (caused by the Sun's tremendous magnetic force. Note the outline and color of the Corona.

Apart from the above there is always a possibility of a comet near the Sun which has not been discovered as yet.

3.2 Methods of Watching

3.2.1 Naked-eye

It is worthwhile mentioning that as far as possible, no attempt should be made to observe the eclipse with naked eyes except during totality. You can use Mylar sheets or over exposed films or dark X ray plates of sufficient thickness to observe the Sun with the naked eyes, although it must be pointed out that such sheets need thorough checking for any "uncoated spots" that may allow unheeded entry of harmful ultraviolet radiation into the eyes.

3.2.2 Projection using a telescope

To project the solar image on a piece of paper, rack out the eyepiece on the telescope a little further out than necessary for normal visual observation. Move the paper screen back and forth until the image thrown on it becomes sharp and clear. A wire frame can be rigged to hold the paper at the correct distance, and it might be worthwhile to drape a piece of black cloth over the wire framework to keep out some of the extraneous light and give a more distinct image. This is not only safe from the point of view of safety to the eyes, but also ensures observation by many people at the same time with just one telescope.

3.2.3 Using a pair of binoculars or a small telescope

If you have access to a solar filter from an extremely reliable source, use it by all means. It will give you the most satisfactory view of the entire proceedings in magnified detail.

3.3 Photography

3.3.1 Photography for the Beginner:

If you have access to a manual camera (NOT automatic - the older the camera, the more likely it is that it will be manual), you can begin right away! The point is, you have to control the duration of exposure during totality (*i.e.* keep the shutter opening and closing in your control to allow more light to fall on the film when the amount of light coming from the source is very less). It is true that automatic cameras control shutter speed by sensing light levels automatically but they are designed to operate only under optimal illumination.

Practicing with the Moon in its various phases will give you a fair idea of what to expect during the eclipse. It must be mentioned that the different phenomenon during the eclipse occur under varying illumination so the exposure timings and filters needed will be different for each event. Go through the next section for technical details.

3.3.2 Photography for the Professional:

Uniquely among celestial objects, the Sun offers the photographer a superabundance of light. The obvious advantages due to this fact are: short exposures, no guiding, slow fine- grain emulsions, with just an amateurs altazimuth mount. An SLR type with shutter speeds upto about 1/500 sec would be ideal. If the shutter is located near the focal plane of the objective, it must be constructed of metal (polished on the outer side and dull black on the plate side). Photography before totality needs filters which should be as dense and monochromatic as is consistent with exposure timings.

According to the length of the exposures, and therefore to the phase of the eclipse, stationary short focus cameras, clockdriven equatorials, or siderostat fed long focus telescopes may be used. Assuming that 0.002 inch is the limit of photographic resolution, we need to be concerned with no movement of the image smaller than this during an exposure. Taking the Sun's apparent angular motion as 15" per second, the maximum permissible exposures with a stationary camera for various focal lengths are as follows:

Focal length (inch)	Maximum permissible angular displacement in arc sec	Max. permissible exposure time (sec)
06	68.9	5.8
12	35.2	2.4
20	20.6	1.4
30	13.8	0.9

Short focus cameras on fixed mountings can thus be used to record the partial phases. Telescopes, as well as wide-angle cameras when photographing the outer corona during totality, must be equitorially mounted and clockdriven. The partial phase can be recorded with a fixed camera making an exposure every 3 minutes (the images seperated by approximately 1/40). During totality considerably greater seperation, or a series of singly exposed plates, is required to avoid overlapping of images of the outer corona. Fixed wide angle camera of short F and small focal ratio can be used to record the inner corona with exposure of 1 sec or less, but to

record the fainter outer regions the camera must be clock driven for exposures between 4 to 20 secs.

A variety of exposures is essential for showing the form of an object which, like the corona, has a considerable intensity gradient. The length of middle exposure of the series can be estimated roughly beforehand by photographing terrestial objects under illumination, e.g. low Sun or overcast sky. Some long exposures, of the order of 2m at f/15, should be included to make sure of outer regions. Hence a battery of cameras- each with its own operators if mounted seperately - is desirable. If commercial shutters are not used, it is quicker to vary the effective exposures by means of aperture stops than by shutter speeds. In any case, the programme must be thoroughly and repeatedly rehearsed, until each action becomes part of an automatic drill.

Some short exposures should be included to show the prominences which disappear in the glare of the corona when the exposure is long enough to record the latter adequately. The longest focus cameras should be used for short exposures with amplifying lenses to reveal te inner coronal structure and the prominences in greater detail.

The coronal spectrum can be photographed with the aid of a transmission grating immediately in front of the objective with the engraved face towards the camera and the rulings vertical. The direct image and the first order spectrum are then recorded on a single plate.

3.4 Warning

It is worthwhile to stress about the dangers of looking at the Sun directly or worse, through optical aids. Use of appropriate filters do not necessarily cut out the harmful wavelengths. This is especially true of chemically coated filters which tend to erode/corrode leaving behind small openings in the coating which allow harmful rays to get through unchecked. It is hence important to personally ensure the quality of filters being used. Other precautions include use of projection methods which do not involve viewing the Sun directly. During totality, of course, viewing the apparition is not dangerous.

4. POSSIBLE SCIENTIFIC PROJECTS

To give an idea of the possible scientific experiments that can be undertaken during a total solar eclipse, we describe very briefly the experiments that had been conducted in India during the Total Solar Eclipse of Feb 16, 1980.

4.1 Astronomy Experiments

As the disc of the moon advances over that of the sun, proceeding occultations of solar photospheric features can be studied, which can reveal the structures of sunspots, and other active regions. The variation of magnetic field, emissions of ultra-violet and x-ray radiation, strengths of several spectral lines can be mapped. In particular, chromospheric and coronal activities can be discerned with reasonable confidence only during the totality. The size estimations of the sun at various wavelengths are usually conducted during the totality. A good polarimeter is extremely useful for coronal studies. The eclipse of 1980 occurred during the peak of solar

activity, which has a cycle of eleven years. The forthcoming totality will be during one of the solar minima. The expected size of the corona will be smaller and it is extremely useful to measure the temperature and density gradients in the corona and isolate the bolometric contributions of corona from the rest of the sun.

During the previous totality of 1980, photographs of polarised corona was obtained with $f/10$ quadruple lens polarigraph in order to determine the polarisation of the coronal light, and high resolution photographs were taken using a long focus camera by a team of scientists from Indian Institute of Astrophysics, Bangalore (IIA). Using a multislit spectrograph at 530.3 nm Fe XIV emission lines from corona was taken for measuring the velocity distribution of the coronal streamers by scientists at Vedhsala Udaipur Solar Observatory (VUSO). At a different wavelength of 637.4 nm for Fe X emission, multislit spectrograph was taken with dispersion measure of 0.25 nm/mm. The measure of line broadening carries the information on the radial velocity of the streamers (IIA).The polarigraph used by Osmania University (OU) consisted of two lenses of focal lengths 1.50 m and 1.30 m, placed side by side in a wooden box with two filters (transmitting around 420 nm and 700 nm) placed in front of the two lenses. Corona was photographed at 530.3 nm at 1 nm bandwidth and polarisation was studied on the line of totality at Gadag by scientists from Physical Research Laboratory, Ahmedabad (PRL), and using an indigenously developed spectral scanning polarimeter (Physics Department, Poona University). As the effect of 'seeing' would be considerable near the solar limb due to turbulence in the solar atmosphere, this effect was studied by photographic method (OU).

Possible existence of a solar ring was searched for using PbS detector coupled to a 6-inch $f/6$ Newtonian Coelostat by scientists from Indian Space Research Organisation, Bangalore (ISRO). Chromospheric flash spectrum at H and K lines and polarimetric studies of coronal lines were taken by Uttar Pradesh State Observatory at Nainital (UPSO). Radio observations using Ooty radio telescope (327 MHz) and another 13.5m dish (1630 MHz) were made of the solar features due to progressive lunar disc, occulting several sunspots, etc. (ORT). Solar microwave fluxes were measured at 2.8, 10, 19.3 and 22.2 GHz during totality at an interval of 5 seconds by a collaborative team of scientists from PRL, SAC, and OU.

4.2 Atmospheric and Ionospheric Experiments

The moving shadow of lunar umbra over the earth's atmosphere and ionosphere brings about certain spontaneous changes which cannot be studied during normal dusks, which last for hours compared to a minute in case of the forthcoming totality. The density and temperature fluctuations and formation of gravity waves in the atmosphere are usually studied during a totality. The total electron content in the shadow regions falls drastically. Also the vertical structure of electric field above the ground and some geomagnetic effects are noticeable.

During the previous totality of 1980, three Centaur rockets were launched from Thumba carrying identical payloads for the D-region of ionosphere to monitor solar Lyman-alpha flux variations in D-layer, changes in mesospheric ozone and oxygen contents (PRL). From the existing national network of ozone stations, the vertical distribution of ozone content, trace gases, atmospheric turbidity, variation of skylight intensity, etc. up to a height of 35 km from the ground was obtained by the India Meteorological Department, New Delhi (IMD), and Indian Institute of Tropical Meteorology, Pune (IITM). IITM also studied the effect of total solar eclipse on oceanic tides. Isolated efforts of measurements of ozone content were made by several university departments, such as University of Kerala. Using UV photometers, ultra-violet

fluxes were measured at 280 nm, 290 nm and 310 nm by scientists from National Physical Laboratory, New Delhi (NPL). Velocity and temperature sensors were employed to study the effect of progressing shadow on atmospheric temperature variations by National Institute of Oceanography, Goa (NIO), Cyclone Warning Centre, Vishakhapatnam (CWC). Electric field and charge measurements were done by teams from IITM, Andhra University, Madras University, Kerala University, Kashmir University, Osmania University and Roorkey University. Effect on line-of-sight microwave link and radio wave propagation at various frequencies were studied by NPL, Delhi University and Institute of Radio Physics and Electronics, Calcutta (IRPE). Many of these University departments measured the fluctuation of the total electron content in the ionosphere. Study of atmospheric gravity waves were conducted by Vikram Sarabhai Space Centre, Trivandrum, NPL, IRPE, National Geophysical Research Institute, Hyderabad (NGRI). Solar eclipse variation on short-period geomagnetic field was studied at Indian Institute of Geomagnetism, Bombay (IIG), and NGRI.

Intensity fluctuations due to shadow bands were photometrically studied by VUSO and PRL.

4.3 Life Science Experiments

As the level of sunlight drops quite drastically to mimic twilight conditions during the totality, the response of the animals, birds, etc. is markedly noticeable. Since the totality of 1980 was on a winter afternoon, the transitory dawn appeared after about eight hours of continuous daylight. In contrast, during the forthcoming eclipse in the forenoon (within about two to three hours of sunrise), the apprehension of a dusk condition is too far fetched, and therefore, the study of animal behaviour is fully warranted. Fortunately enough, the path of totality is going to pass through the Bharatpur sanctuary.

More than twenty life science departments of various universities and research organisations took part during the 1980 solar eclipse. Hundreds of monkeys, hanumans, langurs were under watch for possible behavioural changes associated with total solar eclipse. Studies included activity rhythms, biochemical changes, metabolic and physiological conditions, parents-offspring relations, and social behaviours (Rajasthan University, Jodhpur University, Osmania University). ECG and pulse rate measurements were conducted on rabbits and rats (Osmania University, for example), birds (Zoological Survey of India, Calcutta, for example, snakes and mammals (Banaras Hindu University), marine animals and zooplanktons (National Institute of Oceanography, Goa, Madras University, Tirupati University, etc.). Electrophysiological and neurochemical investigations were made on humans by some medical institutions.

At the amateur level, most experiments, e.g. variations in humidity, temperature, pressure, life science experiments and photographic studies have been conducted during the 1980 eclipse. Amatuer Astronomer's Association (Bombay) had conducted these experiments successfully at Karwar and Bombay.

Most of the research contributions were published by Indian National Science Academy (INSA) 1981.

Table 1. CENTRAL LINE DATA FOR TOTAL SOLAR ECLIPSE OF OCT 24, 1995

(Assumed ΔT = 62.9 sec.)

Time in IST h: m: s	Longitude ° ′ ″	Latitude ° ′ ″	Duration m: s	Sun's Alt ° ′ ″	Width (Km)	Mag.
08:22:36.5	51:06:06 E	+34:49:51	0:15.6	00:00:00	15.68	1.0044
08:23:36.0	59:37:49 E	+32:50:47	0:25.2	07:33:00	23.71	1.0066
08:24:36.0	62:58:04 E	+31:56:38	0:29.5	10:42:17	27.02	1.0076
08:25:36.0	65:26:27 E	+31:13:32	0:33.0	13:07:31	29.54	1.0083
08:26:36.0	67:28:10 E	+30:36:12	0:36.0	15:10:04	31.65	1.0089
08:27:36.0	69:12:56 E	+30:02:34	0:38.7	16:58:08	33.48	1.0094
08:28:36.0	70:45:41 E	+29:31:37	0:41.2	18:35:56	35.13	1.0099
08:29:36.0	72:09:24 E	+29:02:41	0:43.5	20:05:57	36.64	1.0104
08:30:36.0	73:25:58 E	+28:35:23	0:45.7	21:29:50	38.03	1.0108
08:31:36.0	74:36:45 E	+28:09:26	0:47.8	22:48:42	39.33	1.0111
08:32:36.0	75:42:41 E	+27:44:37	0:49.9	24:03:22	40.55	1.0115
08:33:36.0	76:44:30 E	+27:20:47	0:51.8	25:14:27	41.70	1.0118
08:34:36.0	77:42:47 E	+26:57:47	0:53.7	26:22:26	42.79	1.0121
08:35:36.0	78:37:58 E	+26:35:33	0:55.5	27:27:42	43.83	1.0124
08:36:36.0	79:30:26 E	+26:13:59	0:57.3	28:30:33	44.82	1.0127
08:37:36.0	80:20:27 E	+25:53:02	0:59.0	29:31:15	45.77	1.0130
08:38:36.0	81:08:18 E	+25:32:38	1:00.7	30:30:00	46.68	1.0133
08:39:36.0	81:54:11 E	+25:12:44	1:02.4	31:26:59	47.56	1.0135
08:40:36.0	82:38:17 E	+24:53:18	1:04.0	32:22:21	48.41	1.0138
08:41:36.0	83:20:45 E	+24:34:18	1:05.6	33:16:14	49.22	1.0140
08:42:36.0	84:01:43 E	+24:15:42	1:07.1	34:08:45	50.01	1.0142
08:43:36.0	84:41:19 E	+23:57:28	1:08.6	34:59:59	50.78	1.0145
08:44:36.0	85:19:38 E	+23:39:35	1:10.1	35:50:03	51.52	1.0147
08:45:36.0	85:56:46 E	+23:22:02	1:11.6	36:39:00	52.24	1.0149
08:46:36.0	86:32:49 E	+23:04:47	1:13.0	37:26:55	52.94	1.0151
08:47:36.0	87:07:50 E	+22:47:50	1:14.4	38:13:52	53.61	1.0153
08:48:36.0	87:41:55 E	+22:31:10	1:15.8	38:59:53	54.27	1.0155
08:49:36.0	88:15:05 E	+22:14:45	1:17.2	39:45:02	54.92	1.0156
08:50:36.0	88:47:25 E	+21:58:35	1:18.5	40:29:21	55.54	1.0158
08:51:36.0	89:18:57 E	+21:42:40	1:19.8	41:12:53	56.15	1.0160
08:52:36.0	89:49:45 E	+21:26:59	1:21.1	41:55:40	56.75	1.0162
08:53:36.0	90:19:51 E	+21:11:30	1:22.4	42:37:44	57.33	1.0163
08:54:36.0	90:49:17 E	+20:56:14	1:23.6	43:19:07	57.89	1.0165
08:55:36.0	91:18:05 E	+20:41:10	1:24.9	43:59:50	58.45	1.0166
08:56:36.0	91:46:17 E	+20:26:18	1:26.1	44:39:54	58.99	1.0168
08:57:36.0	92:13:56 E	+20:11:37	1:27.3	45:19:23	59.51	1.0170
08:58:36.0	92:41:02 E	+19:57:07	1:28.5	45:58:15	60.03	1.0171
08:59:36.0	93:07:38 E	+19:42:47	1:29.7	46:36:33	60.53	1.0172
09:00:36.0	93:33:45 E	+19:28:37	1:30.8	47:14:18	61.03	1.0174

DATA FOR TSE-95 (continued)

Time in IST h: m: s	Longitude ° ′ ″	Latitude ° ′ ″	Duration m: s	Sun's Alt ° ′ ″	Width (Km)	Mag.
09:01:36.0	93:59:23 E	+19:14:37	1:31.9	47:51:30	61.51	1.0175
09:02:36.0	94:24:36 E	+19:00:46	1:33.0	48:28:11	61.98	1.0176
09:03:36.0	94:49:23 E	+18:47:05	1:34.1	49:04:21	62.45	1.0178
09:04:36.0	95:13:46 E	+18:33:32	1:35.2	49:40:01	62.90	1.0179
09:05:36.0	95:37:46 E	+18:20:08	1:36.3	50:15:12	63.34	1.0180
09:06:36.0	96:01:24 E	+18:06:53	1:37.3	50:49:54	63.78	1.0181
09:07:36.0	96:24:41 E	+17:53:45	1:38.4	51:24:07	64.20	1.0183
09:08:36.0	96:47:38 E	+17:40:46	1:39.4	51:57:52	64.62	1.0184
09:09:36.0	97:10:15 E	+17:27:54	1:40.4	52:31:10	65.03	1.0185
09:10:36.0	97:32:34 E	+17:15:10	1:41.4	53:04:01	65.43	1.0186
09:11:36.0	97:54:36 E	+17:02:34	1:42.3	53:36:25	65.82	1.0187
09:12:36.0	98:16:20 E	+16:50:04	1:43.3	54:08:22	66.21	1.0188
09:13:36.0	98:37:48 E	+16:37:42	1:44.2	54:39:53	66.58	1.0189
09:14:36.0	98:59:01 E	+16:25:26	1:45.1	55:10:57	66.95	1.0190
09:15:36.0	99:19:58 E	+16:13:18	1:46.0	55:41:35	67.32	1.0191
09:16:36.0	99:40:42 E	+16:01:16	1:46.9	56:11:47	67.67	1.0192
09:17:36.0	100:01:11 E	+15:49:20	1:47.8	56:41:33	68.02	1.0193
09:18:36.0	100:21:28 E	+15:37:31	1:48.6	57:10:52	68.36	1.0194
09:19:36.0	100:41:31 E	+15:25:48	1:49.4	57:39:46	68.69	1.0194
09:20:36.0	101:01:23 E	+15:14:11	1:50.3	58:08:12	69.02	1.0195
09:21:36.0	101:21:03 E	+15:02:40	1:51.1	58:36:12	69.34	1.0196
09:22:36.0	101:40:31 E	+14:51:15	1:51.9	59:03:46	69.66	1.0197
09:23:36.0	101:59:49 E	+14:39:56	1:52.6	59:30:52	69.97	1.0198
09:24:36.0	102:18:57 E	+14:28:43	1:53.4	59:57:31	70.27	1.0198
09:25:36.0	102:37:55 E	+14:17:35	1:54.1	60:23:42	70.56	1.0199
09:26:36.0	102:56:44 E	+14:06:33	1:54.8	60:49:25	70.85	1.0200
09:27:36.0	103:15:23 E	+13:55:36	1:55.5	61:14:39	71.14	1.0201
09:28:36.0	103:33:54 E	+13:44:45	1:56.2	61:39:24	71.42	1.0201
09:29:36.0	103:52:16 E	+13:33:59	1:56.9	62:03:40	71.69	1.0202
09:30:36.0	104:10:31 E	+13:23:19	1:57.5	62:27:26	71.95	1.0202
09:31:36.0	104:28:38 E	+13:12:43	1:58.2	62:50:41	72.21	1.0203
09:32:36.0	104:46:38 E	+13:02:13	1:58.8	63:13:25	72.47	1.0204
09:33:36.0	105:04:31 E	+12:51:47	1:59.4	63:35:37	72.72	1.0204
09:34:36.0	105:22:17 E	+12:41:27	1:60.0	63:57:16	72.96	1.0205
09:35:36.0	105:39:57 E	+12:31:11	2:00.6	64:18:21	73.20	1.0205
09:36:36.0	105:57:31 E	+12:21:01	2:01.1	64:38:53	73.43	1.0206
09:37:36.0	106:15:00 E	+12:10:55	2:01.7	64:58:49	73.66	1.0206
09:38:36.0	106:32:23 E	+12:00:54	2:02.2	65:18:09	73.88	1.0207
09:39:36.0	106:49:41 E	+11:50:58	2:02.7	65:36:53	74.09	1.0207
09:40:36.0	107:06:54 E	+11:41:06	2:03.2	65:54:58	74.30	1.0208

DATA FOR TSE-95 (continued)

Time in IST h: m: s	Longitude ° ′ ″	Latitude ° ′ ″	Duration m: s	Sun's Alt ° ′ ″	Width (Km)	Mag.
09:41:36.0	107:24:02 E	+11:31:19	2:03.6	66:12:25	74.51	1.0208
09:42:36.0	107:41:07 E	+11:21:37	2:04.1	66:29:13	74.71	1.0209
09:43:36.0	107:58:07 E	+11:11:59	2:04.5	66:45:19	74.90	1.0209
09:44:36.0	108:15:03 E	+11:02:26	2:04.9	67:00:44	75.09	1.0209
09:45:36.0	108:31:56 E	+10:52:57	2:05.3	67:15:26	75.27	1.0210
09:46:36.0	108:48:46 E	+10:43:32	2:05.7	67:29:25	75.45	1.0210
09:47:36.0	109:05:33 E	+10:34:12	2:06.1	67:42:39	75.62	1.0210
09:48:36.0	109:22:16 E	+10:24:57	2:06.4	67:55:07	75.78	1.0211
09:49:36.0	109:38:58 E	+10:15:46	2:06.7	68:06:48	75.94	1.0211
09:50:36.0	109:55:37 E	+10:06:39	2:07.0	68:17:41	76.10	1.0211
09:51:36.0	110:12:13 E	+09:57:36	2:07.3	68:27:46	76.25	1.0211
09:52:36.0	110:28:48 E	+09:48:38	2:07.6	68:37:02	76.39	1.0212
09:53:36.0	110:45:22 E	+09:39:44	2:07.9	68:45:27	76.53	1.0212
09:54:36.0	111:01:53 E	+09:30:54	2:08.1	68:53:01	76.66	1.0212
09:55:36.0	111:18:24 E	+09:22:08	2:08.3	68:59:43	76.78	1.0212
09:56:36.0	111:34:53 E	+09:13:27	2:08.5	69:05:32	76.90	1.0213
09:57:36.0	111:51:22 E	+09:04:50	2:08.7	69:10:28	77.02	1.0213
09:58:36.0	112:07:50 E	+08:56:17	2:08.8	69:14:31	77.12	1.0213
09:59:36.0	112:24:18 E	+08:47:48	2:09.0	69:17:39	77.23	1.0213
10:00:36.0	112:40:46 E	+08:39:23	2:09.1	69:19:53	77.32	1.0213
10:01:36.0	112:57:13 E	+08:31:03	2:09.2	69:21:12	77.41	1.0213
10:02:36.0	113:13:41 E	+08:22:47	2:09.3	69:21:37	77.50	1.0213
10:03:36.0	113:30:09 E	+08:14:34	2:09.4	69:21:06	77.58	1.0213
10:04:36.0	113:46:38 E	+08:06:26	2:09.4	69:19:41	77.65	1.0213
10:05:36.0	114:03:08 E	+07:58:22	2:09.4	69:17:21	77.71	1.0213
10:06:36.0	114:19:39 E	+07:50:22	2:09.5	69:14:06	77.77	1.0213
10:07:36.0	114:36:11 E	+07:42:26	2:09.4	69:09:58	77.82	1.0213
10:08:36.0	114:52:45 E	+07:34:35	2:09.4	69:04:56	77.87	1.0213
10:09:36.0	115:09:20 E	+07:26:47	2:09.4	68:59:00	77.91	1.0213
10:10:36.0	115:25:57 E	+07:19:03	2:09.3	68:52:12	77.94	1.0213
10:11:36.0	115:42:37 E	+07:11:24	2:09.2	68:44:33	77.97	1.0213
10:12:36.0	115:59:18 E	+07:03:49	2:09.1	68:36:02	77.99	1.0213
10:13:36.0	116:16:03 E	+06:56:18	2:09.0	68:26:41	78.00	1.0213
10:14:36.0	116:32:50 E	+06:48:51	2:08.8	68:16:30	78.00	1.0213
10:15:36.0	116:49:39 E	+06:41:28	2:08.7	68:05:31	78.00	1.0213
10:16:36.0	117:06:33 E	+06:34:09	2:08.5	67:53:45	77.99	1.0212
10:17:36.0	117:23:29 E	+06:26:55	2:08.3	67:41:12	77.98	1.0212
10:18:36.0	117:40:29 E	+06:19:44	2:08.1	67:27:53	77.95	1.0212
10:19:36.0	117:57:33 E	+06:12:38	2:07.8	67:13:49	77.92	1.0212
10:20:36.0	118:14:41 E	+06:05:36	2:07.6	66:59:02	77.88	1.0212

DATA FOR TSE-95 (continued)

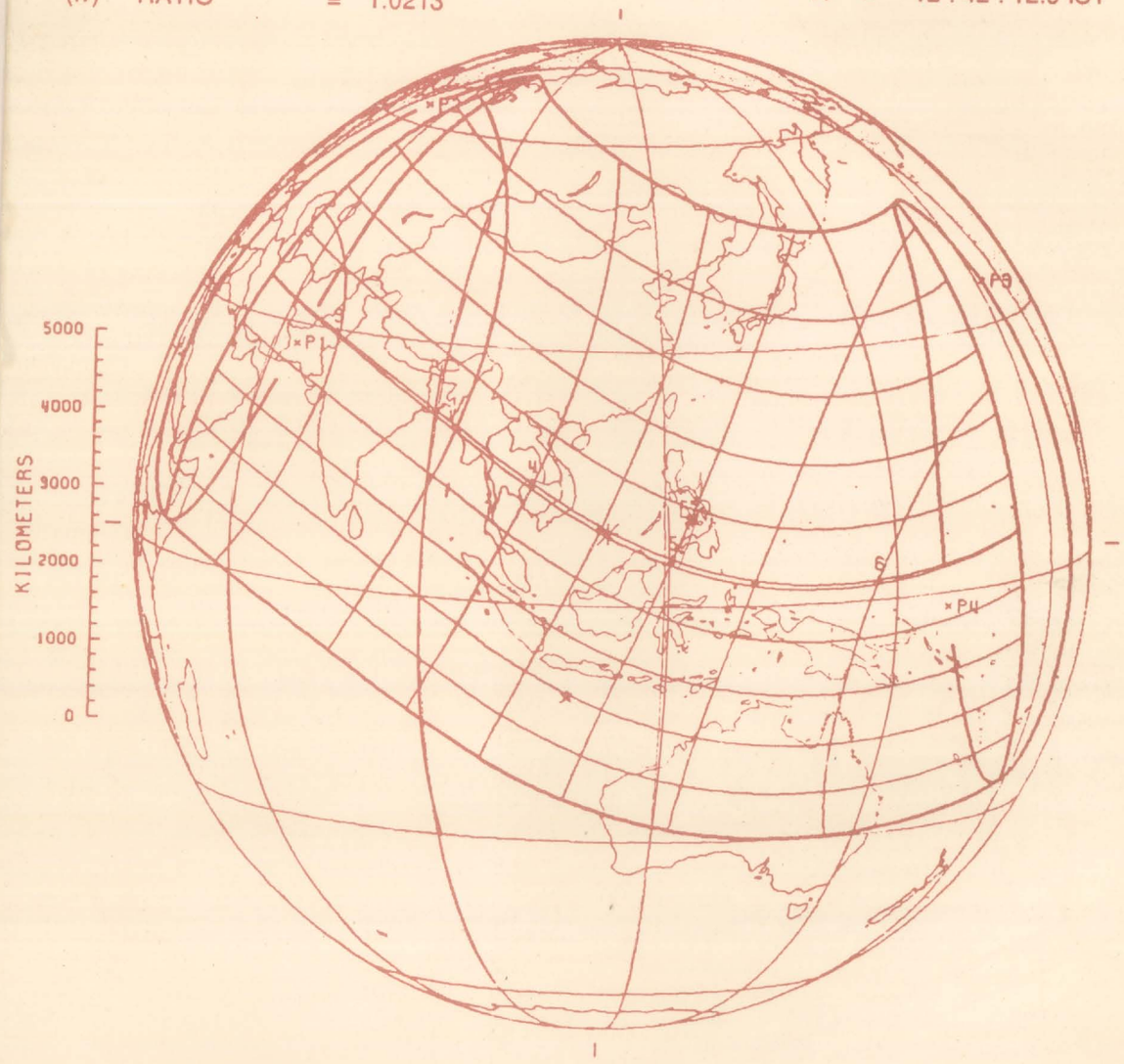
Time in IST h: m: s	Longitude ° ′ ″	Latitude ° ′ ″	Duration m: s	Sun's Alt ° ′ ″	Width (Km)	Mag.
10:21:36.0	118:31:53 E	+05:58:38	2:07.3	66:43:32	77.84	1.0211
10:22:36.0	118:49:10 E	+05:51:45	2:07.0	66:27:21	77.78	1.0211
10:23:36.0	119:06:31 E	+05:44:56	2:06.7	66:10:29	77.72	1.0211
10:24:36.0	119:23:58 E	+05:38:11	2:06.3	65:52:57	77.65	1.0211
10:25:36.0	119:41:30 E	+05:31:30	2:06.0	65:34:47	77.57	1.0210
10:26:36.0	119:59:07 E	+05:24:54	2:05.6	65:15:59	77.49	1.0210
10:27:36.0	120:16:50 E	+05:18:22	2:05.2	64:56:35	77.39	1.0210
10:28:36.0	120:34:39 E	+05:11:55	2:04.8	64:36:34	77.29	1.0209
10:29:36.0	120:52:35 E	+05:05:32	2:04.4	64:15:59	77.18	1.0209
10:30:36.0	121:10:36 E	+04:59:13	2:03.9	63:54:49	77.06	1.0208
10:31:36.0	121:28:45 E	+04:52:59	2:03.4	63:33:06	76.93	1.0208
10:32:36.0	121:47:01 E	+04:46:49	2:02.9	63:10:50	76.80	1.0208
10:33:36.0	122:05:24 E	+04:40:44	2:02.4	62:48:03	76.65	1.0207
10:34:36.0	122:23:55 E	+04:34:44	2:01.9	62:24:44	76.50	1.0207
10:35:36.0	122:42:34 E	+04:28:49	2:01.3	62:00:54	76.34	1.0206
10:36:36.0	123:01:21 E	+04:22:58	2:00.8	61:36:35	76.17	1.0206
10:37:36.0	123:20:17 E	+04:17:12	2:00.2	61:11:46	75.99	1.0205
10:38:36.0	123:39:22 E	+04:11:30	1:59.6	60:46:28	75.79	1.0204
10:39:36.0	123:58:36 E	+04:05:54	1:58.9	60:20:41	75.60	1.0204
10:40:36.0	124:18:00 E	+04:00:22	1:58.3	59:54:27	75.39	1.0203
10:41:36.0	124:37:34 E	+03:54:56	1:57.6	59:27:44	75.17	1.0203
10:42:36.0	124:57:18 E	+03:49:35	1:56.9	59:00:34	74.94	1.0202
10:43:36.0	125:17:13 E	+03:44:18	1:56.2	58:32:58	74.70	1.0201
10:44:36.0	125:37:19 E	+03:39:07	1:55.5	58:04:54	74.45	1.0201
10:45:36.0	125:57:37 E	+03:34:02	1:54.8	57:36:24	74.19	1.0200
10:46:36.0	126:18:07 E	+03:29:01	1:54.0	57:07:27	73.93	1.0199
10:47:36.0	126:38:49 E	+03:24:07	1:53.2	56:38:04	73.65	1.0198
10:48:36.0	126:59:45 E	+03:19:17	1:52.4	56:08:14	73.36	1.0198
10:49:36.0	127:20:54 E	+03:14:34	1:51.6	55:37:59	73.06	1.0197
10:50:36.0	127:42:16 E	+03:09:56	1:50.7	55:07:17	72.75	1.0196
10:51:36.0	128:03:54 E	+03:05:24	1:49.9	54:36:08	72.43	1.0195
10:52:36.0	128:25:46 E	+03:00:57	1:49.0	54:04:34	72.09	1.0194
10:53:36.0	128:47:54 E	+02:56:37	1:48.1	53:32:33	71.75	1.0193
10:54:36.0	129:10:19 E	+02:52:23	1:47.2	53:00:05	71.39	1.0192
10:55:36.0	129:33:00 E	+02:48:16	1:46.2	52:27:10	71.03	1.0192
10:56:36.0	129:55:59 E	+02:44:15	1:45.3	51:53:48	70.65	1.0191
10:57:36.0	130:19:16 E	+02:40:20	1:44.3	51:19:58	70.26	1.0190
10:58:36.0	130:42:52 E	+02:36:33	1:43.3	50:45:41	69.86	1.0189
10:59:36.0	131:06:48 E	+02:32:52	1:42.3	50:10:54	69.44	1.0187
11:00:36.0	131:31:05 E	+02:29:18	1:41.3	49:35:39	69.02	1.0186

7.1 Map for Area of Visibility

Total Solar Eclipse Oct 24, 1995

(i) J.D. = 2450014.690
(ii) SAROS = 143 (23 / 73)
(iii) GREATEST = 10 : 06 : 36 IST
(iv) RATIO = 1.0213

CONTACTS
I = 07 : 21 : 59.5 IST
II = 08 : 22 : 36.5 IST
III = 11 : 42 : 25.4 IST
IV = 12 : 42 : 12.9 IST



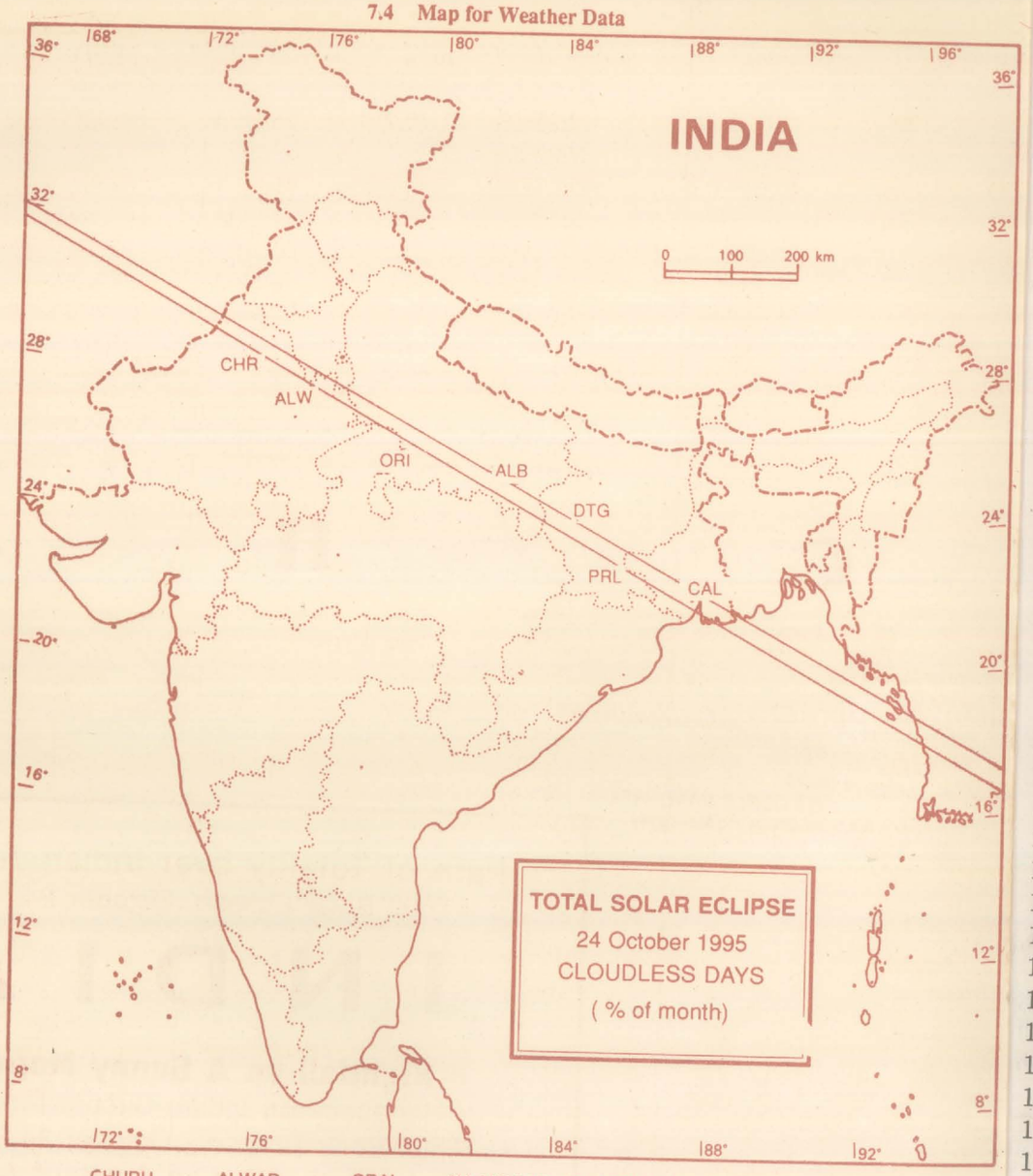
GREATEST ECLIPSE

LAT = 7°50.22' N
LONG = 114° 19.39 E

DURATION = 2 : 9.6
WIDTH = 77.8 Km

SUN ALT = 69°.14
ΔT = 62.9 Sec.

7.4 Map for Weather Data



DATA FOR TSE-95 (continued)

Time in IST h: m: s	Longitude ° ′ ″	Latitude ° ′ ″	Duration m: s	Sun's Alt ° ′ ″	Width (Km)	Mag.
11:01:36.0	131:55:43 E	+02:25:52	1:40.2	48:59:54	68.58	1.0185
11:02:36.0	132:20:44 E	+02:22:33	1:39.1	48:23:40	68.12	1.0184
11:03:36.0	132:46:08 E	+02:19:22	1:38.0	47:46:54	67.66	1.0183
11:04:36.0	133:11:56 E	+02:16:19	1:36.9	47:09:36	67.18	1.0182
11:05:36.0	133:38:10 E	+02:13:24	1:35.8	46:31:46	66.69	1.0180
11:06:36.0	134:04:51 E	+02:10:37	1:34.6	45:53:22	66.18	1.0179
11:07:36.0	134:32:00 E	+02:07:59	1:33.4	45:14:24	65.66	1.0178
11:08:36.0	134:59:38 E	+02:05:30	1:32.2	44:34:49	65.12	1.0176
11:09:36.0	135:27:48 E	+02:03:11	1:31.0	43:54:38	64.57	1.0175
11:10:36.0	135:56:29 E	+02:01:01	1:29.8	43:13:49	64.00	1.0174
11:11:36.0	136:25:45 E	+01:59:01	1:28.5	42:32:19	63.42	1.0172
11:12:36.0	136:55:36 E	+01:57:11	1:27.2	41:50:08	62.82	1.0171
11:13:36.0	137:26:06 E	+01:55:32	1:25.9	41:07:13	62.20	1.0169
11:14:36.0	137:57:15 E	+01:54:05	1:24.6	40:23:33	61.57	1.0167
11:15:36.0	138:29:07 E	+01:52:49	1:23.2	39:39:06	60.92	1.0166
11:16:36.0	139:01:44 E	+01:51:46	1:21.8	38:53:48	60.24	1.0164
11:17:36.0	139:35:08 E	+01:50:56	1:20.4	38:07:37	59.55	1.0162
11:18:36.0	140:09:24 E	+01:50:19	1:19.0	37:20:30	58.84	1.0160
11:19:36.0	140:44:34 E	+01:49:57	1:17.5	36:32:25	58.10	1.0158
11:20:36.0	141:20:41 E	+01:49:50	1:16.0	35:43:16	57.34	1.0157
11:21:36.0	141:57:52 E	+01:49:59	1:14.5	34:53:00	56.56	1.0155
11:22:36.0	142:36:09 E	+01:50:26	1:12.9	34:01:32	55.75	1.0152
11:23:36.0	143:15:38 E	+01:51:11	1:11.4	33:08:47	54.91	1.0150
11:24:36.0	143:56:27 E	+01:52:15	1:09.7	32:14:38	54.05	1.0148
11:25:36.0	144:38:40 E	+01:53:41	1:08.1	31:18:59	53.15	1.0146
11:26:36.0	145:22:27 E	+01:55:29	1:06.4	30:21:42	52.22	1.0143
11:27:36.0	146:07:57 E	+01:57:42	1:04.7	29:22:37	51.25	1.0141
11:28:36.0	146:55:21 E	+02:00:23	1:02.9	28:21:33	50.24	1.0138
11:29:36.0	147:44:51 E	+02:03:34	1:01.0	27:18:17	49.19	1.0135
11:30:36.0	148:36:43 E	+02:07:18	0:59.2	26:12:33	48.09	1.0132
11:31:36.0	149:31:17 E	+02:11:39	0:57.2	25:04:03	46.93	1.0129
11:32:36.0	150:28:54 E	+02:16:43	0:55.2	23:52:22	45.71	1.0126
11:33:36.0	151:30:05 E	+02:22:35	0:53.1	22:37:00	44.42	1.0123
11:34:36.0	152:35:29 E	+02:29:24	0:50.9	21:17:19	43.05	1.0119
11:35:36.0	153:45:55 E	+02:37:21	0:48.6	19:52:26	41.58	1.0115
11:36:36.0	155:02:34 E	+02:46:40	0:46.2	18:21:11	39.98	1.0111
11:37:36.0	156:27:10 E	+02:57:43	0:43.6	16:41:48	38.23	1.0106
11:38:36.0	158:02:20 E	+03:11:03	0:40.7	14:51:36	36.29	1.0101
11:39:36.0	159:52:40 E	+03:27:38	0:37.6	12:45:54	34.05	1.0094
11:40:36.0	162:07:26 E	+03:49:24	0:33.9	10:15:18	31.35	1.0087
11:41:36.0	165:12:31 E	+04:21:44	0:29.2	06:53:26	27.72	1.0077
11:42:25.4	171:48:00 E	+05:38:46	0:20.2	00:00:00	20.23	1.0056

6. THE LOCAL CIRCUMSTANCES DATA

LIST OF CITIES

No.	City	Phase	Page No.	No.	City	Phase	Page No.
1	Agartala	P	17	25	Garhwa	T	23
2	Allahabad	P	17	26	Haldia	T	27
3	Alwar	T	20	27	Hamirpur	T	22
4	Amta	T	26	28	Hyderabad	P	18
5	Bangalore	P	17	29	Jaipur	P	18
6	Balichak	T	25	30	Jalaun	T	22
7	Barakhana	T	23	31	Kulpi	T	27
8	Baruipur	T	27	32	Madras	P	18
9	Basanti	T	27	33	Mathura	P	19
10	Bharatpur	T	21	34	Medinipur	T	24
11	Bhind	T	21	35	Nagpur	P	19
12	Bhubaneshwar	P	17	36	Nawalgarh	T	20
13	Bombay	P	17	37	Panskura	T	25
14	Budge Budge	T	26	38	Portblair	P	19
15	Chandrakona	T	24	39	Pune	P	19
16	Calcutta	P	18	40	Puruliya	T	24
17	Churk	T	22	41	Rajakhera	T	21
18	Daltenganj	T	23	42	Ranchi	T	23
19	Delhi	P	18	43	Ratangarh	T	20
20	Diamond Harbour	T	26	44	Robertsganj	T	22
21	Falta	T	26	45	Tamluk	T	25
22	Fatehpur	T	20	46	Uluberia	T	25
23	Fatehpur Sikkri	T	21	47	Varansi	P	19
24	Ghatal	T	24				

Note : Height of each place is in metres above mean sea level. ' — ' indicates data are not available.

Should you require the local circumstances for a specific place/city/town not covered in this booklet; he/she is to send the longitude, latitude and height (above mean sea level) of that place (with Self Addressed Stamped Envelope) to **Mr. Nilesh Vayada or Mr. Samir Gandhi at 4 A, Prem Kanku, Navroji Lane, Ghatkopar (W), Bombay 400 086.**

NOTES

Table 2. LOCAL CIRCUMSTANCES FOR THE MAJOR CITIES DURING TOTAL SOLAR ECLIPSE OF OCT 24, 1995

(Assumed ΔT = 62.9 sec.)

AGARTALA: Lat. = 23°.82 N, Long. = 91°.28 E; Max. Mag. = .92259

Phase		Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins :	07:35:01.6	+26:51:52.7	290:44:41.6	346:18:47.1
Maximum Eclipse	:	08:53:57.5	+41:35:42.2	026:27:57.4	069:21:17.5
Partial Eclipse	Ends :	10:23:18.4	+52:52:20.7	121:36:02.6	139:07:51.1

BANGALORE: Lat. = 12°.97 N, Long. = 77°.58 E; Max. Mag. = .59620

Phase		Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins :	07:32:58.2	+18:27:23.1	318:29:27.0	030:27:27.2
Maximum Eclipse	:	08:39:07.7	+33:35:00.9	025:41:35.2	091:26:48.0
Partial Eclipse	Ends :	09:54:37.2	+49:36:30.1	092:38:46.8	146:11:45.4

ALLAHABAD: Lat. = 25°.47 N, Long. = 81°.90 E; Max. Mag. = .99956

Phase		Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins :	07:27:02.0	+16:47:37.9	293:39:59.5	325:20:00.5
Maximum Eclipse	:	08:39:33.0	+31:17:54.5	025:09:41.5	075:31:27.4
Partial Eclipse	Ends :	10:02:05.5	+45:02:43.9	116:23:30.3	150:40:03.7

BHUBANESHWAR: Lat. = 20°.25 N, Long. = 85°.83 E; Max. Mag. = .91822

Phase		Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins :	07:30:46.3	+22:55:53.3	300:16:37.3	002:14:48.4
Maximum Eclipse	:	08:46:43.1	+38:35:11.5	026:18:09.9	078:20:34.6
Partial Eclipse	Ends :	10:13:37.9	+52:55:21.7	111:53:20.3	142:53:46.6

BOMBAY: Lat. = 18°.97 N, Long. = 72°.83 E; Max. Mag. = .71531

Phase		Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins :	07:25:42.4	+10:41:07.0	309:55:12.6	017:49:42.5
Maximum Eclipse	:	08:30:59.5	+25:12:39.4	024:22:19.2	086:47:51.2
Partial Eclipse	Ends :	09:45:17.5	+40:35:00.4	098:41:43.7	150:56:46.1

CALCUTTA: Lat. = 22°.58 N, Long. = 88°.38 E; Max. Mag. = .99661

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:12.3	+24:27:14.6	294:42:03.5	353:08:21.6
Maximum Eclipse		:	08:49:39.8	+39:38:49.2	026:20:08.7	073:36:29.0
Partial Eclipse	Ends	:	10:17:52.7	+52:31:33.1	117:28:11.0	141:44:54.9

DELHI: Lat. = 28°.65 N, Long. = 77°.22 E; Max. Mag. = .96315

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:24:56.4	+11:19:28.7	290:39:02.6	347:58:16.0
Maximum Eclipse		:	08:34:06.6	+25:02:57.8	024:08:49.4	074:40:25.2
Partial Eclipse	Ends	:	09:52:22.5	+38:30:45.7	117:29:56.9	155:27:43.1

HYDERABAD: Lat. = 17°.43 N, Long. = 78°.45 E; Max. Mag. = .73833

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:28:25.9	+16:51:09.1	309:40:22.5	017:15:23.8
Maximum Eclipse		:	08:37:46.0	+32:09:18.6	025:27:56.8	086:08:38.1
Partial Eclipse	Ends	:	09:57:08.5	+47:56:16.3	101:01:06.6	147:54:26.1

JAIPUR: Lat. = 26°.92 N, Long. = 75°.82 E; Max. Mag. = .98308

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:24:01.4	+10:32:28.0	294:18:38.9	353:47:02:1
Maximum Eclipse		:	08:32:40.7	+24:33:03.4	024:07:43.9	077:09:41.8
Partial Eclipse	Ends	:	09:50:32.7	+38:35:11.5	113:48:58.1	154:49:55.6

MADRAS: Lat. = 13°.07 N, Long. = 80°.25 E; Max. Mag. = .63470

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:33:43.6	+21:04:45.7	316:35:33.7	027:34:01.2
Maximum Eclipse		:	08:42:41.4	+36:41:45.1	026:09:03.8	090:02:09.7
Partial Eclipse	Ends	:	10:01:35.8	+52:55:22.7	095:23:38.3	144:33:53.4

MATHURA: Lat. = 27°.50 N, Long. = 77°.68 E; Max. Mag. = .99095

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:24:54.7	+12:05:55.9	292:23:37.2	350:40:33.9
Maximum Eclipse		:	08:34:33.4	+26:04:19.4	024:20:19.3	075:40:39.4
Partial Eclipse	Ends	:	09:53:31.9	+39:48:24.3	116:07:27.7	154:28:43.2

NAGPUR: Lat. = 21°.15 N, Long. = 79°.08 E; Max. Mag. = .85474

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:26:22.0	+15:45:22.6	302:41:12.4	006:34:07.1
Maximum Eclipse		:	08:37:06.6	+30:49:31.6	025:12:51.7	081:47:20.8
Partial Eclipse	Ends	:	09:58:00.8	+45:58:14.9	107:30:42.7	149:37:51.8

PORTBLAIR: Lat. = 11°.67 N, Long. = 92°.77 E; Max. Mag. = .78076

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:43:58.3	+35:21:13.7	310:08:00.2	016:41:04.3
Maximum Eclipse		:	09:05:45.7	+52:42:54.4	027:58:19.0	080:25:33.9
Partial Eclipse	Ends	:	10:38:34.3	+65:57:30.6	104:55:54.5	119:53:10.9

PUNE: Lat. = 18°.52 N, Long. = 73°.88 E; Max. Mag. = .71415

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:26:14.5	+11:53:15.2	310:12:29.9	018:13:59.4
Maximum Eclipse		:	08:32:10.0	+26:33:26.5	024:35:26.9	086:54:33.4
Partial Eclipse	Ends	:	09:47:17.6	+42:02:25.2	098:49:38.3	150:25:51.9

VARANASI: Lat. = 25°.32 N, Long. = 83°.02 E; Max. Mag. = .99002

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:27:45.6	+17:56:09.0	293:17:56.7	351:38:37.3
Maximum Eclipse		:	08:41:00.3	+32:29:34.1	025:19:50.1	074:57:47.3
Partial Eclipse	Ends	:	10:04:22.5	+46:04:37.7	117:04:01.6	149:43:32.3

Table 3. LOCAL CIRCUMSTANCES FOR PLACES ON THE PATH OF TOTALITY

RATANGARH: Lat. = 28°.08 N, Long. = 74°.65 E, Height = — m
Duration of Totality: 0m 46s Magnitude: 1.00384

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:23:44.9	+09:07:49.4	292:50:45.5	351:33:06.2
Total Eclipse	Begins	:	08:31:15.0	+22:48:27.6	312:03:08.9	004:39:53.6
Maximum Eclipse		:	08:31:37.7	+22:52:53.1	023:50:17.5	076:24:28.2
Total Eclipse	Ends	:	08:32:00.6	+22:57:19.7	095:41:36.2	148:13:11.5
Partial Eclipse	Ends	:	09:48:25.8	+36:41:33.8	114:43:23.8	155:58:25.5

FATEHPUR: Lat. = 28°.00 N, Long. = 75°.03 E, Height = 114 m
Duration of Totality: 0m 49s Magnitude: 1.00563

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:23:52.5	+09:30:14.9	292:48:41.1	351:28:46.5
Total Eclipse	Begins	:	08:31:34.2	+23:12:27.1	293:58:44.3	346:27:39.9
Maximum Eclipse		:	08:31:58.5	+23:17:09.9	023:54:09.6	076:20:18.6
Total Eclipse	Ends	:	08:32:22.9	+23:21:53.8	113:49:36.1	166:12:57.4
Partial Eclipse	Ends	:	09:49:03.0	+37:05:46.5	114:52:50.7	155:48:02.7

NAWALGARH: Lat. = 27°.85 N, Long. = 75°.30 E, Height = — m
Duration of Totality: 0m 48s Magnitude: 1.00425

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:23:57.1	+09:47:28.0	292:56:42.5	351:40:32.4
Total Eclipse	Begins	:	08:31:49.2	+23:32:04.3	308:40:07.4	001:08:37.5
Maximum Eclipse		:	08:32:12.9	+23:36:40.8	023:57:24.9	076:23:10.8
Total Eclipse	Ends	:	08:32:36.8	+23:41:18.4	099:18:05.4	151:41:05.8
Partial Eclipse	Ends	:	09:49:30.4	+37:26:36.1	114:51:02.8	155:36:58.8

ALWAR: Lat. = 27°.50 N, Long. = 76°.58 E, Height = 271 m
Duration of Totality: 0m 46s Magnitude: 1.00322

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:24:24.7	+11:04:33.8	292:56:02.3	351:35:24.2
Total Eclipse	Begins	:	08:33:03.4	+24:56:16.3	087:12:51.3	139:16:34.4
Maximum Eclipse		:	08:33:26.3	+25:00:41.7	024:10:49.6	076:11:47.3
Total Eclipse	Ends	:	08:33:49.3	+25:05:08.1	141:02:47.7	193:00:58.6
Partial Eclipse	Ends	:	09:51:40.8	+38:50:36.6	115:17:12.1	154:55:46.7

BHARATPUR: Lat. = 27°.22 N, Long. = 77°.50 E, Height = 176 m
Duration of Totality: 0m 32s Magnitude: 1.00117

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:24:46.9	+12:00:55.3	292:58:18.0	351:35:35.6
Total Eclipse	Begins	:	08:34:06.5	+25:59:16.4	060:34:19.2	112:19:50.2
Maximum Eclipse		:	08:34:22.2	+26:02:17.6	024:20:35.1	076:04:09.0
Total Eclipse	Ends	:	08:34:38.0	+26:05:19.9	167:56:12.0	219:37:47.8
Partial Eclipse	Ends	:	09:53:18.6	+39:52:00.0	115:33:24.0	154:21:54.5

FATEHPUR SIKRI: Lat. = 27°.10 N, Long. = 77°.67 E, Height = 180 m
Duration of Totality: 0m 44s Magnitude: 1.00265

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:24:50.6	+12:12:26.8	293:05:21.7	351:46:00.4
Total Eclipse	Begins	:	08:34:10.6	+26:11:16.5	080:05:03.6	131:51:50.1
Maximum Eclipse		:	08:34:32.7	+26:15:31.4	024:22:46.9	076:06:47.8
Total Eclipse	Ends	:	08:34:54.9	+26:19:47.4	148:33:04.2	200:14:18.2
Partial Eclipse	Ends	:	09:53:38.0	+40:06:10.3	115:30:30.5	154:12:49.5

RAJAKHERA: Lat. = 26°.92 N, Long. = 78°.18 E, Height = 160 m
Duration of Totality: 0m 41s Magnitude: 1.00206

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:25:04.1	+12:44:58.8	293:08:42.9	351:49:11.7
Total Eclipse	Begins	:	08:34:45.4	+26:47:21.6	072:44:29.1	124:21:53.6
Maximum Eclipse		:	08:35:05.7	+26:51:15.6	024:28:26.1	076:03:15.5
Total Eclipse	Ends	:	08:35:26.2	+26:55:10.9	156:03:37.2	207:35:50.3
Partial Eclipse	Ends	:	09:54:35.5	+40:41:49.8	115:37:48.8	153:51:17.2

BHIND: Lat. = 26°.57 N, Long. = 78°.80 E, Height = 168 m
Duration of Totality: 0m 55s Magnitude: 1.00503

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:25:20.3	+13:26:38.7	293:25:57.3	352:13:35.3
Total Eclipse	Begins	:	08:35:19.5	+27:33:02.3	283:19:30.8	334:53:52.3
Maximum Eclipse		:	08:35:46.9	+27:38:16.8	024:36:02.8	076:06:51.3
Total Eclipse	Ends	:	08:36:14.4	+27:43:32.6	125:50:00.8	177:17:14.6
Partial Eclipse	Ends	:	09:55:48.4	+41:30:36.3	115:34:56.3	153:18:55.6

JALAUN: Lat. = 26°.13 N, Long. = 79°.38 E, Height =— m
Duration of Totality: 0m 42s Magnitude: 1.00203

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:25:36.6	+14:08:33.7	293:52:31.3	352:52:33.0
Total Eclipse	Begins	:	08:36:07.2	+28:22:27.6	337:40:59.9	029:16:00.3
Maximum Eclipse		:	08:36:28.1	+28:26:28.1	024:43:55.3	076:16:09.4
Total Eclipse	Ends	:	08:36:49.1	+28:30:30.0	071:55:48.3	123:25:14.7
Partial Eclipse	Ends	:	09:57:01.8	+42:21:49.8	115:23:13.3	152:42:31.5

HAMIRPUR: Lat. = 25°.95 N, Long. = 80°.15 E, Height = 109 m
Duration of Totality: 0m 59s Magnitude: 1.00607

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:26:00.8	+14:56:10.7	293:47:11.0	352:40:35.4
Total Eclipse	Begins	:	08:36:52.7	+29:12:09.4	298:28:58.5	349:43:54.8
Maximum Eclipse		:	08:37:22.0	+29:17:44.1	024:51:42.5	076:02:40.0
Total Eclipse	Ends	:	08:37:51.3	+29:23:20.0	111:15:16.3	162:22:13.1
Partial Eclipse	Ends	:	09:58:31.3	+43:10:19.8	115:43:03.6	152:08:52.6

ROBERTSGANJ: Lat. = 24°.70 N, Long. = 83°.07 E, Height = 200 m
Duration of Totality: 1m 05s Magnitude: 1.00687

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:27:47.4	+18:13:15.4	294:19:17.0	353:14:37.7
Total Eclipse	Begins	:	08:40:39.4	+32:48:40.2	294:39:56.4	344:55:36.6
Maximum Eclipse		:	08:41:11.8	+32:54:46.2	025:24:40.1	075:35:25.5
Total Eclipse	Ends	:	08:41:44.4	+33:00:53.3	116:09:14.1	166:15:02.6
Partial Eclipse	Ends	:	10:04:49.9	+46:39:50.7	116:11:54.2	149:12:20.3

CHURK: Lat. = 24°.63 N, Long. = 83°.10 E, Height = 309 m
Duration of Totality: 1m 04s Magnitude: 1.00560

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:27:48.8	+18:16:45.0	294:24:57.3	353:23:20.0
Total Eclipse	Begins	:	08:40:43.4	+32:53:09.8	306:45:17.3	357:03:05.7
Maximum Eclipse		:	08:41:15.2	+32:59:09.5	025:25:25.5	075:38:24.1
Total Eclipse	Ends	:	08:41:47.2	+33:05:10.5	104:08:04.6	154:16:10.9
Partial Eclipse	Ends	:	10:04:56.2	+46:44:59.1	116:07:39.0	149:07:40.9

GARHWA: Lat. = 24°.17 N, Long. = 83°.87 E, Height = — m
Duration of Totality: 0m 50s Magnitude: 1.00233

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:28:22.3	+19:13:14.3	294:46:17.5	353:51:45.9
Total Eclipse	Begins	:	08:41:59.4	+33:57:51.4	337:50:29.6	027:56:04.5
Maximum Eclipse		:	08:42:24.2	+34:02:30.0	025:34:54.2	075:36:37.2
Total Eclipse	Ends	:	08:42:49.1	+34:07:09.8	073:27:51.6	123:25:40.6
Partial Eclipse	Ends	:	10:06:47.9	+47:46:45.0	116:03:40.8	148:06:37.5

DALTENGANJ: Lat. = 24°.05 N, Long. = 84°.07 E, Height = 221 m
Duration of Totality: 0m 43s Magnitude: 1.00167

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:28:31.1	+19:27:53.7	294:51:12.6	353:58:10.2
Total Eclipse	Begins	:	08:42:20.7	+34:14:49.7	345:42:27.6	035:44:09.7
Maximum Eclipse		:	08:42:42.3	+34:18:52.8	025:37:21.7	075:35:39.5
Total Eclipse	Ends	:	08:43:04.0	+34:22:57.2	065:41:59.7	115:36:51.4
Partial Eclipse	Ends	:	10:07:17.2	+48:02:30.6	116:03:15.1	147:50:28.1

BARKAKHANA: Lat. = 23°.62 N, Long. = 85°.57 E, Height = — m
Duration of Totality: 1m 08s Magnitude: 1.00542

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:29:40.9	+21:08:26.0	294:42:06.9	353:32:57.1
Total Eclipse	Begins	:	08:44:23.6	+35:59:56.4	306:45:17.3	357:03:05.7
Maximum Eclipse		:	08:44:57.6	+36:06:13.8	025:52:09.9	074:55:38.2
Total Eclipse	Ends	:	08:45:31.8	+36:12:32.4	131:11:29.9	180:09:34.8
Partial Eclipse	Ends	:	10:10:46.6	+49:35:15.1	116:38:53.2	146:01:46.9

RANCHI: Lat. = 23°.38 N, Long. = 85°.38 E, Height = 652m
Duration of Totality: 0m 22s Magnitude: 1.00037

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:29:33.2	+21:03:11.6	295:12:25.6	354:22:06.6
Total Eclipse	Begins	:	08:44:34.5	+36:01:59.2	007:39:07.4	057:08:07.9
Maximum Eclipse		:	08:44:45.5	+36:04:02.2	025:52:33.0	075:19:43.7
Total Eclipse	Ends	:	08:44:56.6	+36:06:06.7	044:17:51.7	093:43:11.1
Partial Eclipse	Ends	:	10:10:31.9	+49:40:02.4	116:09:31.6	146:01:28.5

PURULIYA: Lat. = 23°.33 N, Long. = 86°.42 E, Height = 255 m
Duration of Totality: 0m 51s Magnitude: 1.00215

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:30:23.3	+22:06:57.9	294:39:55.0	353:22:43.6
Total Eclipse	Begins	:	08:45:53.1	+37:04:10.5	070:25:05.3	119:01:51.9
Maximum Eclipse		:	08:46:18.4	+37:08:49.6	026:00:39.1	074:33:02.8
Total Eclipse	Ends	:	08:46:43.9	+37:13:30.0	161:27:26.8	209:55:25.3
Partial Eclipse	Ends	:	10:12:50.3	+50:28:19.3	116:56:10.0	144:52:07.8

CHANDRAKONA: Lat. = 22°.73 N, Long. = 87°.52 E, Height = 45 m
Duration of Totality: 1m 07s Magnitude: 1.00422

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:24.3	+23:29:55.9	294:59:50.5	353:44:33.3
Total Eclipse	Begins	:	08:47:40.0	+38:33:52.0	089:19:33.5	137:27:09.7
Maximum Eclipse		:	08:48:13.5	+38:39:58.0	026:13:02.4	074:14:35.0
Total Eclipse	Ends	:	08:48:47.1	+38:46:05.3	143:01:03.9	190:56:29.4
Partial Eclipse	Ends	:	10:15:46.3	+51:48:43.5	116:58:13.2	143:00:35.2

MEDINIPUR: Lat. = 22°.43 N, Long. = 87°.33 E, Height = 525 m
Duration of Totality: 0m 20s Magnitude: 1.00029

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:17.9	+23:26:51.8	295:37:10.7	354:45:00.9
Total Eclipse	Begins	:	08:47:53.6	+38:39:16.5	010:37:48.2	059:09:08.6
Maximum Eclipse		:	08:48:03.7	+38:41:07.8	026:13:58.3	074:43:29.4
Total Eclipse	Ends	:	08:48:13.9	+38:43:00.5	042:01:51.5	090:29:31.7
Partial Eclipse	Ends	:	10:15:35.6	+51:58:40.8	116:22:52.5	142:57:00.5

GHATAL: Lat. = 22°.67 N, Long. = 87°.72 E, Height = 15 m
Duration of Totality: 1m 03s Magnitude: 1.00337

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:35.5	+23:44:00.1	294:59:02.3	353:41:04.3
Total Eclipse	Begins	:	08:48:02.8	+38:49:13.0	081:54:37.1	129:53:26.1
Maximum Eclipse		:	08:48:34.0	+38:54:53.2	026:14:56.4	074:08:03.7
Total Eclipse	Ends	:	08:49:05.4	+39:00:34.7	150:28:28.8	198:15:51.2
Partial Eclipse	Ends	:	10:16:16.9	+52:00:39.3	117:02:20.0	142:41:39.2

BALICHAK: Lat. = 22°.37 N, Long. = 87°.55 E, Height = 525 m
Duration of Totality: 0m 44s Magnitude: 1.00142

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:30.0	+23:41:59.2	295:35:45.4	354:40:50.7
Total Eclipse	Begins	:	08:48:04.0	+38:53:09.1	351:00:36.6	039:24:45.0
Maximum Eclipse		:	08:48:25.8	+38:57:08.7	026:16:00.3	074:36:10.9
Total Eclipse	Ends	:	08:48:47.8	+39:01:09.7	061:41:17.5	109:57:27.9
Partial Eclipse	Ends	:	10:16:08.6	+52:11:26.7	116:27:50.1	142:36:48.8

PANSKURA: Lat. = 22°.42 N, Long. = 87°.70 E, Height = 11 m
Duration of Totality: 1m 11s Magnitude: 1.00490

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:37.3	+23:49:49.2	295:24:59.9	354:22:32.5
Total Eclipse	Begins	:	08:48:03.5	+38:57:48.8	317:53:53.5	006:08:31.9
Maximum Eclipse		:	08:48:38.7	+39:04:14.6	026:16:41.6	074:24:54.0
Total Eclipse	Ends	:	08:49:14.1	+39:10:41.4	094:43:56.5	142:45:39.4
Partial Eclipse	Ends	:	10:16:26.9	+52:14:36.2	116:39:41.3	142:28:16.0

ULUBERIA: Lat. = 22°.50 N, Long. = 87°.95 E, Height = 8 m
Duration of Totality: 1m 11s Magnitude: 1.00486

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:49.6	+24:02:53.3	295:07:03.1	353:51:56.4
Total Eclipse	Begins	:	08:48:25.1	+39:09:36.5	274:14:37.9	322:09:15.9
Maximum Eclipse		:	08:49:00.4	+39:16:00.1	026:17:48.8	074:05:56.2
Total Eclipse	Ends	:	08:49:35.9	+39:22:26.6	138:16:29.9	185:58:03.1
Partial Eclipse	Ends	:	10:16:57.2	+52:19:40.9	116:59:24.2	142:13:53.7

TAMLUK: Lat. = 22°.30 N, Long. = 87°.97 E, Height = 7 m
Duration of Totality: 1m 13s Magnitude: 1.00536

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:52.7	+24:09:26.1	295:26:40.0	354:22:43.1
Total Eclipse	Begins	:	08:48:30.8	+39:18:46.9	314:32:42.0	002:37:44.1
Maximum Eclipse		:	08:49:07.1	+39:25:23.3	026:19:25.6	074:17:45.5
Total Eclipse	Ends	:	08:49:43.6	+39:32:00.9	098:09:54.5	146:01:28.5
Partial Eclipse	Ends	:	10:17:09.4	+52:32:04.8	116:42:47.5	142:00:41.4

AMTA: Lat. = 22°.58 N, Long. = 88°.02 E, Height = 7 m
Duration of Totality: 0m 47s Magnitude: 1.00162

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:31:52.3	+24:04:41.6	294:56:04.6	353:34:00.1
Total Eclipse	Begins	:	08:48:41.3	+39:12:22.4	063:53:26.3	111:37:03.3
Maximum Eclipse		:	08:49:04.6	+39:16:35.2	026:17:38.8	073:56:57.6
Total Eclipse	Ends	:	08:49:28.0	+39:20:49.2	168:32:22.6	216:07:20.8
Partial Eclipse	Ends	:	10:17:02.2	+52:17:24.2	117:09:58.6	142:13:42.1

FALTA: Lat. = 22°.28 N, Long. = 88°.12 E, Height = — m
Duration of Totality: 1m 16s Magnitude: 1.00698

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:00.1	+24:19:08.2	295:22:37.2	354:14:55.9
Total Eclipse	Begins	:	08:48:43.8	+39:28:19.1	302:24:59.2	350:21:59.5
Maximum Eclipse		:	08:49:22.0	+39:35:14.8	026:20:35.2	074:10:30.2
Total Eclipse	Ends	:	08:50:00.3	+39:42:11.6	110:17:27.3	158:00:13.0
Partial Eclipse	Ends	:	10:17:31.1	+52:38:58.0	116:48:48.6	141:47:50.7

BUDGE BUDGE: Lat. = 22°.45 N, Long. = 88°.17 E, Height = 6 m
Duration of Totality: 1m 03s Magnitude: 1.00329

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:01.8	+24:17:35.6	295:03:50.4	353:44:49.9
Total Eclipse	Begins	:	08:48:51.2	+39:25:37.9	080:58:43.9	128:41:59.1
Maximum Eclipse		:	08:49:22.4	+39:31:17.5	026:19:40.8	073:57:06.8
Total Eclipse	Ends	:	08:49:53.9	+39:36:58.2	151:33:43.5	199:05:17.2
Partial Eclipse	Ends	:	10:17:29.6	+52:31:06.0	117:05:49.4	141:53:56.2

DIAMOND HARBOUR: Lat. = 22°.18 N, Long. = 88°.20 E, Height = 7 m
Duration of Totality: 1m 13s Magnitude: 1.00537

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:06.7	+24:27:03.4	295:29:32.8	354:25:04.3
Total Eclipse	Begins	:	08:48:56.1	+39:37:53.9	314:41:30.9	002:38:38.5
Maximum Eclipse		:	08:49:32.7	+39:44:32.2	026:21:54.5	074:12:13.1
Total Eclipse	Ends	:	08:50:09.4	+39:51:11.6	098:06:03.9	145:49:29.5
Partial Eclipse	Ends	:	10:17:47.7	+52:48:06.6	116:44:14.8	141:35:10.5

KULPI: Lat. = 22°.10 N, Long. = 88°.25 E, Height = — m
Duration of Totality: 1m 06s Magnitude: 1.00375

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:10.4	+24:32:28.5	295:36:03.7	354:34:52.3
Total Eclipse	Begins	:	08:49:06.8	+39:45:07.3	327:50:35.8	015:48:35.9
Maximum Eclipse		:	08:49:39.8	+39:51:06.3	026:22:52.4	074:14:42.9
Total Eclipse	Ends	:	08:50:12.9	+39:57:06.5	085:01:23.4	132:47:00.8
Partial Eclipse	Ends	:	10:17:58.8	+52:54:58.3	116:39:28.2	141:26:06.4

HALDIA: Lat. = 22°.07 N, Long. = 88°.07 E, Height = 11 m
Duration of Totality: 0m 20s Magnitude: 1.00027

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:00.9	+24:22:05.4	295:46:28.5	354:53:00.8
Total Eclipse	Begins	:	08:49:13.1	+39:39:28.7	011:30:01.2	059:37:05.5
Maximum Eclipse		:	08:49:22.9	+39:41:16.7	026:21:51.6	074:27:05.7
Total Eclipse	Ends	:	08:49:33.0	+39:43:06.1	041:25:18.9	089:28:41.1
Partial Eclipse	Ends	:	10:17:34.9	+52:49:44.2	116:27:24.7	141:38:51.9

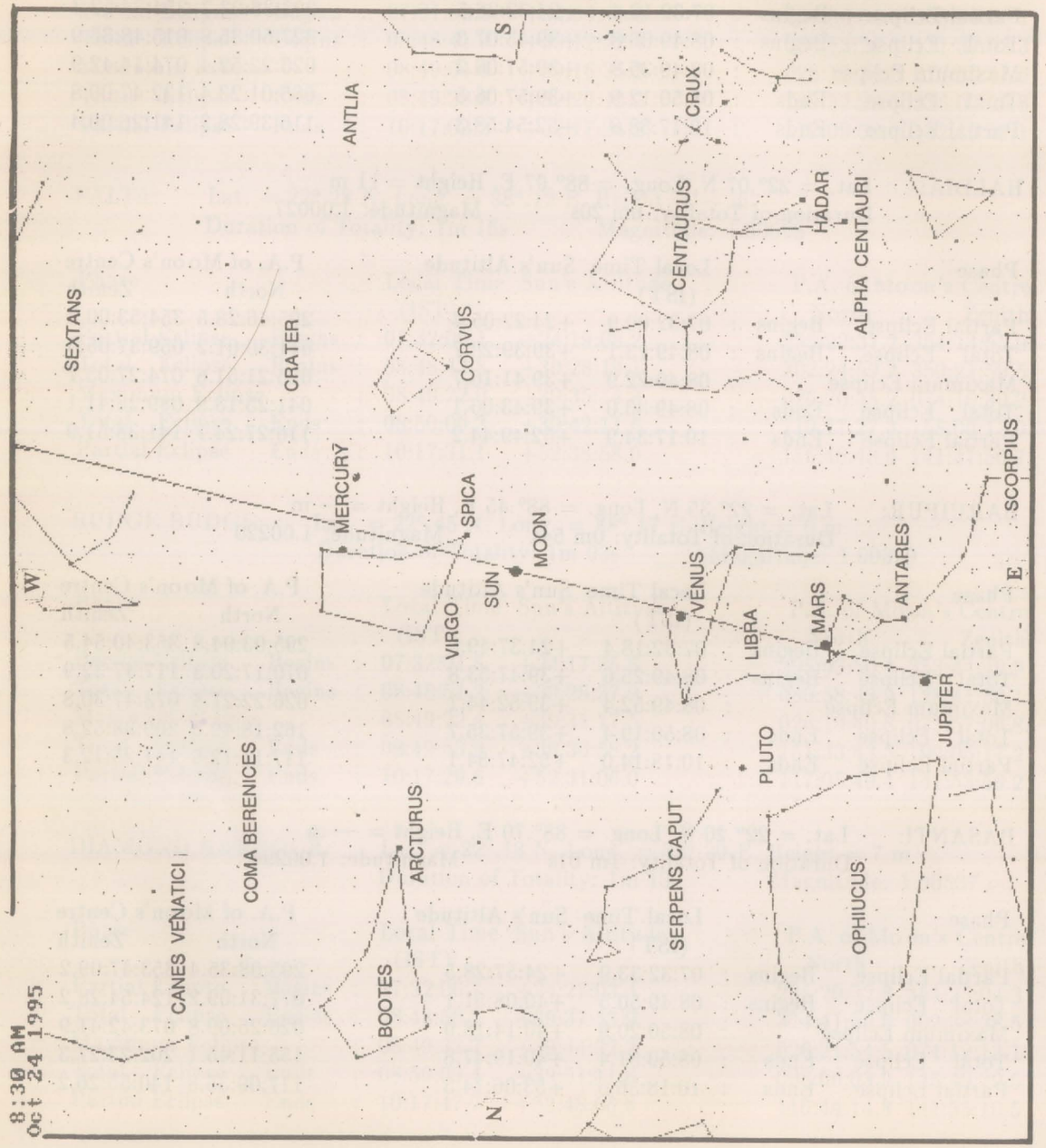
BARUIPUR: Lat. = 22°.35 N, Long. = 88°.45 E, Height = — m
Duration of Totality: 0m 54s Magnitude: 1.00220

Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:18.4	+24:37:49.8	295:03:04.8	353:40:54.5
Total Eclipse	Begins	:	08:49:25.6	+39:47:53.8	070:17:20.3	117:47:32.9
Maximum Eclipse		:	08:49:52.4	+39:52:44.1	026:22:21.5	073:47:30.8
Total Eclipse	Ends	:	08:50:19.4	+39:57:35.7	162:18:49.5	209:38:52.8
Partial Eclipse	Ends	:	10:18:14.0	+52:47:54.1	117:11:12.6	141:25:12.3

BASANTI: Lat. = 22°.20 N, Long. = 88°.70 E, Height = — m
Duration of Totality: 1m 01s Magnitude: 1.00294

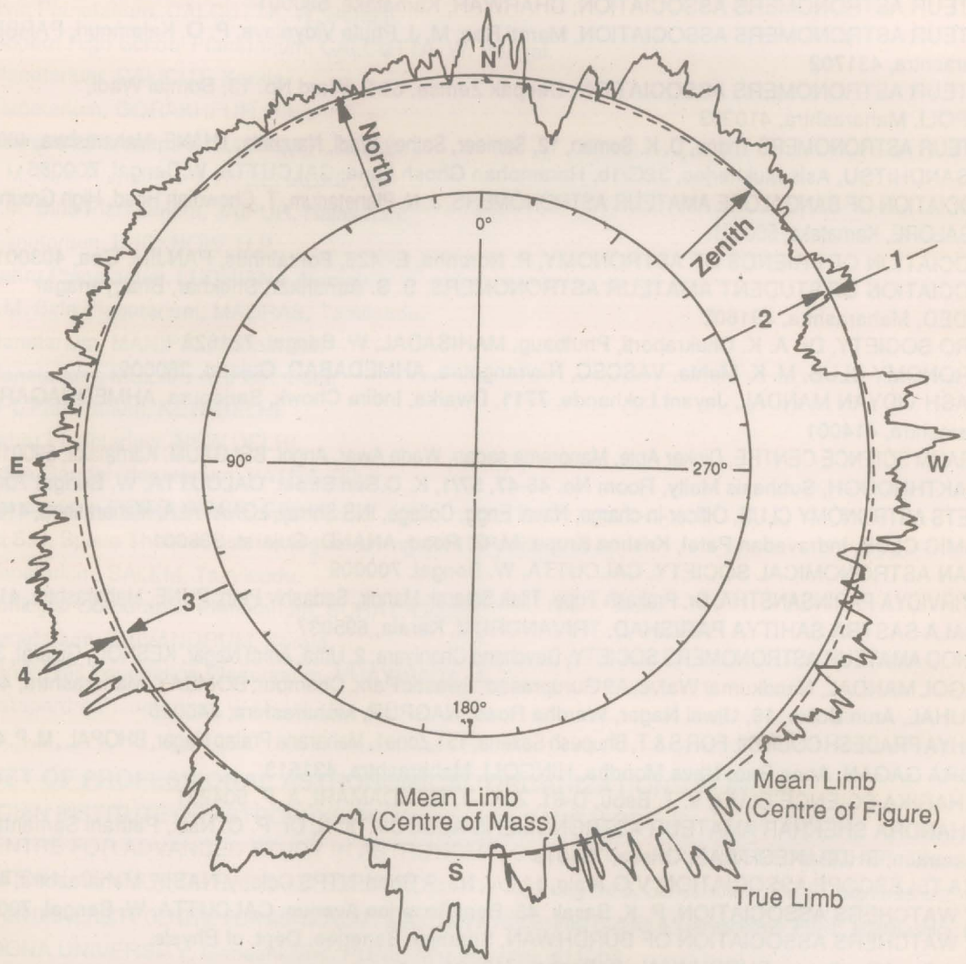
Phase			Local Time (IST)	Sun's Altitude	P.A. of Moon's Centre North	Zenith
Partial Eclipse	Begins	:	07:32:33.9	+24:57:28.5	295:08:35.4	353:47:09.2
Total Eclipse	Begins	:	08:49:50.5	+40:08:51.1	077:31:09.2	124:54:28.2
Maximum Eclipse		:	08:50:20.9	+40:14:18.9	026:25:09.8	073:42:41.9
Total Eclipse	Ends	:	08:50:51.4	+40:19:47.8	155:11:45.1	202:23:27.3
Partial Eclipse	Ends	:	10:18:56.6	+53:06:14.3	117:09:35.8	140:55:26.2

7.5 Map for Sky during Totality



7.6 Lunar Limb Profile

Watt's Datum of the Lunar Limb Profile as seen from 90°E longitude on the Central Path. (For all practical purposes it can be used for India & Myanmar)



The lunar limb profile is based on extensive research done by Watts. Almost 60000 occultations have been used to generate the same. The profile will give some idea on where you can expect to see the Diamond ring and Baily's beads along the profile. The profile is used by professionals for accurate calculations pertaining to contact timings.

8.1. LIST OF AMATEUR ASTRONOMERS ORGANISATIONS IN INDIA

1. AKASH MITRA, Hemant Mone, Nilkanth Chhaya, Datta Ali, KALYAN, Maharashtra, 421301
2. AKASH NIRIKSHAK MANDAL, Datta Krupa, Saraswati Colony, AURANGABAD, Maharashtra, 431001
3. AMATEUR ASTRONOMERS' ASSOCIATION (BOMBAY), Prof. R. V. Kamat, C/o Physics Dept. St. Xavier's College, BOMBAY, Maharashtra, 400001
4. AMATEUR ASTRONOMERS ASSOCIATION OF DELHI, C. B. Devgun, Nehru Planetarium, Teen Murty House, NEW DELHI, 110011
5. AMATEUR ASTRONOMERS ASSOCIATION OF RAJKOT, Shreekumar Acharya, L/89, Anand, GHB Colony, Near Mahila College, RAJKOT, Gujarat, 360001
6. AMATEUR ASTRONOMERS ASSOCIATION, DHARWAR, Karnataka, 580001
7. AMATEUR ASTRONOMERS ASSOCIATION, Maroti Rao, M. J. Phule Vidyalaya, P. O. Kalamnuri, PARBHANI, Maharashtra, 431702
8. AMATEUR ASTRONOMERS ASSOCIATION, Deepak Zemse, 65/2, Ward No. 13, Somjai Wadi, KHOPOLI, Maharashtra, 410203
9. AMATEUR ASTRONOMERS Thane, D. K. Soman, 12, Sameer, Sathey Wadi, Naupada, THANE, Maharashtra, 400602
10. ANUSANDHITSU, Asis Mukherjee, 32G/1b, Haramohan Ghosh Lane, CALCUTTA, W.Bengal, 700085
11. ASSOCIATION OF BANGALORE AMATEUR ASTRONOMERS, J. N. Planetarium, T. Chowdiah Road, High Grounds, BANGALORE, Karnataka, 560001.
12. ASSOCIATION OF FRIENDS OF ASTRONOMY, P. Noronha, E- 426, Fontainhas, PANJIM, Goa, 403001
13. ASSOCIATION OF STUDENT AMATEUR ASTRONOMERS, S. S. Aundhkar, Shekhar, Bhagyanagar NANDED, Maharashtra, 431602
14. ASTRO SOCIETY, Dr. A. K. Chakraborti, Phulbaug, MAHISADAL, W. Bengal, 721628
15. ASTRONOMY CLUB, M. K. Mehta, VASCSC, Navrangpura, AHMEDABAD, Gujarat, 380009
16. AVKASH VIDYAN MANDAL, Jayant Lokhande, 7711, Dwarka, Indira Chowk, Sarjepura, AHMEDNAGAR, Maharashtra, 414001
17. BELGAUM SCIENCE CENTRE, Dinkar Apte, Manorama sadan, Wada Awar, Angol, BELGAUM, Karnataka, 590010
18. BREAKTHROUGH, Subhasis Maity, Room No. 46-47, 57/1, K. C.Sen Street, CALCUTTA, W. Bengal 700031
19. CADETS ASTRONOMY CLUB, Officer-in-charge, Naval Engg. College, INS Shivaji, LONAVALA, Maharashtra, 410402
20. COSMIC CLUB, Indravadan Patel, Krishna Krupa, M. G. Road, ANAND, Gujarat, 388001
21. INDIAN ASTRONOMICAL SOCIETY, CALCUTTA, W. Bengal, 700009
22. JYOTIRVIDYA PARINSANSTHA, Dr. Prakash Tupe, Tilak Smarak Mandir, Sadashiv Peth, PUNE, Maharashtra, 411030
23. KERALA SASTRA SAHITYA PARISHAD, TRIVANDRUM, Kerala, 695037
24. KESHOD AMATEUR ASTRONOMERS SOCIETY, Devchand Chaniyara, 2, Uma, Amrit Nagar, KESHOD, Gujarat, 364220
25. KHAGOL MANDAL, Nandkumar Walve, A9 Guruprasad, Swastic Park, Chembur, BOMBAY, Maharashtra, 400071
26. KUTUHAL, Arun Dolke, 18, Ujwal Nagar, Wardha Road, NAGPUR, Maharashtra, 440025
27. MADHYA PRADESH COUNCIL FOR S & T, Bhupesh Saxena, 151,Zone1, Maharana Pratap Nagar, BHOPAL , M. P. 462011
28. MUGRA GAGAN, Anna Rao, Nava Mondha, HINGOLI, Maharashtra, 431513
29. NEEHARIKA SCIENCE CLUB, V. T. Babu, D-61, Zone-1, MANDAMARI, A. P. 504231
30. S. CHANDRA SHEKHAR AMATEUR ASTRONOMERS ASSOCIATION, Dr. P. C. Naik, Pathani Samanta Planetarium, BHUBANESHWAR, Orissa, 751013
31. SKY & TELESCOPE ASSOCIATION, V.G.Atale, 11/2/4, Nasik Road, NTPS Colony, NASIK, Maharashtra, 422104
32. SKY WATCHERS ASSOCIATION, P. K. Basak, 45, Beni Banerjee Avenue, CALCUTTA, W. Bengal, 700031
33. SKY WATCHERS ASSOCIATION OF BURDHWAN, Sriranjan Banerjee, Dept. of Physis, University of Burdhwan, BURDHWAN, W. Bengal, 713104
34. SRIJINIKA, Binoy Pattanayak, Jaganare, P. O. Khandagiri, BHUBANESHWAR, Orissa, 751030
35. TAMILNADU ASTRONOMICAL ASSOCIATION, V. S. Venkataraman, 115, M. G. Road, Kalkshetra Colony, MADRAS, Tamilnadu, 600090
36. TAMILNADU SCIENCE FORUM, 7 ARK Colony, Eumas Road, MADRAS, Tamilnadu, 600018
37. UNIVERSE QUEST & CONQUERER, R. Bhattacharya, 57, Tagore Road, CALCUTTA, W. Bengal, 700063
38. VEGA CLUB, K. R. Nair, S/11/14, Jeevan Bima Nagar, Borivali (W), BOMBAY, Maharashtra, 400103
39. VISHWAVEDH, Prof. Mohan Apte, 18, Roopali, Dixit Road, Vile Parle (E), BOMBAY, Maharashtra, 400057
40. VISTAS Prof. -in-charge, V.E.S. Inst. of Tech, Sindhi Society, Chembur, BOMBAY, Maharashtra, 400071
41. VYOM VIHAR, Bharat Trivedi, 31/199, Ellora Park, VADODRA, Gujarat, 390007

Note : The above list is compiled on the basis of reports of past AIAAMs.

8.2 LIST OF PLANETARIA IN INDIA

1 Jawahar Planetarium, ALLAHABAD, U.P.
2 Jawaharlal Nehru Planetarium, BANGALORE, Karnataka.
3 Sardar Patel Planetarium, BARODA, Gujarat.
4 Pathani Samanta Planetarium, BHUBANESHWAR, Orissa.
5 Bombay Marine Training Institute Planetarium, BOMBAY, Maharashtra.
6 Nehru Planetarium, BOMBAY, Maharashtra.
7 Meghnad Saha Planetarium, BURDHWAN, W. Bengal.
8 Birla Planetarium, CALCUTTA, W. Bengal.
9 Modern High School Planetarium, CALCUTTA, W. Bengal.
10 Planetarium, CALICUT, Kerala.
11 Planetarium, GORAKHPUR, Bihar.
12 Guwahati Planetarium GUWAHATI, Assam.
13 B.M. Birla Planetarium, HYDERABAD, A.P.
14 B.M. Birla Planetarium, JAIPUR, Rajasthan.
15 Planetarium, LUCKNOW, U.P.
16 Nehru Planetarium, LUDHIANA, Punjab.
17 B.M. Birla Planetarium, MADRAS, Tamilnadu.
18 Planetarium, MANIPAL, Karnataka.
19 Planetarium, MUZAFFARPUR, Bihar.
20 NPL Planetarium, NEW DELHI.
21 Nehru Planetarium, NEW DELHI.
22 Indira Gandhi Planetarium, PATNA, Bihar.
23 Planetarium, PORBUNDER, Gujarat.
24 Sri S.S. Space Theatre Inst. for Higher Living, PUITIPARTHI, A.P.
25 Planetarium, SALEM, Tamilnadu.
26 Municipal Corporation Planetarium, SURAT, Gujarat.
27 Planetarium, TRIVANDRUM, Kerala.
28 Gandhi Hill Foundation Planetarium, VIJAYWADA, A..P.
29 Pratapardra Planetarium, WARANGAL, A.P.

8.3 LIST OF PROFESSIONAL ASTRONOMICAL ORGANIZATIONS IN INDIA

1 INDIAN INSTITUTE OF ASTROPHYSICS, Koramangla, BANGALORE, Karnataka, 560034
2 CENTRE FOR ADVANCED STUDY IN ASTRONOMY, Osmania University, HYDERABAD, A.P. 500007
3 NATIONAL CENTRE FOR RADIO ASTROPHYSICS, TIFR, Post Bag No.3, Ganeshkhind, PUNE, Maharashtra, 411007
4 INTER UNIVERSITY CENTRE FOR ASTRONOMY & ASTROPHYSICS, Post Bag No.4, Ganeshkhind, PUNE, Maharashtra, 411007
5 POONA UNIVERSITY, Ganeshkhind, PUNE, Maharashtra, 411007
6 PHYSICAL RESEARCH LABORATORY, Navrangpura, AHMEDABAD, Gujarat, 380009
7 TATA INSTITUTE OF FUNDAMENTAL RESEARCH, Homi Bhabha Road, Colaba, BOMBAY, Maharashtra, 400005
8 UTTAR PRADESH STATE OBSERVATORY, Manora Peak, Naini Tal. U.P. 263129
9 INDIAN INSTITUTE OF SCIENCE, BANGALORE, Karnataka, 560012
10 RAMAN RESEARCH INSTITUTE, Sir C.V. Raman Avenue, BANGALORE, Karnataka, 560080
11 ISRO SATELLITE CENTRE, Air Road, Vimanpura, BANGALORE, Karnataka, 560017
12 UDAIPUR SOLAR OBSERVATORY, 11, Vidya Marg, UDAIPUR, Rajasthan, 313001
13 VAINU BAPPU OBSERVATORY, KAVALUR, Karnataka.

9. PROJECTS / ACTIVITIES FOR TOTAL SOLAR ECLIPSE

CIAA has prepared a set of 20 programmes/experiments that can be taken up for study of the Total Solar Eclipse. These experiments cover most aspects of TSE and whosoever is interested to take up the same or know each module in detail may send Rs. 5/- by Cash / M.O. / Unused Postal Stamps to **the General Secretary -CIAA at 32G/1b, Haramohan Ghosh Lane, Calcutta, W.Bengal, 700085.**

1) To select a place and a particular location where from observation of the TSE-1995 could be made to get maximum viewing time with other favourable conditions for observation.
2) To find out the latitude, longitude and height of the place from Mean Sea Level upto two decimal places, which is very essential for any scientific astronomical observations.
3) To record the time accurately of the 4 contacts of the Eclipse.
4) To arrange proper filters for direct observation by projecting the image of the Sun with Eye, Binocular or Telescope.
5) To arrange alternative viewing of the Eclipse by projecting the image of the Sun indirectly
   a) Without telescope b) With telescope
6) To measure the light intensity reduction rate due to the Eclipse.
7) To measure the fall of atmospheric temperature due to the Eclipse.
8) To record the electro-magnetic disturbances with Radio Telescope.
9) To find out the position of the Sun with its R. A., Declination and its angular diameter and the speed of movement.
10) To check the predicted and observed line of the northern and southern limits of the umbral track.
11) To observe Shadow Band and Shadows under trees.
12) To observe 'Baily's Beads'.
13) To observe photo sensitive plants and animal behaviour during TSE.
14) To observe Diamond Ring.
15) To observe different human beings, and study their behaviour towards the Eclipse in particular noting of their attitudes towards superstitions.
16) To take photographs: a) Without telescope, b) With telescope, c) Video
17) To observe (during totality) : a) Planets and comets, if any, near the Sun, b) Suns coronal pattern, c) Stars in the Sky.
18) To know more about the Sun, Moon and Earth (School Project and Exhibition.)
19) To measure theoretically the mass and radius of Sun, Moon, and Earth and distance of Sun and Moon from Earth.
20) Coordinating a project, (Manpower / Material / Logistics / Observation / Data recording / Reports and Feedback).

NOTES

CONFEDERATION OF INDIAN AMATEUR ASTRONOMERS'

CIAA was formed in the 4th All India Amateur Astronomers' Meet at Calcutta on 22nd January 1994 to co-ordinate the activities of Amateur Astronomers in India in a more organized way.

Objectives

- To disseminate astronomy among the people as a part of developing scientific temperament by exposing the natural laws related with astronomy which govern our daily life.
- To involve Amateur Astronomers in more project oriented activities in an organized way for effective data collection that can be of some research value.
- We hope ultimately this would help produce the required manpower in the professional institutions in the field of astronomy with proper motivation.
- To develop Regional Centers, and if possible, one or more observatories in different parts of the country, reserved exclusively for the amateurs. In addition, the regional centers would be expected to carry out the goals more effectively that are set forth by then national body.

Observations

- To encourage people to observe and record by various means, the stars, Messier objects, variable stars, comets, meteor showers and occultations, etc.

Instrumentation

- To help procure the right kind of instruments for observation at the lowest possible price.

Popularization

- Introducting School level projects, conducting Certificate courses, generation of centralized resource materials for exhibition, conducting seminars, debates and essay contests, astro-cartoons, astro-balleys, bringing out slides and audio and video cassettes, etc.

SCIENTIFIC ADVISORY COMMITTEE (SAC)

Prof. N.C. Rana, IUCAA, Pune, Chairman
Dr. G.S.D. Babu, IIA, Bangalore
Dr. J.J. Rawal, Nehru Planetarium, Bombay
Prof. K.D. Abhayankar, Hyderabad
Dr. A.K. Bhatnagar, USO, Udaipur
Dr. R. Sarkar, Birla Planetarium, Calcutta

NATIONAL ORGANISING COMMITTEE (NOC)

President : **Mr. D. K. Soman**
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Anybody over 21 years and is involved in amateur astronomy activities for more than three years can become a member provided he/she paid the subscription and agreed to abide by the rules.

Subscription :

Life Membership : Rs. 500/-
Yearly Membership : Rs. 25/-
Institutional Membership : Rs. 100/-

Admission fees for all Rs. 10/-

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