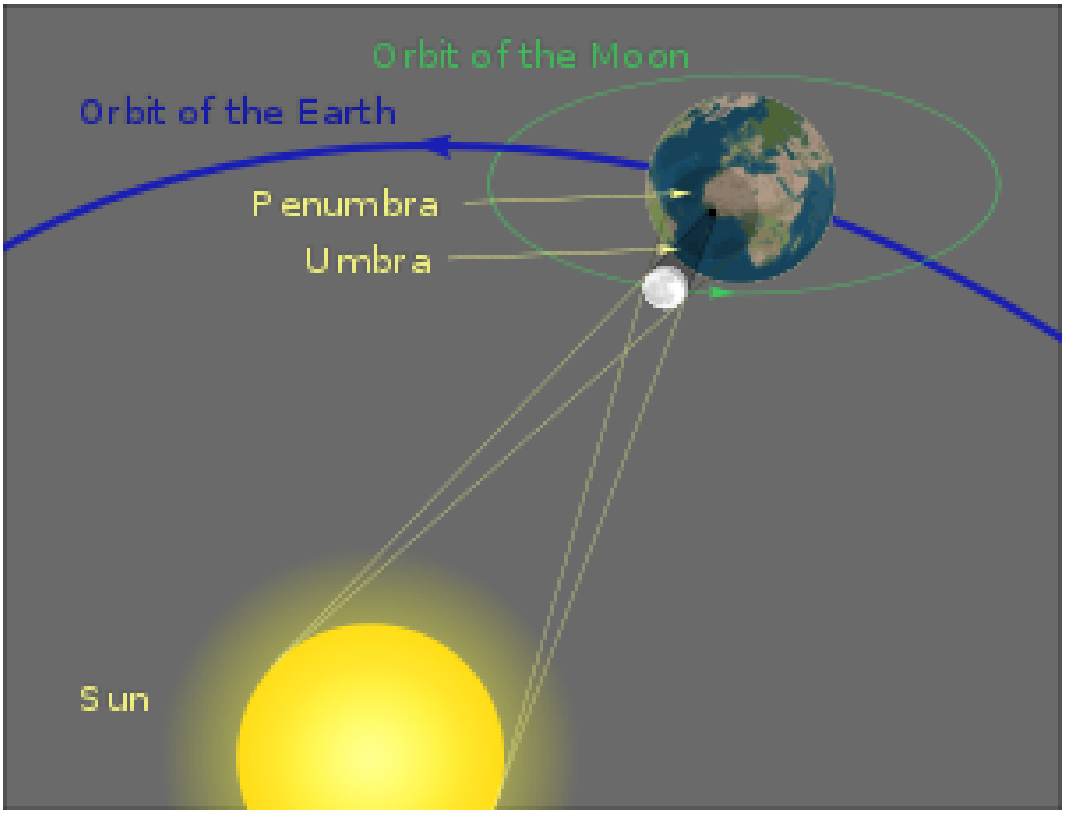
A SOLAR ECLIPSE MANUAL

N.D. HARI DASS AND KAMAL LODAYA



Contents

Acknowledgement

In preparing this manual NDH has relied on his experiences of the 1980 Solar Eclipse which he viewed and photographed from the scenic Magod Falls area of Karnataka, as well as the excellent material contained in the following pamphlets:

(1) *Total Solar Eclipse of 16 February 1980 – Circumstances Relating to India* issued by The India Meteorological Department.
(2) *Solar Eclipse – Photography for the Amateur*, Kodak Publication No.AM-10, produced by the Consumer Markets Division of the Eastman Kodak Company, Rochester, NY 14650, USA.

The solar eclipse photography as well as viewing were a success largely due to these two pamphlets.

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Credits. This text is adapted from the solar eclipse manual prepared by Dr. N.D. Hari Dass for the total solar eclipse of 24 October 1995. Section 8 is adapted from Calla Cofield in *Skywatching*.

Wikipedia provided many of the pictures. The India eclipse map in Figure 7 is from the website:
time.unitarium.com/events/eclipse/122019/india.
The South India eclipse map in Figure 9 was prepared by Michael Zeiler for *Sky and Telescope*. Figure 4 is by Deepak Khemani from his book *Signs of the Zodiac*, pubished by Bharat Gyan Vigyan Samiti. The data in the tables in Figure 8 and 10 is from two web sites:
www.timeanddate.com/eclipse/solar/2019-december-26,
and the interactive map provided at Fred Espenak's Nasa Eclipse page:
eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2019Dec26Agoogle,
it also has Figure 6.

NDH, Mysuru, and KL, Bengaluru

FIGURE 1. The Sun's corona (outer atmosphere) and prominences (pink) during a total solar eclipse on 11 August 1999

1. A PRIMER ON ECLIPSES

This section is mainly for readers who are not clear about how an eclipse happens. If you have no problem with the mechanics, skip ahead to Section 2.

FIGURE 2. The annular solar eclipse of May 2012

1.1. **What is an eclipse?** An eclipse stands for blocking of light. In a cinema, when a person blocks light from the projector, he "eclipses" the screen and the film being shown on it. The Earth eclipses the Moon in the same way in a *lunar eclipse.*

With a coin, you can block the Sun's light from falling on your eye. For your eyes, the Sun is "eclipsed." The Moon eclipses the Sun like this to show us a *solar eclipse.*

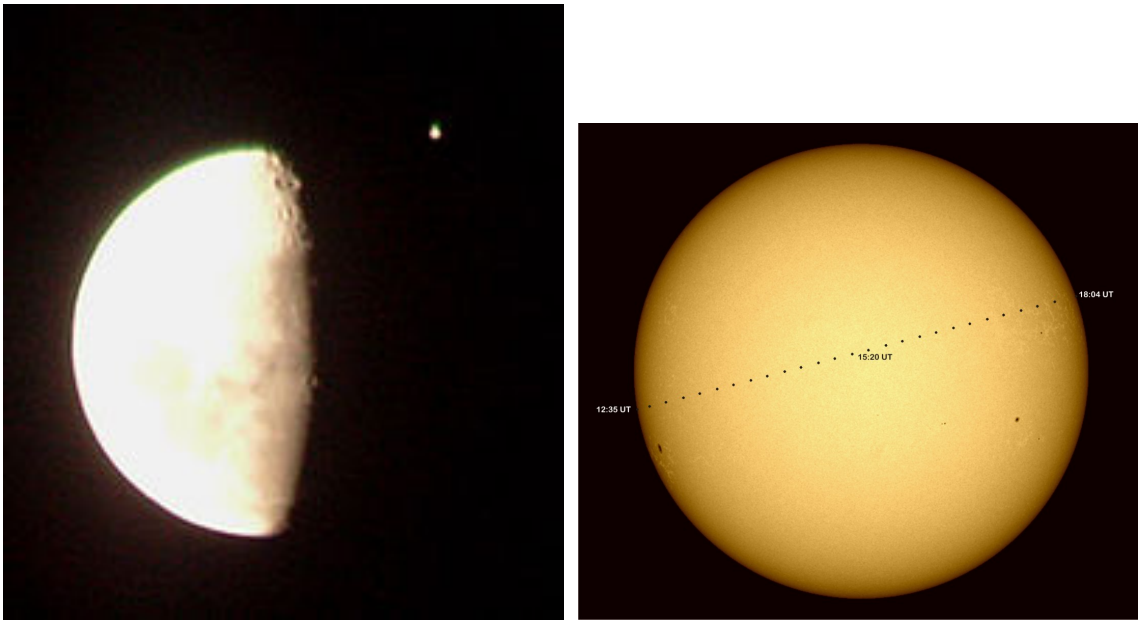


FIGURE 3. Occultation of Jupiter about to take place on 16 June 2005, and transit of Mercury across the Sun on 11 November 2019

1.2. **Are there other eclipses?** Sure. The planets Mercury (Budha) and Venus (Shukra, Velli) come between the Earth and the Sun. But they are so far away from us that they appear just as tiny dots on the Sun, not even visible to the unaided eye. So these "eclipses" (called *transits*) are of interest only to people having telescopes. Careful observation of transits on other stars than the Sun have provided evidence of their planets, these are called *exoplanets.*

The moon also (occasionally) passes in front of stars, "eclipsing" them. (This is called an *occultation.*) Again, these are not easy to see with the naked eye. In fact, in 1977, a team of astronomers (including Indians) discovered that the planet Uranus had rings around it by observing it when it occulted a star.

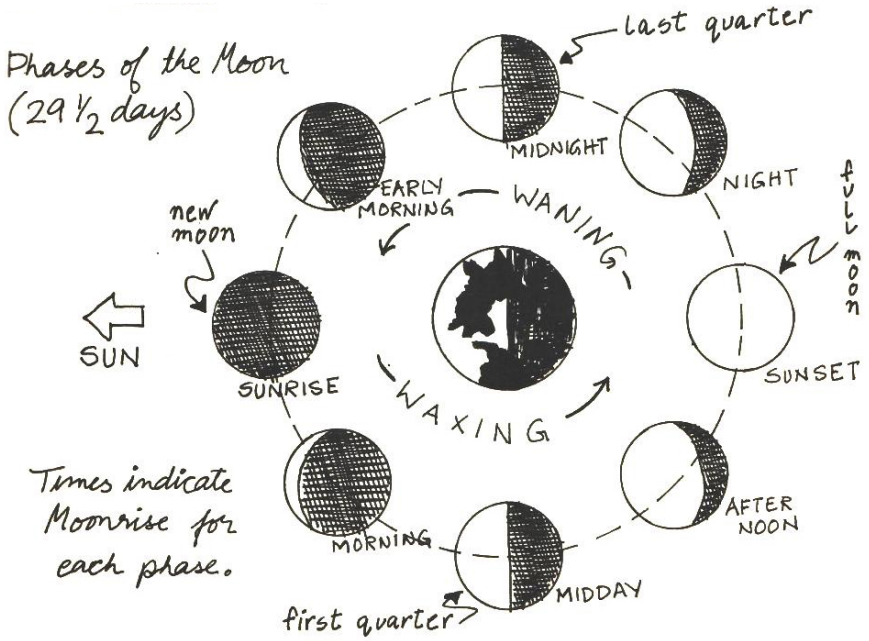


FIGURE 4. Phases

1.3. **Are eclipses related to phases of the Moon?** No. Phases of the Moon are a view of the sunlit portion of the Moon, seen from different angles as the Moon goes around the Earth. Deepak Khemani's picture from *Signs of the Zodiac* shows how.

But eclipses require that the Sun, Moon and Earth be in a straight line (so that the shadow of one can fall on the other). Hence they can only happen on New Moon (*amavasya*) or Full Moon (*poornima*). Since December 26, 2019, is an *amavasya*, the Moon can come between the Sun and the Earth on that day. Its shadow falls on the Earth, giving us a solar eclipse.

1.4. **Why don't eclipses happen every New and Full Moon?** The plane of the Moon's path around the Earth is tilted at an angle of 5° to that of the Earth's path around the Sun, as shown in Figure 5. So on most New and Full Moons, the Sun, Earth and Moon do not stand in a straight line.

1.5. **What are partial and total eclipses?** Because the Moon's path is at an angle, only part of it may fall in the Earth's shadow. This gives rise to a *partial* lunar eclipse.

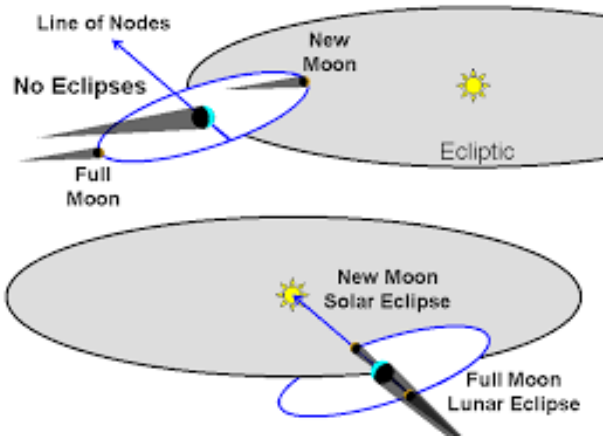


FIGURE 5. Eclipses do not happen every New and Full Moon

For a *solar* eclipse to be partial, there is an additional reason. The Moon's shadow on Earth is very small. So a central solar eclipse will be partial when seen from most places, and central on a narrow path.

2. Solar Eclipses

A total solar eclipse is one of the most spectacular of celestial phenomena. A solar eclipse is caused when the Moon obstructs our line of sight to the Sun. The eclipses are classified as:

Partial: when the Moon only partially obstructs the Sun, and
Central: when the Moon maximally obstructs the Sun,
Total: when the Moon completely obstructs the Sun, and
Annular: when a thin ring of the Sun's disc is not covered by the Moon.

Due to the variation in the Earth–Moon distance, the angular diameter of the Moon and the Sun need not match exactly during a central solar eclipse. Because of this, when the Moon is farther enough from the Earth we get an **annular** eclipse. When the Moon is close enough to the Earth we get a **total** eclipse. The fraction of the solar *diameter* covered by the Moon is called the **magnitude** of the eclipse, and the fraction of the solar *area* covered the **obscuration**. Sometimes these fractions are indicated to be greater than one! This simply means that at the greatest phase the angular diameter or area of the Moon is greater than that of the Sun. Obviously, that happens only during a total eclipse.

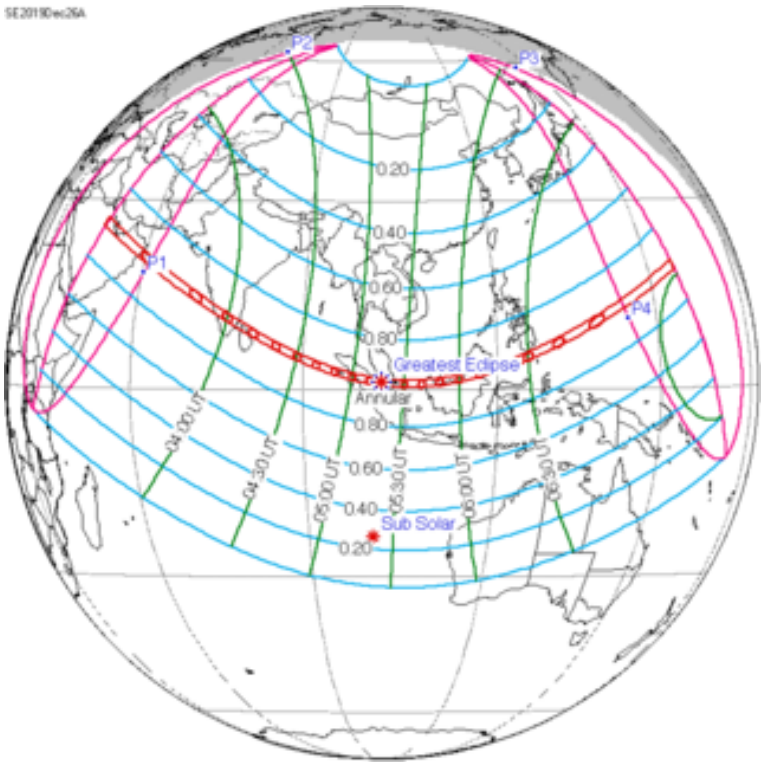


FIGURE 6. Eclipse path on 26 December 2019 from Arabia to the Pacific

At any given place on the Earth, the average frequency of a central solar eclipse is about once every 3 centuries though partial eclipses are more frequent. The next central solar eclipse visible in India is annular, on 26 December 2019, the path of annularity passes through South India around 9:30 am. Details are provided below.

A partial eclipse where even as much as 95% of the Sun is obscured, or an annular eclipse, is still no match to the total eclipse as the brightness of daylight during partiality can still be some 10,000 to 100,000 times the brightness during totality! This is why total eclipses are so special. The same is true of annular eclipses also where the obscuration of the sun is of similar amount. That is why it is very important to pay attention to safety aspects even during annular eclipses though a 95% obscuration may give a false sense of safety. In the coming annular annular eclipse of 26 December 2019, obscuration levels are at 94-95%.

After that we have another annular eclipse around 12:10 on 21 June 2020, the path of annularity passes through Suratgarh in Rajasthan, Sirsa and Kurukshetra in Haryana, Dehradun and Joshimath in Uttarakhand. The maximum annularity duration for this 0.997 magnitude eclipse is 38 seconds at Joshimath. On the other

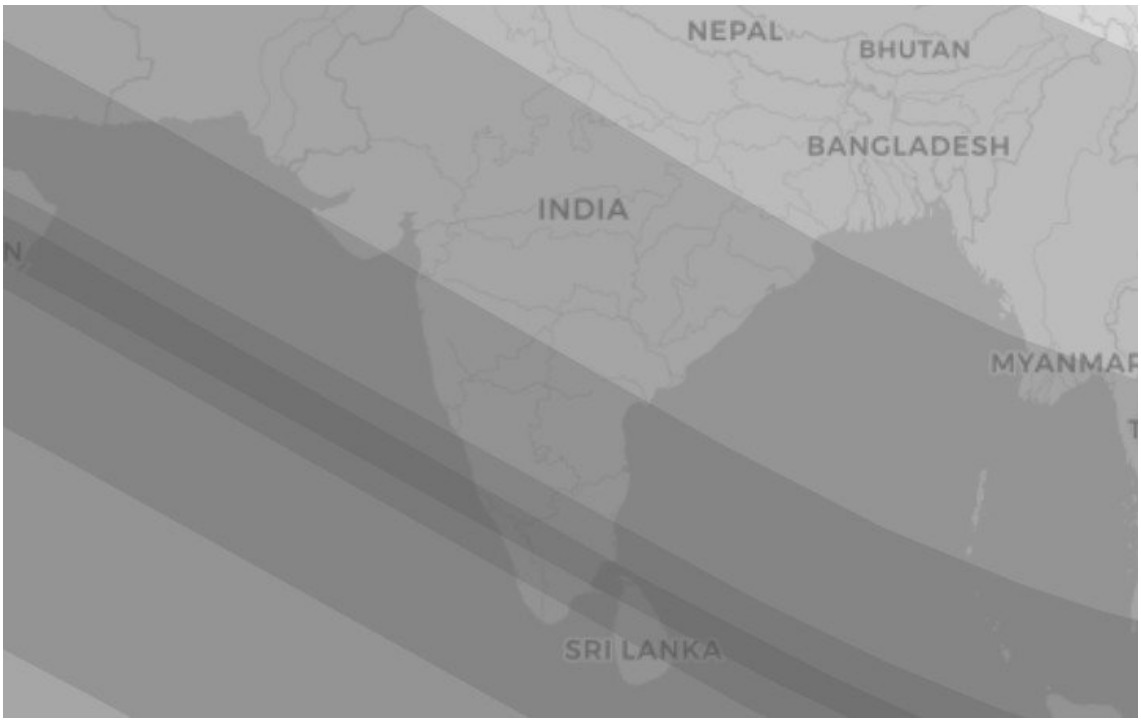


FIGURE 7. Eclipse on 26 December 2019 in India: darkest belt is path of annularity, next belts show obscuration of 90%, 75% and 50%

hand, for the coming annular eclipse on 26 December with magnitudes around 0.97, the durations in India are as long as 3 minutes in several places!

Central solar eclipses begin with partial eclipsing of increasing magnitude, and are followed by partial eclipsing of decreasing magnitude. The total duration of the eclipse, beginning with the first contact of the projected lunar disc with that of the Sun and ending with the last contact can be nearly 3 hours. But the duration of the totality or annularity itself is only a few minutes at best.

The duration of centrality is determined by the speed with which the shadow of the moon sweeps the earth on the one hand, and by the excess of the angular diameter of the Moon over that of the Sun on the other. In the absence of Earth's rotation, this speed would have been approximately 3380 kilometres per hour. But due to the fact that the Earth is rotating in the same general direction in which the lunar shadow is sweeping the Earth, the velocity of the shadow is reduced to about 1670 km/hr at the equator. At higher latitudes, the shadow moves much faster. Also, when the shadow falls very obliquely (as happens close to sunrise and sunset) the velocities can be very high - as great as 6000 to 8000 km/hr. Under the most

City	Begins	Magnitude	Ends
Ballari	8:06	0.88	11:08
Belagavi	8:04	0.90	11:01
Bengaluru	8:06	0.93	11:11
Bijapur	8:05	0.86	11:03
Chennai	8:08	0.89	11:19
Chikkamagaluru	8:05	0.95	11:05
Davangere	8:05	0.91	11:05
Dharmapuri	8:06	0.94	11:13
Dharwad-Hubbali	8:05	0.90	11:03
Gulbarga	8:06	0.83	11:06
Hassan	8:05	0.95	11:07
Haveri	8:04	0.91	11:04
Karwar	8:03	0.93	11:00
Kochi	8:06	0.94	11:09
Mysuru	8:06	0.96	11:09
Namakkal-Salem	8:07	0.96	11:14
Raichur	8:06	0.85	11:08
Ramanathapuram	8:08	0.96	11:17
Shimoga	8:04	0.94	11:03
Thanjavur	8:07	0.96	11:17
Thrissur	8:06	0.95	11:09
Tiruvarur	8:08	0.97	11:16
Trivandrum	8:07	0.91	11:12
Udupi	8:04	0.96	11:03

FIGURE 8. Partial eclipse data for some cities in South India

favourable conditions, the duration of totality can reach its maximum value of $7\frac{1}{2}$ minutes! Such a spectacular total eclipse will be visible in India on 5 July 2168.

3. Annular Solar Eclipse 2019

The next central solar eclipse visible from India will be on the day after Christmas, 26 December 2019. All of India will see at least a partial eclipse. Less than half the solar surface will be covered (this is called **obscuration**) in Kolkata, about three quarters in Hyderabad and 85% in Chennai. Chennai will have a maximum **magnitude** (fraction of diameter covered) of 0.89, Bengaluru of 0.93, Kanyakumari and Thiruvananthapuram of 0.91, Puducherry of 0.92 and Karaikkal of 0.95. Partial eclipse will begin after 8 am and last beyond 11 am. Maximum eclipse will be

FIGURE 9. Annularity belt on 26 December 2019 from Kerala to Sri Lanka

between 9:24 am and 9:34 am for South India. Figure 7 shows, on both sides of the annularity path, obscuration belts of 90%, 75% and 50%.

The two tables in Figures 8 and 10 give more detailed data for some cities of Karnataka, Kerala and Tamil Nadu.

Annularity will occur in India between 9:24 am to 9:34 am. The path of annularity will stretch from Mangalore at 13° north latitude, through Kasaragod, Kannur, Kalpetta and Palakkad in Kerala, Madikere and Gundlupete in Karnataka, Ootacamund, Coimbatore, Tiruppur, Palani, Pollachi, Erode, Tiruchi, Karur, Dindigul, Pudukkottai and Karaikkudi in Tamil Nadu at 9° north latitude, before moving on to Sri Lanka. The northern parts of Madurai city and Rameswaram island will have annularity for half a minute. The speed works out to 4000 kmph.

City	Begins	**Annularity**	Magnitude	**Duration**	Ends
Mangaluru	8:04	**9:24:04**	0.97	**2:11**	11:03
Kasaragod	8:04	**9:24:05**	0.98	**2:58**	11:04
Kannur	8:05	**9:24:48**	0.98	**9:27:47**	11:07
Thalassery	8:05	**9:25:07**	0.98	**2:51**	11:05
Madikere	8:05	**9:25:51**	0.97	**1:50**	11:06
Kalpetta	8:05	**9:26:00**	0.98	**3:10**	11:07
Kozhikode	8:05	**9:26:52**	0.97	**1:01**	11:07
Ootacamund	8:05	**9:27:08**	0.98	**3:09**	11:09
Gundlupete	8:06	**9:27:25**	0.97	**2:16**	11:09
Palakkad	8:06	**9:28:08**	0.97	**1:08**	11:09
Coimbatore	8:06	**9:27:42**	0.98	**2:57**	11:10
Tiruppur	8:06	**9:28:19**	0.98	**3:04**	11:11
Erode-Palani	8:07	**9:29:36**	0.97	**1:48**	11:13
Karur	8:07	**9:29:56**	0.97	**2:37**	11:14
Dindigul	8:07	**9:29:49**	0.98	**2:45**	11:14
Tiruchchirappalli	8:07	**9:31:28**	0.97	**1:45**	11:16
Madurai–Vaigai river	8:07	**9:31:30**	0.96	**0:36**	11:16
Sivaganga	8:07	**9:31:31**	0.97	**1:52**	11:16
Karaikkudi-Pudukkottai	8:08	**9:31:16**	0.98	**3:08**	11:16

FIGURE 10. Central eclipse data for Karnataka, Kerala and Tamil Nadu

In Figure 10, annularity timings (that of **second contact**) and duration are in **boldface**. The eclipse data is taken from two sources:
www.timeanddate.com/eclipse/solar/2019-december-26,
and the interactive map provided at Fred Espenak's Nasa Eclipse page:
eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2019Dec26Agoogle.

The data may be off by upto half a minute. Making precisely timed observations of the four contacts is important. *Even where the eclipse is annular, its magnitude is below 1 since the entire Sun is not covered.*

4. Where to View The Eclipse

The choice of an ideal site to view the eclipse is determined by several factors which could sometimes be mutually exclusive! The most important among such factors are :

4.1. **Duration of Centrality.** Naturally it would be best if one could view centrality for as long a duration as possible. First choose a site where the eclipse will be total. This can be done by choosing sites well within the band of centrality. Sites close to the edges of the band will have lesser durations than those within. Then try to choose a site with the lowest latitude possible. This last point is useful only if substantial reduction in latitude could be achieved; otherwise one can ignore this consideration.

If one is only interested in experiencing the great spectacle of the solar eclipse without any plans for photography or experiments, a duration of 20 to 30 seconds of centrality will suffice. This will allow a greater flexibility in choosing the site.

4.2. **Weather Conditions.** It is better to avoid regions where it is likely to be cloudy around the time of centrality. So study the weather pattern around the region of your site for the latter part of December.

4.3. **Aesthetics.** In addition to the above factors which are crucial for a successful viewing of the event, the psychological impact of the event can be heightened by choosing a site with beautiful natural surroundings. Lots of trees and vegetation around affords the unique opportunity of seeing them under very peculiar lighting.

For example, you could pick a vantage point from a hill top from which one has a clear view of the distant horizon. These places do exist though one has to do some homework to find them!

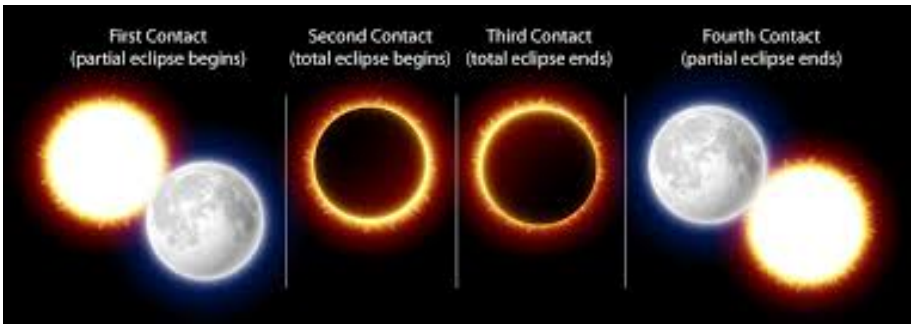


FIGURE 11. Contacts

5. WHAT TO SEE

The solar eclipse is characterised by the four so-called **contacts**; the **first contact** is when the edge of the Moon first touches the edge of the Sun. This is the beginning

of the phase of partial eclipse. The solar disc from then on is eclipsed to a greater and greater degree till the **second contact**. At the time of the second contact the eclipse is total or annular depending on the circumstances. The **third contact** is characterised by the cessation of total or annular eclipse when a thin crescent of the solar disc begins to be observable, and finally the **fourth contact** is when the Moon leaves the Sun's disc. The duration between the first and second contacts, as well as between the third and fourth contacts is the **partial phase**. The duration between the second and third contacts is the **centrality phase**.

5.1. **During the Partial phase....** Several interesting phenomena may also be seen during this phase. One such is the monitoring of progress of the eclipse itself. This will require seeing the partially eclipsed sun.

Great care must be exercised to protect your eyes from getting damaged. The surface brightness of the solar disc is unaltered during the partial phase. Please read Section 6 of this book, on Precautions, carefully before attempting to observe the partially eclipsed sun.

FIGURE 12. Pin-hole camera effect

5.1.1. *Pin-hole camera effect.* Another interesting phenomenon to observe during partial phase is the "Pin-hole" camera effect created by the leaves of trees as sunlight filters through them (more precisely, through gaps in them). Before the eclipse begins, the ground is covered by overlapping discs which are actually the images of the sun. As the eclipse progresses, these discs take the shape of the eclipsed sun. When the eclipse is quite advanced, one sees a myriad collection of crescents! The effect may be enhanced by spreading a white sheet on the ground.

5.1.2. *Shadow Bands.* Just before the shadow of the Moon reaches the observation site (as totality is about to begin), one can see quivering, ripple-like bands of shadows on the ground. Their visibility can be enhanced by spreading a bright white sheet on the ground. These bands are a very beautiful phenomenon to watch. They give the impression of a multitude of snakes crawling on the ground!

These bands are caused by the irregularities in the refraction of the earth's atmosphere observed under the lighting conditions prevalent just before the onset of the totality.

Shadow bands can be visible during annular eclipses too. But the obscuration has to be around 98% at least. In the coming annular eclipse the maximum obscuration is around 95%, so shadow bands will not be visible.

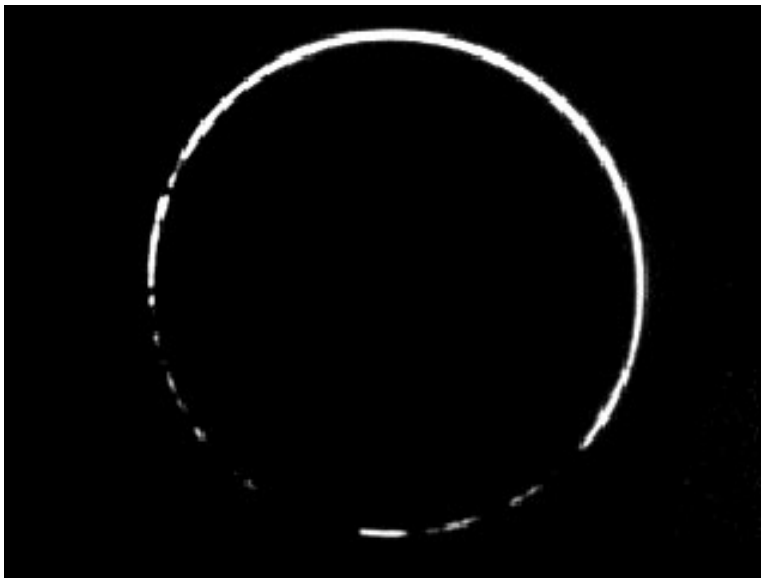


FIGURE 13. Bailey's Beads during annularity

5.2. **During the Central phase....**

5.2.1. *Bailey's Beads.* For a second or two, just before centrality and again as the Sun emerges at the end of centrality, light breaks through the valleys on the rim of the Moon, forming what looks like a beaded necklace along the edge of the Moon. This is a very spectacular effect and is rather short-lived. But to observers situated near the edge of the band of centrality the Beads can be visible for several seconds.With the disappearance of the last bead on one rim of the moon, centrality begins; this occurs just around the time of the second contact. likewise, with the disappearance of the last bead on the other rim, centrality ends, just around the time of the third contact.

6. Precautions to be Taken ...

Looking at the Sun, either directly or through the view-finder on your camera, can burn your eyes and cause blindness. Never look at the sun without adequate protection. Protecting your eyes adequately means reducing exposure to ultra-violet and infra-red radiation, which can damage your eyes instantaneously without your immediately being aware of it. Also, adequate protection will increase eye comfort by reducing the intensity of sun's visible rays.

The intensity of sunlight for direct safe viewing should be reduced by at least 100,000 times and ultra-violet and infra-red part of the solar radiation should be effectively cut off. Therefore always use a filter that will absorb equally and sufficiently the ultra-violet, infra-red and visible energy of the Sun.

There have been erroneous recommendations suggesting the use of materials that absorb the visible energy but do not absorb the dangerous, invisible infra-red rays.

Filters that are NOT safe

- ***Smoked Glass***
- ***Crossed-Polarising elements***
- ***Colour film***
- ***Sunglasses***

Filters that ARE safe

- ***Dark arc-welders glass***
- ***Two or three thicknesses of BLACK and WHITE (NOT colour) photographic film completely exposed and developed***

Place the filter in FRONT of your eyes before facing the sun.

Such a filter can be made by exposing the black and white film completely and developing to maximum density. The film can be completely exposed by unrolling it in broad daylight. The film should then be fully developed according to the manufacturer's recommendations. *Such Films Are Not Good for Photographic Use.*

These days filters and goggles are sold by many commercial platforms. But ensure their safety by reading reviews about the products. This is extremely important. Don't always go for cheaper alternatives, safety comes before savings!

6.1. **Projected Images.** Partial phases can also be observed by projecting the image of the Sun. The following simple arrangement should work quite well: cover a plane mirror with a piece of paper having a circular hole of diameter 1 to 2 cms. The sunlight reflected from this arrangement may be thrown on to a shaded wall indoors. Reduction in the diameter of the hole in the paper will increase the sharpness of the image at the loss of its brightness. Alternately, one can just build

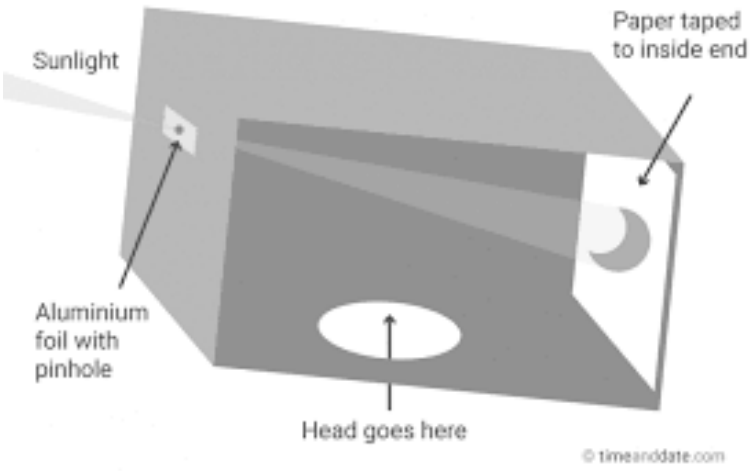


FIGURE 14. Projecting the image

a *pinhole camera* with two plane cardboard sheets. In one, make a hole that is not too small (smaller the hole, less bright will be the image), nor too big (bigger the hole less sharp will be the image). A separation of 1 metre can produce an image of about half a cm.

7. What to Photograph and How to Do it

7.1. **The Three Unforgettables...**

7.1.1. *Camera Protection.* The Sun can burn holes in focal-plane shutters, warp the leaves of the between-the-lens shutters, and melt composition shutter blades. Use small lens openings and *Neutral Density Filters (ND-Filters)* that are made for *photographic* use. If the camera must be pointed toward the Sun throughout the eclipse, shade it between exposures.

7.1.2. *Aiming The Camera. NEVER* look at the Sun through a camera finder without suitable filters. This is especially important with single-lens reflex cameras, both still and movie. It is best to aim the camera without using its finder. (A way to do this will be explained shortly.)

If you must use the finder, use filters (as described in the section on safety precautions) held in front of the view-finder if the camera is *NOT* of the single-lens reflex type, and in front of the lens if it *IS* a single-lens reflex camera. While using the filters for viewing, remove the Neutral Density filters and put them back while photographing. After the ND-filters have been put back, do not look through the finder.

7.1.3. *Aiming Without Using The Finder.* A simple device that allows one to aim the camera at the sun without using the view-finder is the following: mount a thin straight wire of about 6 inches on a flat platform of roughly 1 square inch area such that the wire is at right angles to the flat area. Now to aim the camera, place the flat area on the front part of the camera body and move the camera till the shadow of the wire on the body disappears. Now the camera is exactly facing the Sun.

Typical Exposures	
Film Speed	64-80 ASA
ND Filter	5
Lens Opening	f/8
Exposure Time	1/125 second
Exposure Time for Bailey's Beads	1/15 second

7.2. **Exposure and filters.** The light from the Sun's surface is so intense that even to photograph a well eclipsed Sun, the intensity must be reduced by factors of 10,000 to 100,000. Neutral density filters are the best way of cutting down the light to allow normal exposures. During the partial phase, the intensity of the surface of the Sun is the *SAME* as in normal sunlight. Therefore the best exposures for the partial phases can be determined well ahead of the eclipse by making test exposures of the Sun with a *Neutral Density 5* filter.

Kodak Wratten Neutral Density Filters, No.96 are available in various densities ranging from 0.10 to 4.0. Higher densities can be obtained by combining two or more filters. It is not advisable to use more than two filters in a combination. If you can get hold of a single ND 5 filter, that would be the best.

An ND filter of density D cuts down the intensity of light by a factor 10^D. Thus a neutral density 5 filter cuts down the intensity by a factor of 100,000.

In addition to neutral density (ND) filters, so called *Solar Filters* are also available. Solar filters cut out more infrared than ND. Optical density filters (OD) work similar to ND filters.

It is advisable to use *Full Aperture* filters. With filters, the film speed is not critical and any reasonable ISO should be fine. This is because there is enough brightness even after filtering. Interested readers can further consult: nikonusa.com/learn-and-explore/a/tips-and-techniques/how-to-photograph-a-solar-eclipse.html.

Techniques for using mobile phone cameras will be discussed a little later. The safety hazards with the use of mobiles can be greater so readers are urged to carefully read that section.

Remarks. Always try, where possible, to also take exposures that are equivalent to one f-stop more and one f-stop less than the exposures recommended in this manual.

7.3. **Photography During the Partial phase....** An interesting thing to photograph during partial phase is the record of the eclipse that includes the partial phase before centrality, centrality phase and the partial phase after centrality. One could start roughly one hour before centrality and go on for one hour after centrality. The camera should be mounted on a firm support and a series of exposures at 5-minute intervals should be made on the *same* film frame. The position of the Sun will change about 15° per hour. A normal focal length camera lens will cover a sufficient angle for a 2-hour exposure. It should be so planned that at the time of totality the sun is at the center of the frame. The timing of the progress of the eclipse is necessary to plan the camera position as well as the exposure schedule.

Remarks. The fraction of the film occupied by the image of the Sun depends on the effective angle of view of the lens. For example, on a 200 mm telephoto lens the image of the sun is much bigger than with a 55 mm normal lens. The actual image size (diameter) on the film can be estimated by dividing the focal length by 100. You should carefully calculate the number of exposures and the interval between exposures so that images do not overlap. Because of the multiple exposures you may be afraid that the background may be over exposed. But since the eclipsed sun

FIGURE 15. Various stages of an annular eclipse on a single frame

is being photographed with a neutral density 5 filter which cuts down the intensity by a factor of 100,000 even 100 exposures of the background on the same frame will only let one thousandth the brightness of the background to be recorded on the film.

If photography on the same frame of film proves difficult, try recording the progress of the eclipse as follows: make sure that during the entire period of the record, the sun is visible in the field of view of the camera which should be so oriented that at centrality, the fully eclipsed sun is at the centre of the frame. Keep this orientation of the camera *fixed* during all the exposures which will be on *different* frames on film. For best results, use film for slides. Projection of these slides in rapid sequence can recreate the entire history of the eclipse in a short span of time!

7.4. **Photography During the Centrality phase....** *Centrality during the coming Eclipse will last at most for about* 3 *minutes.* Therefore, plan well in advance and be prepared so that you can take many exposures during this brief period.

Caution. As the time available during centrality is limited and the exposure times are relatively long, *it is very important to reduce camera shake as much as possible.*

If you are planning serious photography, prior planning based on use of tripods is important. It is advisable to use data on the height of the sun during various phases. Such information for the place you are observing from can be found for example at www.timeanddate.com.

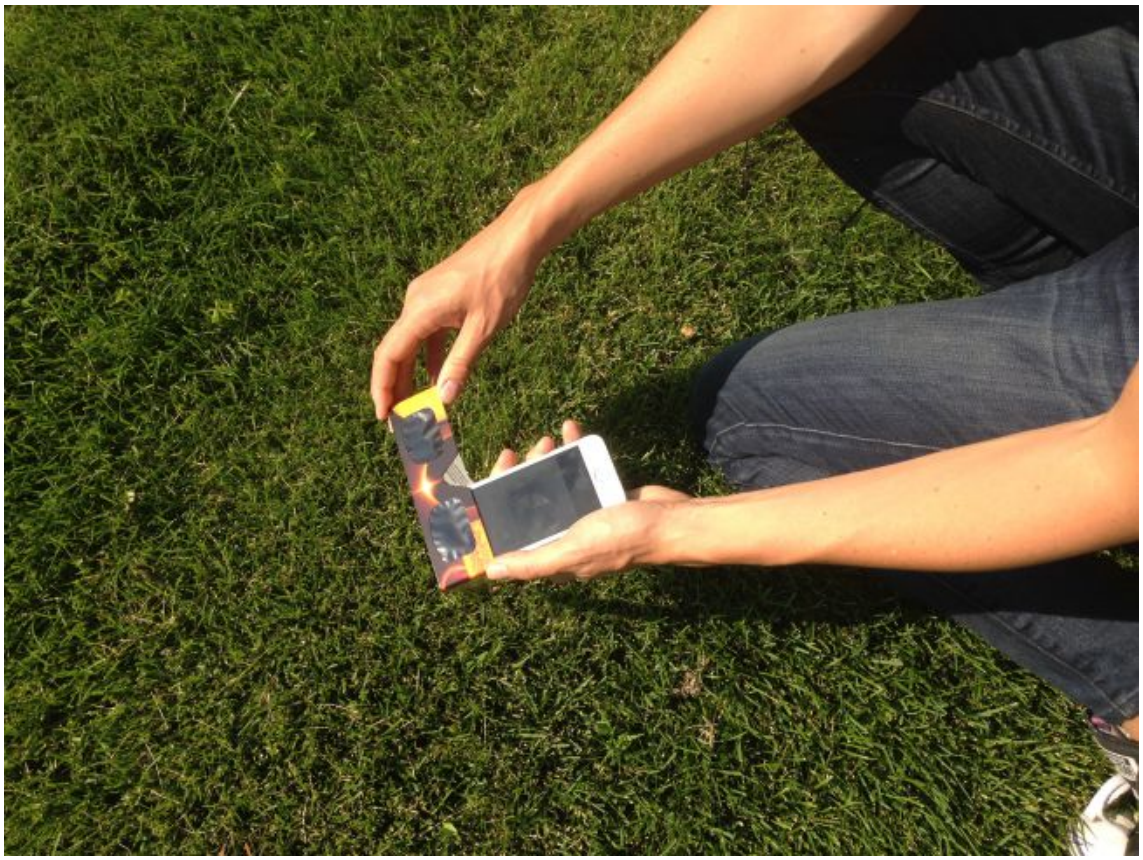
8. Photographing solar eclipses with mobiles

A large number of people will likely be using their mobile phones for photographing the eclipse. There are several safety aspects that need to be stringently adhered to. Unlike DSLR cameras, filters cannot be rigidly mounted on to mobile cameras, at least not very easily.

One way is to stick suitable filters to cover the camera openings with the help of scotch tapes. It is not advisable to simply hold goggles over the camera openings. Even after fixing filters over camera openings, the danger is that one may inadvertently look up at the sun directly, which should be avoided at all costs.

Calla Cofield in *Skywatching* has suggested an ingenious way of avoiding this danger. The picture on the next page should be helpful in understanding her suggestion.

The idea is to have the Sun *behind* you so the danger of even accidentally looking at the Sun directly does not arise. Most mobile phones come with front facing and back facing cameras. Choose the camera that faces your face and scenes behind your back. Now cover that camera opening with a layer of suitable filter. Now you can look at the screen of the camera without looking directly at the Sun. You can make things more efficient timewise by using the height of the Sun information that I mentioned earlier. A tripod on which the mobile can be mounted will make it even more hassle-free.



Do not spend all your time staring at your camera !

Get as much visual impression of the eclipse as possible !!