

THE COMING TOTAL SOLAR ECLIPSE AND THE AMATEUR ASTRONOMER

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Abstract

Details of a total solar eclipse, with special reference to the forthcoming February 16, 1980 eclipse, has been given, along with how an amateur astronomer can best utilize this opportunity.

INTRODUCTION :

There is going to be a total solar eclipse on February 16, 1980. Its path of totality passes through the southern part of India, beginning near Karwar on the West coast of India, crosses near Puri over the head of Bay of Bengal and reaches the coast of Bangladesh near Chittagong. (Fig. 1) This is considered to be an excellent opportunity for the astronomers and other research scientists since it is occurring in the month of February when this part of India is practically free from rains and clouds ; and also because the time of mid-totality is in the afternoon at 3-40 p.m., when the Sun will be at a suitable altitude in the clear blue sky well above the horizon for comfortable

observation. The duration of totality is also long enough, varying from about three minutes near Karwar to nearly two and a half minutes near Puri where the sun will be about twenty degrees above the western horizon.

In the past, such a highly favourable and rare opportunity was to be had in India only eighty two years ago, on January 22, 1898, when a total solar eclipse was observed by many teams of foreign and Indian astronomers from several places in the Deccan and Central India⁽¹⁾. The problems that were being debated then were concerning the nature and origin of the flash spectrum, the location of prominences in relation to the coronal

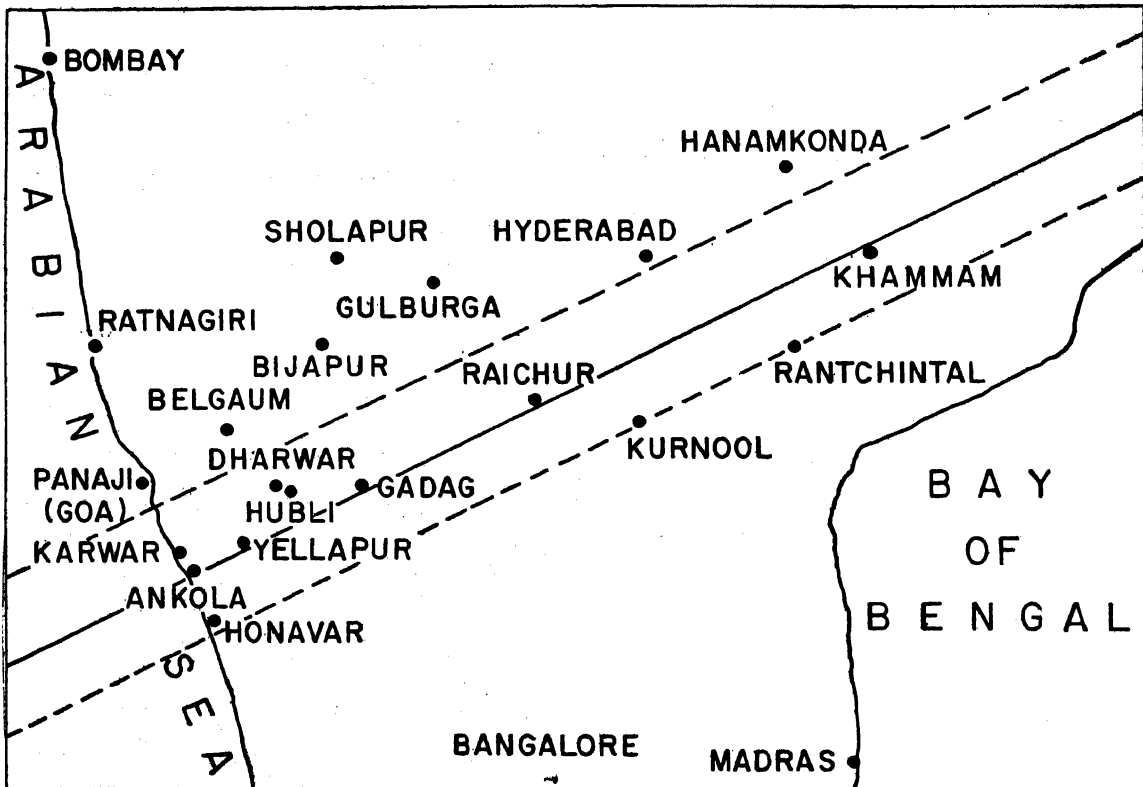


Fig. 1 : Map of a part of India showing the path of totality of the Solar Eclipse of 16th Feb. 1980. Some important cities lying on the shadow path and some in the neighbourhood are marked for selection of suitable sites for observation.

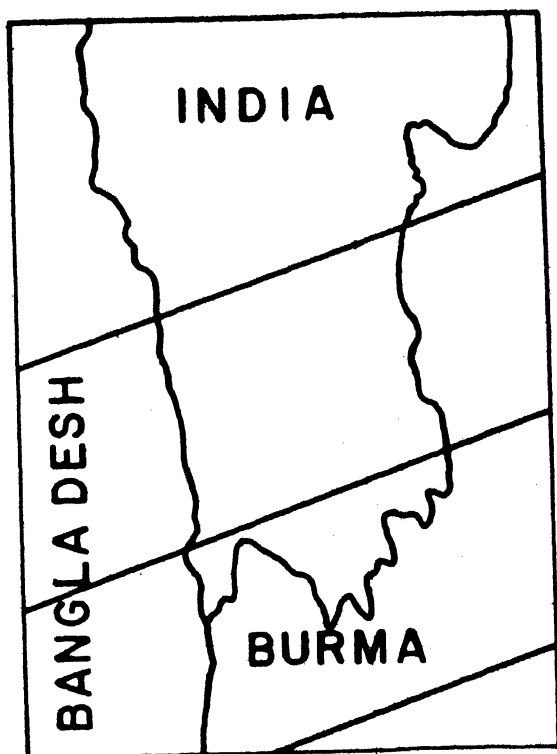


Fig. 1: Continued

streamers, the nature and spectrum of coronal material, the origin of "Shadow bands", and the effects of a total solar eclipse on weather and the biological world in general. Although during these past eighty years or so lot of progress has been made by the professional astronomers and the research scientists the world over, in our understanding not only of the phenomenon of a total solar eclipse but also about the Sun and the numerous newly discovered, solar terrestrial relationships, still most of the above questions of old should, in the opinion of the author, form worthwhile challenges to be taken up again by the Indian amateur astronomers*, if not by the professional scientists.

WHAT THE RESEARCH SCIENTISTS WILL DO:

This time also in addition to the Indian astronomers and research scientists many teams of foreign astronomers are bound to visit India with their far improved instruments and techniques for securing fresh observational data on the several newly vexing problems regarding the Sun and the solar-terrestrial relationships.

They will naturally select different sites along this path suitable for their contemplated investigations and choose techniques appropriate for modern conveniences of operations. Apart from the ground based observations with the usual optical and radio techniques, some teams

*N. B.: An appeal, similar to this present one was in fact made to the then interested Indian amateur observers well in advance of the 1898 solar eclipse, but to the best of the present author's knowledge, no reports seem to have been made by any of them.

flying in the well equipped air planes may even race along the path of totality to lengthen the available period of observation; others may like to fire in succession several rockets from suitable locations; still others may like to send up guided balloon born observational platforms. Suitable radio and radar techniques for the upper atmospheric investigations up to and even beyond the ionospheric levels may also be used at well distributed ground stations across the path of totality; and satellites may also be used at the proper epoch and place for some investigations outside the earth's atmosphere. In the case of ground based observations, luck plays a dominant role.

WHAT AN AMATEUR CAN DO:

There are two strong reasons why the Indian amateur astronomers need not be frightened at the above mentioned highly sophisticated paraphernalia and modern techniques of the professional astronomers. He can still do his job well in his much simpler ways, of course, with good previous understanding and systematic planning for the occasion. (i) He will be in a position to visit and acquaint himself with the new instrumentation brought by the professionals and (ii) if luck would have it, he alone may be able to secure the best possible observations, which the professional astronomers due wholly to their ill luck, could not secure from their selected sites, due to local clouding and bad weather! Of course, one must not bank upon these, because the reverse may also happen. But in any case one must be prepared to volunteer boldly and intelligently at the eleventh hour, if occasion demands.

Few amateurs, however, know what and how an observation during a total solar eclipse should be taken which would be worthwhile. This is quite understandable since really no body has perhaps seen a total solar eclipse. Hence it will be quite useful and illuminating to quote here first an authentic and very vivid description of this rare astronomical event. The following extract taken from Todd's book "Total Solar Eclipses" was reproduced by Prof. K.D. Naegamvala in his report of the 1898 solar eclipse⁽¹⁾ and is reproduced here from that report (see figs. 2-5).

DESCRIPTION OF A TOTAL SOLAR ECLIPSE:

"As the entire duration of an eclipse, partial phases and all, embraces two or three hours, often for an hour after "first contact" insects still chirp in the grass, birds sing, and animals quietly continue their grazing. But a sense of uneasiness seems gradually to steal over all life. Cows and horses feed intermittently, bird-songs diminish, grasshoppers fall quiet, and a suggestion of chill crosses the air. Darker and darker grows the landscape so much as five minutes before the total obscurity, it may be possible to detect strange wavering lines of light and shade dancing across the landscape—the "shadow bands", as they are called—a curious and beautiful effect not yet fully understood.

"Then with frightful velocity the actual shadow of the moon is often seen approaching, a tangible darkness advancing almost like a wall, swift as imagination, silent

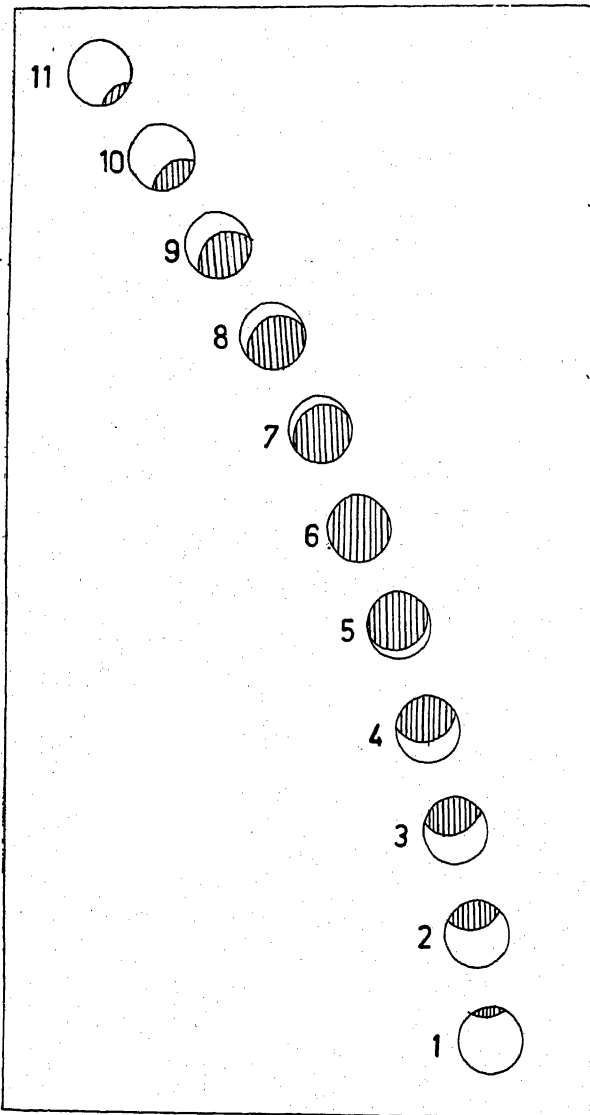


Fig. 2: A sketch of the progressive stages of a Total Solar Eclipse. Note that these eclipse stages are in the morning sky. The solar eclipse always begins at the west limb of the Sun with the east limb of the moon advancing on the solar disc.

as doom. The immensity of nature never comes quite so near as then; and strong must be the nerves not to quiver as this blue-black shadow rushes upon the spectator with incredible speed. A vast palpable presence seems overwhelming the world. The blue sky changes to grey or dull purple, speedily becoming more dusky, and a death-like trance seizes upon everything earthly. Birds with terrified cries fly bewildered for a moment and then silently seek their night quarters. Bats emerge stealthily. Sensitive flowers the scarlet pimpernel, the African mimosa, close their delicate petals, and a sense of hushed expectancy deepens with the darkness. Some times the shadow engulfs the observer smoothly, some times apparently with jerks; but all the world might well be dead and cold and turned to ashes. Often the very air seems to hold its breath for sympathy, at other times a lull suddenly awakens into a strange wind, blowing with unnatural effect.

"Then out upon the darkness, gruesome but sublime, flashes the glory of the incomparable corona, a silvery, soft, unearthly light, with radiant streamers stretching at times millions of uncomprehended miles into space, while the rosy flaming protuberances skirt the black rim of the moon in ethereal splendour. (figs. 4 & 5) It becomes curiously cold, dew frequently forms and the chill is perhaps mental as well as physical.

Suddenly, instantaneous as a lightning flash, an arrow of actual sunlight strikes the landscape, and the earth comes to life again, while corona and protuberances melt into the returning brilliance, and occasionally the receding lunar shadow is glimpsed as it flies away with the tremendous speed of its approach."

THE AIM OF THE AMATEUR ASTRONOMER :

It must be emphasized that whatever facilities and instruments the amateur astronomer may already possess or is likely to possess for carrying out his contemplated observations during the eclipse period, he must be clear and firm in his mind as to what he wants to do with them and what he can do with them. He must be sure, if all goes well, what he will get with them will be worth-

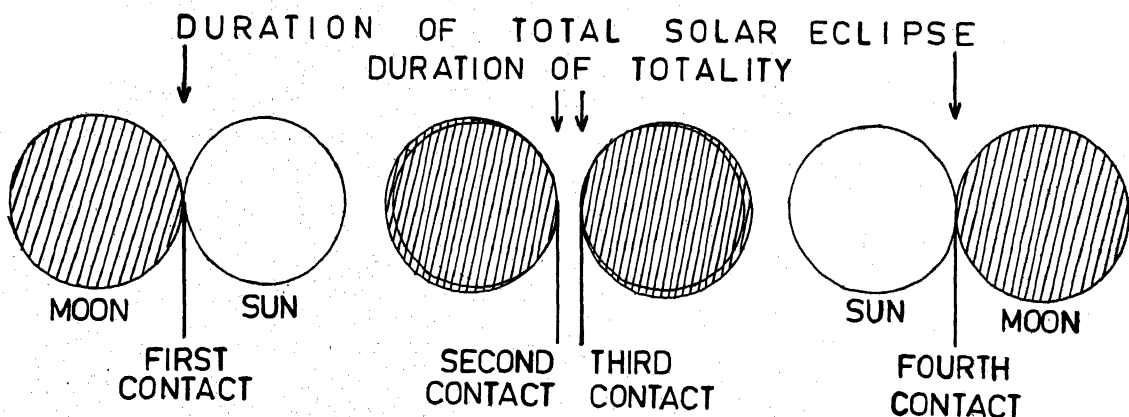


Fig. 3: Explaining the definitions of important terms and epochs of the total solar eclipse.

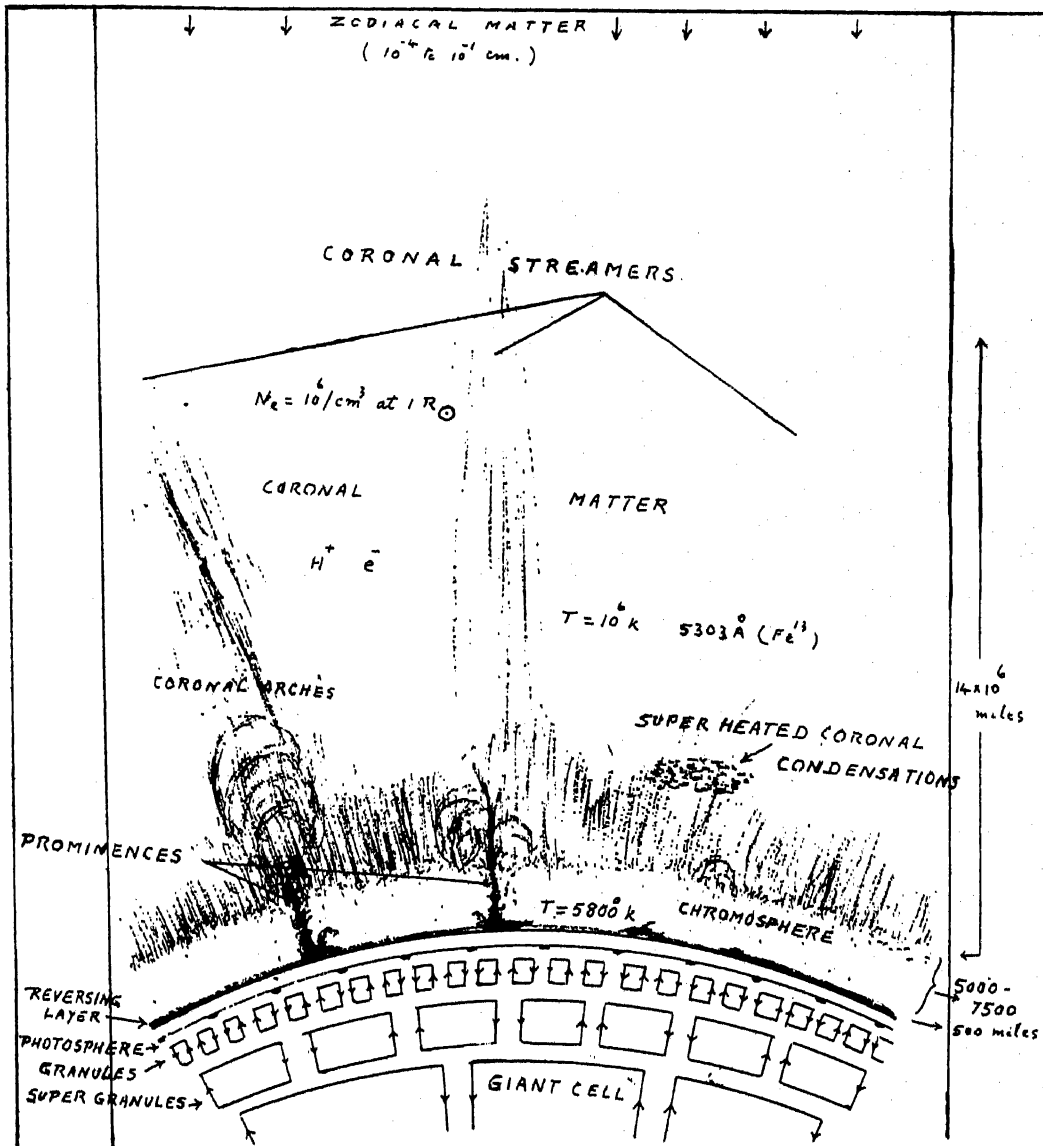


Fig. 4: A sketch (not to scale) to explain the different important parts of the solar atmosphere normally invisible to the eye, and visible only during a total Solar eclipse.

while. Thinking loosely and at random in air will not serve the purpose, which is, of course, true in all matters of high achievements in modern life. But here is an extremely rare opportunity and perhaps the only one he is even likely to get soon. He may be required to move to a suitable place in the path of totality a day or two before the eclipse day and must have spent quite some time and effort in preparing for the occasion. He must not, therefore, return without achieving anything substantial. The total solar eclipse is really an ideal occasion for a cooperative effort and a dozen Indian amateurs of different disciplines should pool together all their resources to form a group of Solar Eclipse Observers. As far as can be said in this context, in a general way, is that either singly or collectively they must not lose this rare opportunity. The only solace, if that can be, is that luckily two more total solar eclipses are scheduled to be observable in India in 1995 and 1999. But then it will

be wise not to run after them leaving the present one. So the aim of the amateur astronomers will thus be to form a cooperative group of at least half a dozen enthusiasts to observe the coming total solar eclipse and to plan well in advance the programme of work after duly studying and discussing the possibilities of achieving definite worth while objectives.

SELECTION OF A SITE :

Two short tables are prepared and presented here for the consideration of the Indian amateur astronomers⁽³⁾. In Table 1 are given the predicted times and durations of the totality at different points on the axis of the shadow path of this eclipse, as also the altitude of the

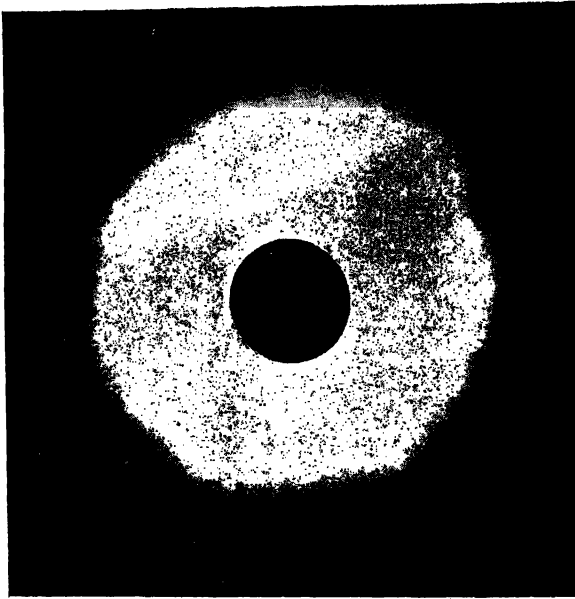


Fig. 5: A typical photograph of the solar corona observed during a total solar eclipse near solar maximum.

Table 1

Predicted times, durations and positions of the Sun in the sky. Some positions on the axis of the shadow path of the eclipse of 16th Feb. 1980.

Time I. S. T. Hrs. Min.	Latitude (North)	Longi- tude (East)	Dura- tion of totality Min. Sec.	Altitude of the Sun	Width of the shadow path (Miles)
15 30	11 47.0	63 33.0	3 10.0	48°	84
35	13 02.4	70 55.7	3 01.3	44°	82
40	14 23.3	73 35.1	2 51.9	40°	80
45	15 51.3	76 37.3	2 41.6	36°	78
50	17 28.8	80 12.7	2 30.2	31°	75
55	19 20.7	84 41.3	2 17.2	25°	72
16 00	21 39.0	90 54.6	2 01.3	18°	68

Sun at the time and place selected. The middle three rows are more relevant to us and so in Table 2 the mean monthly meteorological data for the month of February are given for five selected typical places falling in this region. Apparently Hubli-Dharwar region may be judged to be the most favourable for observation yet the region between Gadag and Raichure seems to the present author to be better from practical considerations. In any case, it should be remembered that in a serious study like this, one has to camp at a place which is safe and also far enough (8-10 miles away) from the city

Table 2

Mean Monthly Meteorological Data for the Month of February.

Station	Honavar	Gadag	Raichur	Kurnool	Hyde- rabad
Latitude (North)	14° 17'	15° 25'	16° 12'	15° 50'	17° 27'
Longitude (East)	74° 27'	75° 38'	77° 21'	78° 04'	78° 28'
Height above m.s.l. (meters)	26	650	400	281	545
Relative Humidity (%)					
Morning	75	54	54	57	64
Evening	64	31	29	25	35
Tempera- ture Min. 21 (°C). Max. 31		19 33	20 33	19 35	17 31
Rainfall min. 0.0 (m.m.) max. 0.1		0.2 1.6	0.6 6.0	0.5 5.0	0.8 11.4
Wind velo- city(km/hr)	5.2	7.1	9.4	6.9	8.9
Days of clear sky	7	4	12	10	9
Days of overcast sky	0.0	0.0	0.0	0.1	0.0
Cloudiness (all types) (octans)	2.4	2.8	2.1	2.1	2.1

crowds of onlookers and other disturbances of highways, railways⁽¹⁾ and airways too! The airplanes of the foreign professional and research astronomers will most profitably and probably too, fly east-ward from the coast of Africa along the shadow path which lies over the Arabian sea before reaching Karwar⁽⁴⁾, and are not likely to disturb the ground based observations in India.

SUGGESTED OBSERVATIONS :

The amateur eclipse observers may carry out all or some of the following observations depending, of course, upon their instrumental resources and training. They may enlist some research workers or induce them to continue to work their units at their locations during the eclipse period. They are suggested because some of them are directly linked with the modern advances in Solar Physics and some with the solar-terrestrial relationships; and doing this the amateurs will be proud to have contributed to this growing branch of science or at least

helped to raise the standard of amateur work in India. A must in all these observations is that at every instant, along with every observation, *exact* time must be recorded.

Observations suggested to be taken during the coming total solar eclipse :

1. Changes in the appearance of the sky from horizon to horizon noting the approaching and receding moon-shadow.
2. Changes in the behaviour of plants (like mimosa), insects (like chirping grass-hoppers), birds (like sparrows, crows, etc.), and animals (like bats, cows, sheep).
3. Changes in the total illumination on the horizontal open ground.
4. Quantitative observations of the "shadow bands", noting their widths, orientation and speed.
5. Timing the duration of the visibility of corona seen through two or three different colour filters.
6. Timing the accurate duration of totality (see Figs. 2 & 3).
7. Time-lapse sketches or photographs of the solar corona (see Figs. 4 & 5).
8. Effect of travelling moon-shadow on the micro-barograph records, located at various distances from the moon-shadow path,—a study.
9. Reception of signals or broadcasts across the eclipse path.
10. Effect of the total solar eclipse upon the reception of atmospherics, (radio noise) preferably on different frequency bands.
11. Observation of the spectrum of the corona with a direct vision hand spectroscope, with fully dark-adapted eyes; but with great care.

Immediately after the event, before the impressions on the mind fade away or the memory fails, a detailed report must be written out with the help of one's own untampered notes. Qualitative description, of course, is less amenable to comparison than quantitative notings.

In the end, while conceding that a more detailed information and instruction regarding how to take these observations in practice, etc., could not be given in such a short article as this, it must be emphasised that those

who want to make the best of this unique opportunity should do well to study in advance relevant portions from some standard text books, and discuss boldly with the experts and teachers about the contemplated plan of observations. They should also acquaint themselves with elementary methods of surveying the sky. This will be an excellent opportunity for getting a training under the direction of sympathetic and able experts in astronomy for serious amateurs. The least gain will be a good training in astronomical observational work; and this will stand in good stead for them during the observation of the future total solar eclipses of 24th October 1995 and 11th October 1999 visible in India.

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Further Reading :

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