ROYAL ASTRONOMICAL SOCIETY OF CANADA
Standing Committee on Observational Activities
Programme for Solar Eclipse of July 20, 1963

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Basic Observation Programme
Section A. Precision Observations

In this bulletin we cover briefly the procedure to be followed for each of the projects that come under the heading of Precision Observations, as outlined in Bulletin No. 2.

OBSERVER'S CO-ORDINATES

All reports must give the observer's co-ordinates - latitude, longitude and elevation above sea level - for there is little value in making precision observations unless the observer knows exactly where he is when he makes them. For those who have neither the instruments nor the experience to make an actual survey, the best method is to plot one's position on a government survey map from which the co-ordinates can then be calculated with a fair degree of accuracy. If survey maps are not obtainable, the observer's position can be plotted on a road map, with a notation giving the distance, as measured by car speedometer, from the nearest intersection. This road map is then attached to the observation report. The method of determining co-ordinates or position should always be stated in the report.

METHODS OF TIMING

There are several methods of timing and the one selected will depend on the degree of accuracy required, the equipment available and personnel available. Four methods are described below. (Anyone using more elaborate methods needs no guidance from us!) The timing method used should be stated on the observation report.

(1) With Ordinary Watch. If an ordinary watch or clock with a second hand is used, two persons are required - one to watch the phenomenon and one to watch the watch. When the observer calls "Time!" the timekeeper notes the time, to the split second if possible. This involves some sacrifice on the part of the timekeeper, for he cannot take his eyes off the watch. The timekeeper has a record sheet handy and several minutes before the phenomenon is scheduled to occur he begins to write down the time each minute, making a pencil stroke as each second elapses. He then has a means of re-checking his timings later.

The watch used should be set by radio time signals and its accuracy checked for some period both before and after the event. If short-wave time signals are not available, then the Dominion Observatory one o'clock time signal on the broadcast band can be used, in which case the watch must be checked for several days, both before and after, and the error noted. The timings should not be adjusted for watch error but the record of watch errors should accompany the report.

(2) With Short-Wave Radio. Two persons are required for this method - one to observe the phenomenon and one to record the time. The timekeeper follows much the same procedure as under (1) above, except that he listens instead of watches, writing down the time each minute and recording each second that elapses. This method is somewhat more accurate than Method (1) but requires great concentration on the part of the timekeeper, who will be completely lost if he allows his attention to be distracted even momentarily. Also, it is dependent on good reception throughout.

METHODS OF TIMING (cont'd.)

(3) With Stopwatch and Short-Wave Radio. Equipped with a stopwatch and short-wave radio, the observer can be his own timekeeper. He starts the watch when the phenomenon occurs and then stops it at a given time signal. By deducting the watch reading from the given time, one obtains the observed time of the phenomenon. The stopwatch should be stopped on the next time signal possible, preferably within five minutes, for if it is allowed to run too long, the accuracy of the watch will have to be checked as under (1) above. Method (3) is much more accurate than either (1) or (2) but is dependent on good radio reception.

(4) With Short-Wave Radio and Tape Recorder. With radio and tape recorder running continuously, both time signals and the voice of the observer as he calls "Time!" are recorded on the tape. This method has both advantages and disadvantages. It can be extremely accurate and the observer can record all other details of this observation on the tape. However, reports are not available immediately. Much playback time is required before written reports can be produced. Also, because extraneous noise can be a serious handicap, the method is probably better suited to a lone observer than a group effort.

It can be seen that the timekeeper is a very important member of the team. Both timekeeper and observer must become thoroughly familiar with the procedure to be followed, the equipment and time signals to be used. It is recommended that several drills be held well in advance of eclipse day.

REPORT FORMS

Attached is a copy of Report Form No. 1 that can be adapted to most observations in this section of the programme. Where the observer makes a series of observations of the same nature, such as the occultation of sun-spots, the information could be arranged in tabular form on one report. Otherwise, a separate form should be completed for each observation made. (In an organized field station, some of the work will be centralized - such as recording of seeing conditions, etc. - thus relieving the individual observers of the necessity of recording this detail. This will be described in a later bulletin.)

EYE PROTECTION

It cannot be emphasized too strongly that where binoculars or telescopes are to be used, extreme care must be taken to protect the eyes during the partial phases, for permanent blindness could result if the eyes are exposed even momentarily to the light of the sun. For binoculars, a welder's glass placed over the objectives would be sufficient. For telescopes, unless one has proper solar equipment - an objective diaphragm, Herschel wedge and solar eyepiece filter - it is safer to use the projection method, projecting the sun's image onto a screen attached by rods to the telescope tube. A SOLAR FILTER ON THE EYEPIECE IS NOT SUFFICIENT. It will quickly crack and the eye will be exposed to the sun's heat.

Even those who just want to watch the partial phases of the eclipse with the unaided eye should equip themselves with some protection - a piece of heavily exposed film or dark glass, preferably welder's glass.

PRECISION OBSERVATIONS

1. DURATION OF TOTALITY

This is a straightforward observation that can be performed, without optical equipment, by junior members or by members who feel that they lack the experience to undertake anything more difficult. It can be developed into a project in which the general public can participate, as will be described in a later bulletin. For this observation we are not interested in the time at which totality occurs but simply in the length of the period of totality. This should be timed, as accurately as possible, using an ordinary watch with a second hand or a short-wave radio (see timing methods (1) and (2) or a stopwatch.

2. TIMING OF CONTACTS

The main purpose for the accurate timing of the eclipse has been to determine geodetic positions. While it is true that more accurate results can now be obtained using satellite orbits, the timing of contacts is nevertheless of considerable interest. The beginning and end of totality (2nd and 3rd contacts) are very definite and can be observed without optical aid. They should be timed with great accuracy, to the split second if possible. If Timing Method (3) is used, two stopwatches are needed, for there will not be time between contacts to check the watch to time signals and have it ready for use again. Telescopes are needed to observe the 1st and 4th contacts (the first and last contacts of the moon's disk with that of the sun) which are very indefinite and cannot be timed with the same accuracy. It might be better to reserve the telescopes for other work or possibly combine timing of 1st and 4th contacts with observation of the occultation of sun-spots, which is described below.

3. OCCULTATION OF SUN-SPOTS

The purpose of this project is to make available accurate timings of occultation of sun-spots for correlation with radio observations of the sun made during the eclipse. Preferably, the project should be undertaken by an experienced solar observer, using a telescope equipped with a Herschel wedge, etc. or a projection screen. The observer makes a regular solar observation earlier in the day, recording the usual data, plotting on a disk the positions of all sun-spot groups and assigning a number to each for ready reference in the eclipse report. During the eclipse, between first contact and the beginning of totality, the observer clocks the time at which each sun-spot group is occulted by the moon. If it is a large group, contacts with both preceding and following edges should be clocked. If it is a small group, the time at which it is bisected should be clocked. Although we are going through a period of minimum solar activity, let us hope that there are some conspicuous spots on the sun's disk that day. If there are a number, then Timing Method (3) would not be practical because of the number of stopwatches required. Occultations need be timed only to the nearest second and therefore any of the other three timing methods can be used. The occultation reappearance of the sun-spots can be clocked, too, of course.

4. TIMING THE FLASH SPECTRUM

For a brief instant at the beginning and end of totality, the narrow dark Fraunhofer absorption lines of the sun's spectrum are reversed, that is, they shine out as bright lines, the more intense background of the light from the surface of the sun having been cut off. If binoculars are used to observe the flash spectrum, a grating (4000 lines or more to the inch) should be placed over one objective and welder's glass over the other. The observer can then watch the approach of totality through one lens and be ready to observe the flash spectrum through the other. A telescope can be used with either a grating over the objective or a spectroscope attachment at the eyepiece, while the finder, with welder's glass over the objective, can be used to watch the approach of totality. The flash spectrum should be timed as accurately as possible and the observer's impressions as to the intensity of the lines, etc. should be recorded. A clock drive on the telescope would be an advantage.

5. TIMING THE SHADOW BANDS

The shadow bands are fleeting shadows that race along the ground before ans after the main shadow. The direction of these bands and their line of motion differ before and after totality and with the position of the observer relative to the line of totality. They can be best seen against a white background. Therefore, two white sheets should be spread on level ground - one to observe the bands before totality and the other for after totality. A team of three is required - one timekeeper and two observers. The procession of shadow bands may last from ten to fifteen seconds. The observers call "Time!" the instant the bands appear and again when they disappear, the timekeeper recording the times to the nearest second. One observer has a supply of sticks or bamboo rods which, as the bands appear, he quickly places on the sheet to indicate their direction and line of motion. The other observer concentrates on the width of the bands, whether they are straight or wavy, their colour and any other characteristics. The rods are left in position so that, with the aid of a compass, their true direction can be determined unhurriedly after totality is over. All such details as to time, duration, direction, will be of value from every point on the eclipse path. It will be seen that for this project the team will need to practice to get operations down to a routine.

6. METEOROLOGICAL DATA

There are two reasons for recording weather conditions - (1) because of the effect of the weather on observations made, and (2) because of the effect of the eclipse on atmospheric conditions. For the former, one needs no special equipment, simply recording the observing conditions (seeing, transparancy, cloud cover) during the period of the eclipse. These should be recorded at five-minute intervals and, in addition, whenever a change in conditions occurs. For the latter, Equipment consisting of wet and dry thermometers, barometer, anometer, photometer, etc., should be in operation for a full hour before first contact and a full hour again after fourth contact. During these tqo one-hour periods, readings should be made at five-minute intervals. During the eclipse - the partial phases and totality - readings should be made at two-minute intervals. An electric clock, with sweep second hand, would be sufficiently accurate for recording the readings. If possible, the equipment should be installed on the previous day and the team should make readings for the same period as on eclipse day. Not only will this furnish comparison graphs but will give the team the practice needed to carry out operations smoothly on eclipse day.

7. RADIO RECEPTION

The purpose of this project is to study the local effect of the eclipse on the ionosphere by measuring changes in signal strength. The installation consists of three or four receivers with signal strength meters. These are tuned in on different radio stations both in the line of the eclipse and off the path. To establish a norm, the equipment should be in operation for a full hour before first contact and a full hour after fourth contact. During these two one-hour periods, signal strength readings should be taken every minute. During the eclipse - partial phases and totality - readings should be recorded more frequently. Ten-second intervals are suggested but these should be somewhat longer - 15 or 20 seconds - if it is found that the signal remains fairly steady.

If possible, the equipment should be installed on the previous day and the team should go through the full routine for the same period as on eclipse day. Not only will this furnish comparison graphs but will give the teams the practice needed to carry out operations smoothly on eclipse day. Two persons should be assigned to each receiver so that they can work on shifts.

A special report form is being drawn up for this project and is available on request.

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We realize that the brief descriptions given here may leave some questions unanswered. If you have any particular problems, please let us know and we shall try to help you solve them. Additional copies of this bulletin and the report form are available, in limited quantity, on request. Bulletins 4 and 5, covering Photographic Projects and Visual Observations, will be issued shortly.

In planning your programme we would caution you against being too ambitious. The period of totality is very short. There will be no time for flase starts. It is better to undertake only one project and do it well than to attempt several with indifferent results. Also, if you have never seen a total eclipse of the sun, you will want some time just to enjoy this wonderful spectacle. So plan your programme well, practice the routine, become thoroughly familiar with your equipment, and - weather permitting! - all will go well on eclipse day.

Please let us know about your plans as they develop and about any special projects you may have in mind.

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