

Advertiser 20. 9. 22.

DARKENING OF THE SUN'S FACE

FURTHER NOTES ON THE ECLIPSE

TESTING THE EINSTEIN THEORY

IMPORTANT TIMES TO-MORROW.

The Eclipse begins	2.22 p.m.
Attains its maximum phase	3.32 p.m.
The Eclipse ends	4.36 p.m.

Sufficient has been published in regard to the coming eclipse of the sun to prepare the public for the main features of to-morrow's phenomenon, but as the time of its occurrence draws nearer it will be of general interest to go over the ground in relation both to the partial eclipse, which will be visible in all the settled portions of this State, and the total eclipse. As already explained, the total phase, with which the scientific parties are so greatly concerned, can only be viewed in the sparsely inhabited parts of the interior, until late in the afternoon people in south-eastern Queensland and on the northern border of New South Wales will be privileged to see the sun's face completely darkened. Scientific men and medical authorities are emphasizing the care which should be taken everywhere by amateur observers for the protection of the eyesight. In the official brochure dealing with the subject, the Commonwealth Meteorologist (Mr. H. A. Hunt) has issued the following warning:—

Serious and permanent injury to the sight may be incurred by continued staring at the sun during the partial eclipse, even with the unaided eye, if it is insufficiently protected. Much more probable are ill-effects if optical instruments such as binoculars or telescopes are used. Very dark green or neutral tinted glass is suitable, or glass heavily smoked over a lamp or candle. For naked eye observations a dense portion of a photographic negative is sometimes suitable, but for use with optical instruments it is advisable to have the proper solar eye-piece material, or black glass, such as is used by electricians as a protection against the glare from arc lamps. If the only glass obtainable is not sufficiently dark it is an advantage to attach a layer piece of it to the objective instead of the eyepiece of the instrument.

Promised Thrills.

During the progress of the partial phase there is nothing of very special interest to be seen, remarks Mr. Hunt, until the sun is almost covered by the moon, although before that time arrives the shadows cast by foliage begin to have a peculiar appearance. The sunlight shining through every small space among the leaves, instead of forming a little circle of illumination on the surface of the ground, shows a small crescent an image of the partly covered sun. In Adelaide and most other parts of South Australia at the maximum phase three-quarters of the sun's disc will be obscured. The people in the South-East will see rather less of the eclipse, and those in the upper north rather more. There is every reason to believe, from past experience, that as soon as the eclipse begins the population will be thrilled. The moon will be seen to appear just alongside the sun at 2.22 p.m., seeming almost to touch it. Gradually the black moon will cover more and more of the luminous face, and an uncanny shadow will spread over the earth. The greatest thrill will, of course, be experienced in the region where the eclipse is complete. Everything will be still, the birds will go to roost, and the animals will be wonder-struck. Consternation will probably reign among the aborigines. A weird wind will blow, the temperature of the air will fall a few degrees, and stars may appear in the shadowed portion of the sky. One of the most wonderful features of the total eclipse will then take place, for the corona will form a dazzling halo of glory, flashing round the sun. On every white surface on earth bands or fringes appear, alternately light and dark; these bands are wave-like pulsations of light and shade, and may be observed for a few seconds, not exceeding about 30, just before and after totality. At some

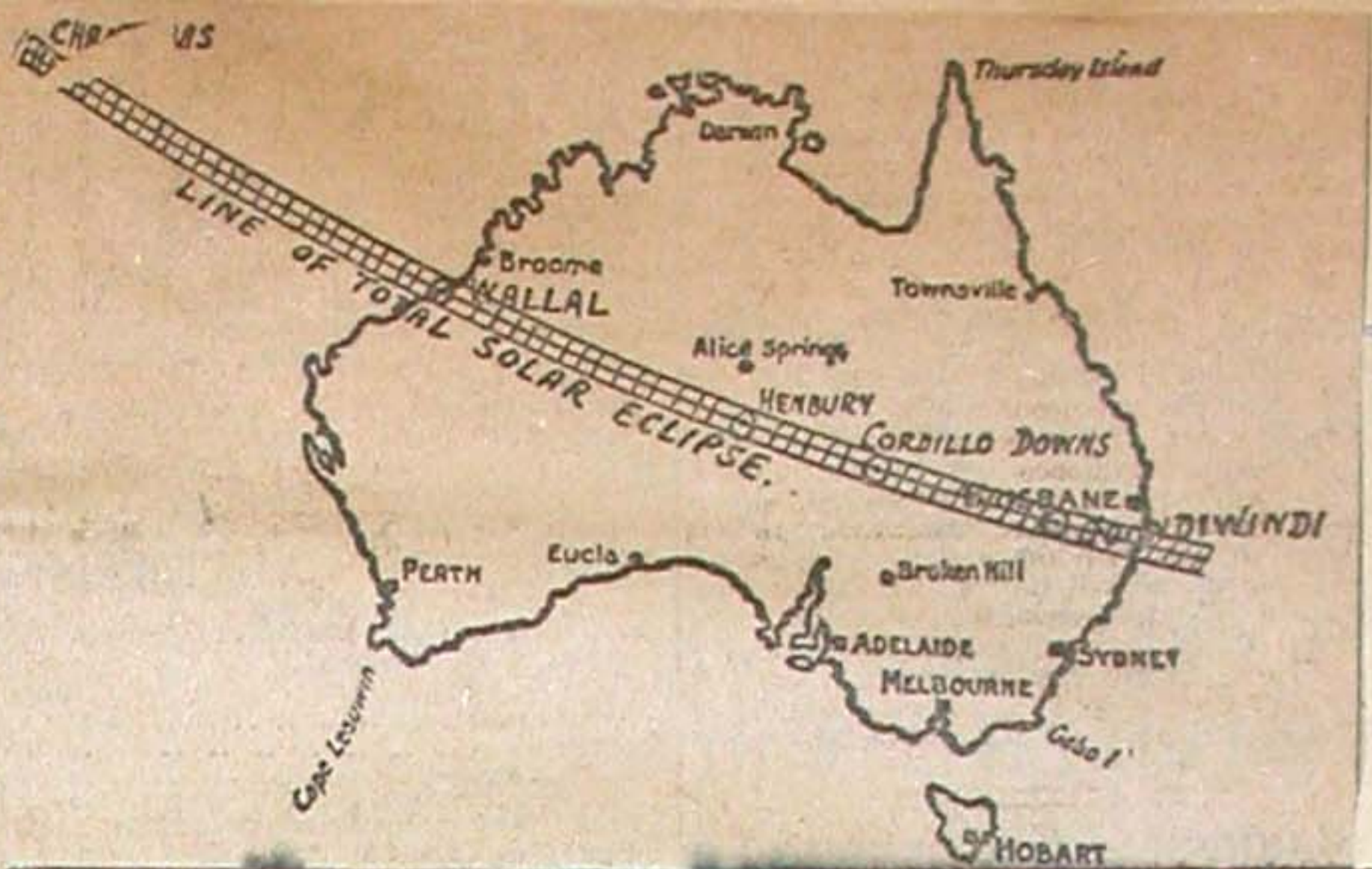
eclipses they have not been in evidence. These bands have been compared to the appearance of sunlight reflected from the rippled surface of a pond of water on to the surface of a white wall. They are a few inches wide, and from 1 to 3 ft. apart. They seem to be generally parallel to the edge of the moon's shadow, and the rate of movement is something like 12 miles per hour. The phenomenon has not yet been fully explained; they may be due to atmospheric refraction of the light coming from the very narrow strip of the sun's limb just at the time of its disappearance, or possibly a diffraction effect at the edge of the lunar disc.

An Uncanny Feeling.

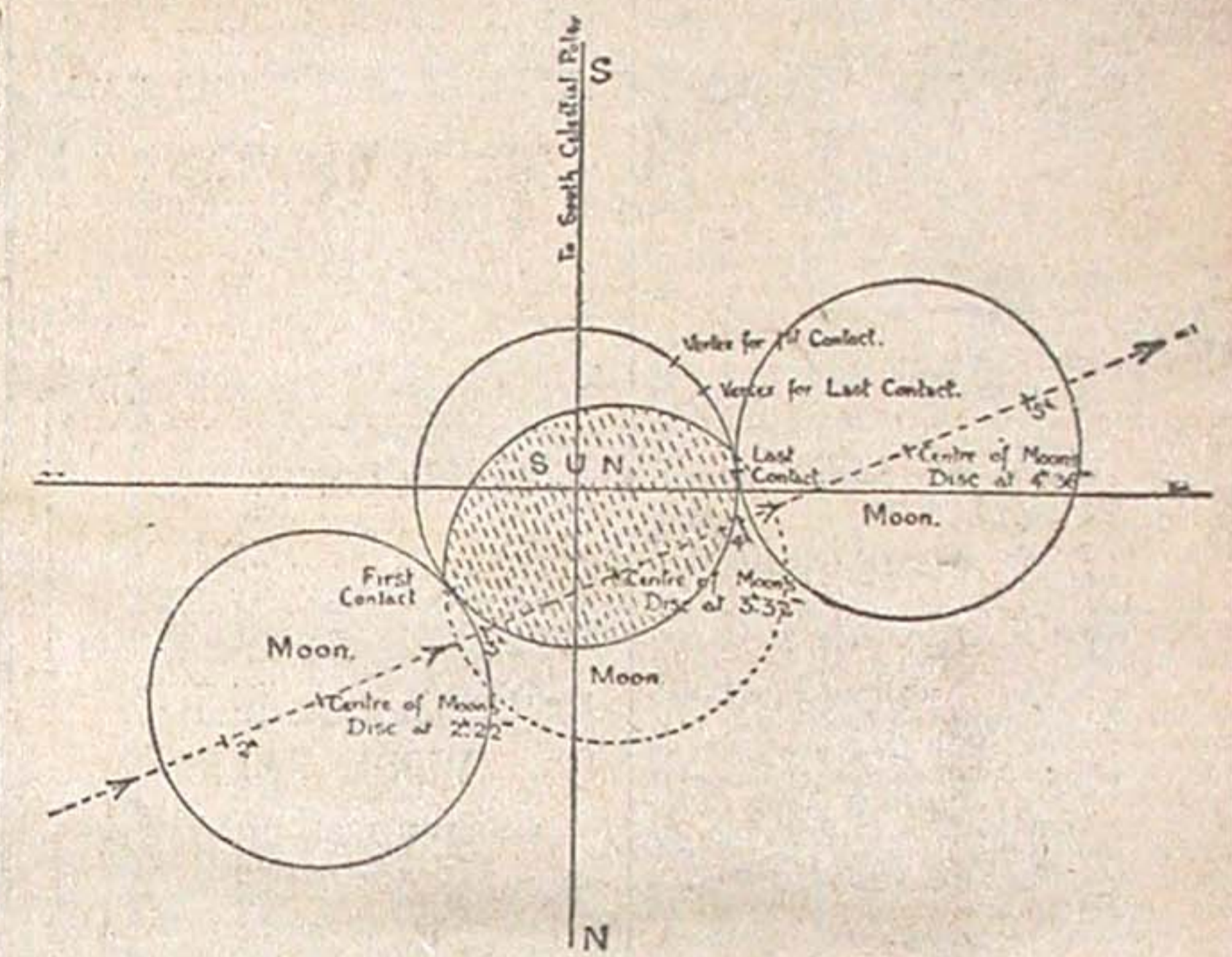
Many people will recall the partial eclipse of the sun which was visible from Adelaide on May 9, 1910. The conditions on that occasion were not altogether favorable for the making of observations. The contact began at 2.36 p.m., reached its greatest phase at 3.36, and ended at 4.56 p.m. At 2.30 the sky was overcast, with rain threatening, and until after 3 o'clock it was impossible to get more than an occasional glimpse of the phenomenon. Towards half-past 3, however, the sky suddenly cleared, and people had a capital opportunity of seeing the eclipse, the sun appearing as a brilliant crescent with the dark shadows of the moon gradually passing over the solar face. The waning of the sun's light caused an uncanny feeling to come over people, a temporary twilight and appreciable drop in the temperature being noted. In the streets hundreds of amateur observers peered skywards through pieces of smoked glass, shaded films, or broken pieces of dark colored bottles. In that year the scientists who proceeded to Brani Island, off the coast of Tasmania, with the object of seeing the total phase, met with a great disappointment, as the sky was completely overcast and drizzling rain was falling. The darkness during the period of totality was comparable to that of a starlit night. Twenty-six observers were engaged with coronagraphs, equatorials with cameras attached, photo-heliographs, and other apparatus, but all the preparations were in vain. On July 30, 1916, an annular eclipse of the sun was observed in this State.

The Scientific Aspects.

The partial eclipse to-morrow will be closely watched by the staff at the West-terrace Observatory, although no special scientific importance is attached to it. A careful checking of the times will take place, and the features of the phenomenon will be noted. The expeditions at Wallal, Cordillo Downs, and elsewhere on the path of totality shown in the diagram published to-day will be engaged upon investigations of the utmost value, for the results of which men of science in all parts of the world are eagerly waiting. The other diagram illustrates the relative positions of sun and moon at various phases of the phenomenon. The eclipse will begin at dawn on the east coast of Africa, south of Aden, and move westwards across the Indian Ocean until it falls on Christmas Island, south of the western extremity of Java. On this island a large party of British astronomers will make their observations. The eclipse there will take place at noon, when the sun is at its highest point in the heavens, the duration of totality being 3½ minutes. At Wallal, the first point on the Australian coast on which the dark shadow will fall, the total eclipse is timed to last 5 minutes 19 seconds at 1.30 p.m., the longest duration of any of the observing stations. By about 2 o'clock it will have reached Cordillo Downs, in this State, where Mr. G. F. Dodwell, Professor Kerr Grant, and others of the party whose names were given in "The Advertiser" yesterday, have set up their equipment. The moon's shadow will then pass on to Goodinindi in south-



The map, which was prepared by Mr. G. F. Dodwell, B.A. (Government Astronomer), shows the path of the sun's eclipse on September 21. The arrows point the way the moon's shadow will move. On both sides of the central line for a distance of about 2,000 miles a partial eclipse will be visible. This is scientifically termed the penumbra, or region of diminished light, within which the solar disc is not all hidden. The umbra is the cone of shadow within which the solar disc is completely hidden and the eclipse is total.



The above is a rough sketch of the relative positions of sun and moon at various phases of the eclipse.

east Queensland, leave the Australian coast at Lismore, northern New South Wales, and move across the waters of the Pacific Ocean, ending at sunset in the ocean north of New Zealand.

The Einstein Theory.

The astronomers who have made their preparations with such thoroughness in readiness for the eclipse are hoping to secure strong additional evidence bearing upon the Einstein theory, with a view to determining whether it represents a fact of Nature. This theory requires that the stars, which will be observed in the immediate vicinity of the sun, though vastly farther away than the sun, should not be received on photographic plates in their natural position, but that their images should be shifted very slightly, owing to the fact that the rays from the stars, in passing close to the sun, and through the sun's gravitational field, should be bent from a straight line by amounts in inverse proportion to the distance of the rays of these stars from the centre of the sun. The measurement of this displacement is an exceedingly delicate matter. To secure dependable results, it was necessary that the critical group of stars, in the centre of which the sun will be at the time of the eclipse on September 21, should be photographed at precisely the same altitude above the horizon several months before or after the eclipse. Photographs of the critical group of stars for the present occasion were secured by Dr. Trumpler in June on the island of Tahiti. Dr. Trumpler passed through Adelaide some weeks ago, and is now with the other members of the Lick Observatory expedition at Wallal. Granted clear skies during the critical moments of the eclipse, the photographs of the group of stars secured at Wallal will be measured at Broome. A comparison of the measurements of the Wallal plates, without the sun in the midst of the group of stars, with the measurements of the Wallal plates, with the sun in the centre of the group, should show whether the positions of the stars have been deflected in accordance with Einstein's prediction. This test was the motive of the two British expeditions sent out in 1919 to observe the eclipse of that year on the West Coast of Africa and in Brazil. The results obtained with plates of the best quality were in confirmation of Einstein's prediction, but those obtained with another instrument were not in satisfactory agreement.

The Sun's Corona.

Though the testing of the Einstein theory during the eclipse is attracting world-wide attention, it is not the only purpose of the expeditions. The largest instruments brought to Australia by the American astronomers is a camera equipped with a lens 5 in. in aperture and a focal length of 40 ft. This will be used chiefly to photograph the coronas of the sun. As soon as the moon completely covers the sun the sky grows relatively dark, and great coronal streams extending out from the sun in all directions—some of them millions of miles in length—come into view. The study of the corona has always been a leading eclipse problem, and something has been learned concerning its chemical composition and its physical state, but the nature of the forces which produce it still remains an enigma. "We know almost nothing of the motions of the finely divided material composing it," said Dr. Campbell, in a recent interview, "whether the forces originally in the sun give out these materials by radiation, pressure, or otherwise, and later draw them down upon the sun by gravitational attraction, and so on. It is hoped that the eclipse expedition of the Adelaide Observatory at Cordillo Downs will be favored with clear skies to enable it to secure photographs of the corona with a camera the exact duplicate of that to be used by the Lick observers at Wallal. A comparison of the Cordillo Downs and Wallal plates is looked forward to in the search for the evolution of motions occurring within the coronal structure during the 35 minutes required for the moon's shadow to pass from Wallal to Cordillo Downs." The great 40 ft. camera at Wallal will be used by Dr. C. E. Adams, Government Astronomer of New Zealand, and a volunteer member of the expedition, to photograph the thin crescents of the sun immediately before and after the total phase, for the purpose of determining very accurately the relative positions of the sun and the moon. There are other cameras for recording more efficiently the outer features of the coronal structure. Dr. J. H. Moore, from the Lick Observatory, will be in charge of five spectrographs, whose sole purpose is to increase the world's knowledge of the constitution of the corona. As indicative of the public interest which is being taken in Adelaide in the eclipse, the firm of Clarkson, Limited, have prepared a large number of handy gazing blocks for the use of amateur observers. A number of them were forwarded to us on Tuesday. The eye-piece is of dark-green glass, through which it is possible to look at the sun without the slightest discomfort to the vision.