gradually towards it." In the South of the Pacific Ocean called the Great South Sea or Mar del Zur is the following note. "The Line of no Variation y^t passes near y^e coast of China divides again y^e West from y^e East variations y^t in all probability is to be met with allmost all over this Immense Ocean ; but have not attempted to describe the Curves therein wanting accounts and journals to ascertain the same." The line of no variation referred to in this note is marked on the map as passing to the west of Van Diemens Land—through New Holland and the East Indian Islands to China, and thence through China to the north of Pekin. In the Indian Ocean, just north of the Antarctic Circle, is the following note. "By the Variation of the Magnetical Needle or Mariners Compass is meant its deflection from the true Meridian, for it has been observed that there are but few places where its direction is true North but varies therefrom either to y^e Eastward or Westward in some places more in others less. Now this variation is of that great concernment in the Art of Navigation that the neglect thereof does little less than render useless one of the noblest Inventions Mankind ever yet attained to, for which reason we have here inserted them as they ware found by D^r Halley in y^e year 1700. The Curve Line passing over those places whose degrees of variation are superscribed."

The map is dedicated to the Right Honourable Richard Boyle, Earl of Burlington and Cork, &c., by John Senex, by whom it was drawn and engraved. It was "sold by J. Senex at the Globe against St. Dunstan's Church in Fleet Street, London, 1725." THOS. WARD.

Northwich, June 13.

P.S.—I have just discovered the following note in the Indian Ocean to the South of Madagascar. "In this Indian or Eastern Ocean after you pass Madagascar y^e Westerly Variation was in y^e year 1700 on y^e decrease y^e faster y^e more Westerly and Southerly, and it was then in a manner at a stand when you came to the length of Java."

THE TOTAL ECLIPSE OF THE SUN.

THE following suggestions were compiled for a special purpose. As it is probable that many amateurs will take advantage of the coming occasion to observe the various phenomena, the suggestions are published here in the hope that they may prove useful to some who are witnessing a total eclipse for the first time.

J. NORMAN LOCKYER.

(1) *Time Observations.*

Observers who are supplied with a first-rate chronometer, of which the error and rate are known, may make valuable observations of the four contacts.

For the first contact a telescope is necessary to observe the first small encroachment of the moon on the sun's limb ; of course, if a spectroscope is used to observe the gradual eclipse of the chromosphere indicated by the gradual shortening of one of the lines of hydrogen (C for choice), so much the better, but care must be taken by sweeping along the limb to secure that the chromosphere immediately above the first contact is under observation ; here, of course, the line will be shortest.

The second contact will be heralded by the sweep of the moon's shadow through the air. Mr. Crommelin has calculated that in Norway this will move at the rate of two miles a second ; the shadow on the land- or sea-scape will, of course, be best seen from the most elevated stations.

To observe the exact time of contact, a green shade should be used, as the disappearance of the white light of the photosphere and the appearance of the red light of the chromosphere will be emphasised. Prof. Harkness has also pointed out that the exact moment of second contact is also clearly indicated by the "seemingly miraculous appearance of the complete outline of the moon, round and black, reposing upon the wondrous radiance of the corona."

The approach of the third contact is indicated by the rapid brightening of the chromosphere at the point of the moon's limb where the sun is about to reappear. The green shade should again be used, and two or three seconds later a fine cusp of photosphere will make its appearance, announcing the termination of totality.

The green shade is here especially useful, as often the reappearance of the lower brighter chromospheric level has been mistaken for the reappearance of the sun itself.

For the fourth contact a telescope should be used if possible, otherwise a smoked glass.

It is desirable that, if possible, each party observing the contacts should consist of three persons ; one to watch, without any interruption whatever, the face of the chronometer and to count the seconds immediately before each contact is expected, another to make the observation, and another to record the exact time, minute, second, and part of second at which the signal is given by the second observer.

(2) *Disc Observations.*

These observations are for noting the greatest extent of the corona, and can only be made by shore parties.

Calculate the altitude and azimuth of sun's centre, at place, at mid-eclipse. Make a disc of such a size that at a distance *from the eye* of 20, 30, or 40 feet, as may be decided on, it will cover the sun, and extend three minutes of arc beyond the limb all round.

Erect this on a vertical pole, so that from the chosen observing point it will eclipse the dark moon and the lower parts of the corona (3′ high) at mid-eclipse.

A hole should be cut in a piece of wood or cardboard, fixed at the proper height, to show the exact position of the eye. This should be free to move in altitude and azimuth to secure exact adjustment.

Test the accuracy of everything, if possible, the day before at the time the sun is nearest the mid-eclipse position.

Before totality one observer should make the adjustments before referred to, and should see that at ten seconds after the beginning of totality the lower part of the corona all round the dark moon is completely covered by the disc.

Another observer, whose eye has been lightly bandaged to make it as sensitive to faint light as possible, should then be placed at the eye-hole, and should look for the faintest extensions. He should dictate to an amanuensis the length of extensions in diameters of dark moon; and their bearing, the vertex representing magnetic north.

Immediately the totality is over, the actual observer should draw what he has seen on a card similar to that used by the sketchers of the corona (see later). This drawing should include everything seen, but the extensions should be noted with the greatest care.[1]

(3) *Eye Observations of the Corona.*

All can do serviceable work by sketching very carefully the corona during the time of totality. The observers should provide themselves with a card (or cards) one foot square, on which a circle two inches in diameter is drawn in ink, and darkened to represent the moon's disc. The diameter will serve as a scale, so that the distance the boundaries and rays of the corona extend from the dark moon may be carefully noted. Imagine both the dark moon and dark disc to represent a compass card, then the various details may be sketched at their appropriate bearings, the top of the card representing mag. N. (The points may be marked on the card in any detail that may be required, but eight should suffice.)

These observations should, if possible, be made by

[1] For phenomena thus observed in eclipse of 1878, see "Lockyer's Astronomy," p. 115.

observers in pairs, and they should not compare notes. If telescopes are used, two inches aperture and a power of twenty should be employed for choice.

Before Totality.

(I.) Note how long the corona is visible before totality, along the edge of the dark moon opposite the point at which the sun is about to disappear.

(II.) Sketch any rays visible before totality; give length, colour, and structure as well as position.

At Commencement of Totality.

(III.) Sketch general outline and rays (streamers) and rifts (dark intervals between bright rays.)

(IV.) Note if there be a blaze of light or glare where the sun has just disappeared, and whether the base of the corona is brightest near or away from prominences.

Middle of Totality.

(V.) Sketch general outline rays (streamers) and rifts; note colour and direction of greatest extension.

Near End of Totality.

(VI.) Sketch general outline, and any rays or streamers or rifts; note colours.

(VII.) Note if there be a blaze of light or glare where the sun is about to reappear.

After Totality.

(VIII.) Sketch any rays that may be visible; give length, colour, and structure, as well as position.

Questions to be answered in writing immediately Totality is over.

(*a*) Has there been any change in the appearance of the corona during the eclipse? If so, specify what change.

(*b*) Have especially the dark rays or rifts changed during the eclipse.

(*c*) Describe what has been unchanged throughout, and define its structure.

(*d*) State the colours you observed outside the red prominences.

(*e*) Were the colours anywhere arranged in layers round the sun?

(*f*) Were the colours anywhere arranged radially?

(*g*) State colours of rays, and of spaces between them.

(*h*) Did the dark rifts extend down to the moon, or did they stop short above the denser layers of the chromosphere?

(*i*) Were the rays brightest near, or far away from the moon?

(*k*) What was the comparative brightness of the rays, the bright ring near the sun, and the outer corona?

(4) *Colours of Land- and Sea-scape.*

Some time before totality there will be a notable change in the colours of sky, cloud, and land and water surfaces.

Each of these should be noted separately, and the gradual changes, both as totality is approached and after it is over, should be carefully recorded.

This apparent change of colour has its origin in the coloured chromosphere and prominences; those witnessing the eclipse are thus enveloped in coloured—generally red—light, which bathes the landscape. The sky, ordinarily blue, is seen through a red haze, and therefore puts on a purple tint.

That the sky appears more purple at some eclipses than at others, is owing to the fact that the quantity of red light is not always the same, but varies with the brightness and magnitude of the prominences visible at the time.

The following table will give an idea of the colours, both of the corona and landscape, which have been previously recorded.

Year	Inner corona	Outer corona	Rays	Landscape, &c.
1605	Reddish hue (Kepler)			
1715	Pale whiteness or rather pearl coloured (Halley)			
1733	Ruddy (Vatterini)	Greenish colour		
1766	Ruddy	Yellow and white		Livid yellow (Le Gentil).
1778	Reddish hue, pale yellow to white (Ulloa)			
1806			Bluish tint (de Witt)	
1842	Yellow			
1842	Peach colour (Airy)			Greenish olive (Pinaud)
				Greyish violet heavens at Lipesk.
1851	White first and then blue			Land dusky yellow, water deep purple, clouds yellow, sky purple. — Dunkin.
	Dull rose colour			
	Light violet			
				Sea and land dark green. Deep yellow colour beneath clouds in south. (Snow).
	Pure white			Landscape dark olive tint (Hind).
	Brightest / More feeble (Carrington)			Clouds deep purplish grey (Dawes)
	Silvery white (Swan)			
	Light violet, nearly white (Silverstolpe)			A sickly neutral green coloured sea and tinged atmosphere.
	A cold unearthly light (Adams)			
	Orange (Liveing)			
1860	Yellow (Rümker)			
1869	Silvery grey (Farrell)		Fine violet mauve coloured white and yellowish white (Farrell)	
	Silvery white. Greenish violet (Eastman)			
	Clear Pinkish yellowish green (Myer)		Silvery	Bands of pink, purple, yellow, orange, fiery red, no green or blue except a blue tinge in purple, all divided by black stripes.

(5) *The Visibility of Stars during the Eclipse.*

The light radiated by the solar surroundings varies very much from eclipse to eclipse. Hence sometimes lamps are necessary for certain of the operations, while at others they are superfluous.

The number of stars visible, therefore, varies considerably. The sun this year at the time of the eclipse will be near the chief stars in the constellation Leo, which will be to the left of the sun.

Note, by means of a star map, what is the magnitude of the faintest stars visible, whether first, second, third, or fourth.

Suggestions for Timing the Progress of the Eclipse.

In Sicily, in 1870, the following method of recording the lapse of time during totality was introduced, and was found to prevent all excitement, and made the 80 seconds seem a long time.

Determine the number of seconds of totality at the station—say 100.

Then, at the moment of totality, let a person attached to each party of observers, carefully observing the face of a chronometer or watch, say, "You have now 100 seconds." After 5 seconds, "You have still 95

seconds." After another 5 seconds, "There are still 90 seconds remaining." And so on.

A clever man can do this in a very encouraging way. The time counter should take care not to distract himself by losing sight of the face of the watch or chronometer; and it is to be impressed upon him that much of the success of the observations will depend on his undivided attention, as his statement of time in the case of parties with large instruments, is an order to individual observers to do certain work. Hence there should be two time counters, who should change over at the middle of the eclipse, care being taken that the counting is not interrupted. *The times at which any of the phenomena occur must be noted by another observer.*

Caution with regard to the use of Telescopes.

Observers equipped with telescopes, whether they be small instruments or equatorially mounted, must be very careful about not observing the sun before or after totality without the aid of dark glasses. For small hand-telescopes a dark glass will be found sufficiently safe; but with instruments of greater power, the dark glass should be supplemented by a solar or diagonal eye-piece. If one half of the reflecting surface of the glass be silvered and the glass be made to slide, it may be used during totality. In any case, *do not forget, immediately before totality, to remove the dark glasses.*

THE KELVIN JUBILEE.

WE are glad to be able to supplement our report of the celebration of Lord Kelvin's jubilee with the address presented by M. Mascart on behalf of the Institute of France. By such cordial expressions as those in which the Institute addressed our distinguished countryman, men of science are made to feel that they belong to a universal brotherhood, all the members of which have but one aim—the accumulation of scientific knowledge. The following is the address:—

MILORD ET CHER CONFRÈRE,—L'Académie des Sciences de Paris, dans laquelle vous êtes aujourdhui le doyen des associés étrangers, a voulu se joindre aux savants de tous les pays du monde, à vos admirateurs, à vos amis, pour vous apporter des félicitations chaleureuses à l'occasion du cinquantenaire de votre arrivée comme professeur à l'Université de Glasgow que vous avez tant illustrée.

Il y a quelques mois, l'Institut de France célébrait le centième anniversaire de sa fondation, ou plutôt de la reconstitution des anciennes Académies sur des bases plus larges. Nous ne pouvons oublier l'élévation de langage avec laquelle le Président de la Société Royale de Londres vint alors traduire les sentiments de cordialité de cette grande et célèbre Institution.

Dans une autre réunion, où vous parliez en votre nom personnel, vous nous avez causé une profonde émotion en déclarant que vous aviez une dette de reconnaissance envers notre pays, que nos grand esprits tels que Fourier, Laplace et Sadi Carnot avaient été vos inspirateurs et que vous considériez la France comme l'"alma mater" de votre jeunesse scientifique.

Si la dette existe, vous l'avez payée avec usure. Dans la longue série de travaux et de découvertes qui jalonnent; votre admirable carrière, une des plus nobles que l'on puisse réver, vous avez abordé toutes les questions des cette science a laquelle la littérature anglaise conserve le beau nom de "philosophie naturelle," soit pour contribuer aux progrès des conceptions théoriques, soit pour en déduire des applications utiles au développements de l'industrie et au bien de l'humanité.

Quoi que l'avenir réserve au génie inventif de l'esprit humain, votre nom restera comme ayant été le guide le plus sûr dans une époque féconde, et le véritable éducateur de la génération actuelle dans le domaine de l'électricité.

Je suis particulièrement heureux que l'Académie des Sciences m'ait confié le soin de vous remettre une médaille d'or à l'effigie d'Arago, médaille qu'elle réserve pour rendre hommage aux services exceptionnels rendus à la science et qui porte cette devise, "Laudes damus posteri gloriam."

Vos confrères de l'Institut de France espèrent que vous voudrez bien considérer ce souvenir comme un témoignage de haute estime et de leurs sentiments les plus affectueux.

It is due to the Council of the Royal College of Science to state that they were not less desirous than the rest of the scientific world of doing honour to Lord Kelvin. An address was prepared and signed by every member of the Council of the College, with the exception of one who was temporarily out of reach. This address was presented to Lord Kelvin at the same time as the addresses from other Colleges in London, but mention of it was inadvertently omitted from our report. A congratulatory address was also sent by the Institute of Chemistry.

THE BRITISH ASSOCIATION MEETING IN LIVERPOOL.—LOCAL ARRANGEMENTS.

THE preparations for the British Association Meeting in Liverpool next September are now going on rapidly. A large and influential Local Committee of about 500 of the leading citizens, under the chairmanship of the Lord Mayor (the Earl of Derby), was appointed a couple of years ago. The smaller Executive Committee has broken up into Sub-Committees dealing with the subjects of—(1) Finance, (2) Hospitality, (3) Buildings, (4) Excursions, (5) Publications, and (6) Evening Entertainments. Most of these Sub-Committees have been actively at work for the last few months, and a report embodying the results of their deliberations has just been submitted to a meeting of the large Committee held in the Town Hall. The following is an outline of the arrangements completed so far:—

The reception room and the general offices will be at St. George's Hall, in the centre of the town, a few yards from Lime Street Station, the London and North-Western Terminus. One of the Sections (Geography) will occupy the concert room of St. George's Hall, and three other Sections (Geology, Anthropology, and Mechanical Science) have been allotted rooms in the closely adjoining Public Museum and Walker Art Gallery. The Section of Economics will be located in the Town Hall, opening on to the Exchange flags, and in the centre of the business life of the city; while the five remaining Sections (Physics, Chemistry, Zoology, Physiology, and Botany) will be placed in the laboratories and lecture theatres of University College, about 1050 yards from the reception room. A main artery, and tramway route, leads from Lime Street to Ashton Street, from which the College opens, and arrangements will be made for a constant service of convenient omnibuses in addition to the tram-cars. Permission to use these various buildings has been obtained from the Lord Mayor and the Corporation, and the Council of University College; and the Philharmonic Hall, which holds about 3000, has been engaged for three evenings, on the occasions of the President's address and the two evening discourses. The lecture to the working classes will be given in the Picton Lecture Hall. The first conversazione will be given by the Lord Mayor (Lord Derby) in the Town Hall, and the second by the Local Committee in the range of Corporation buildings occupied by the Public