

*Newspaper
Cuttings.*

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THE EXPEDITION
TO HERNÖSAND, SWEDEN

TO OBSERVE
THE TOTAL ECLIPSE OF THE SUN
1917, AUG. 21

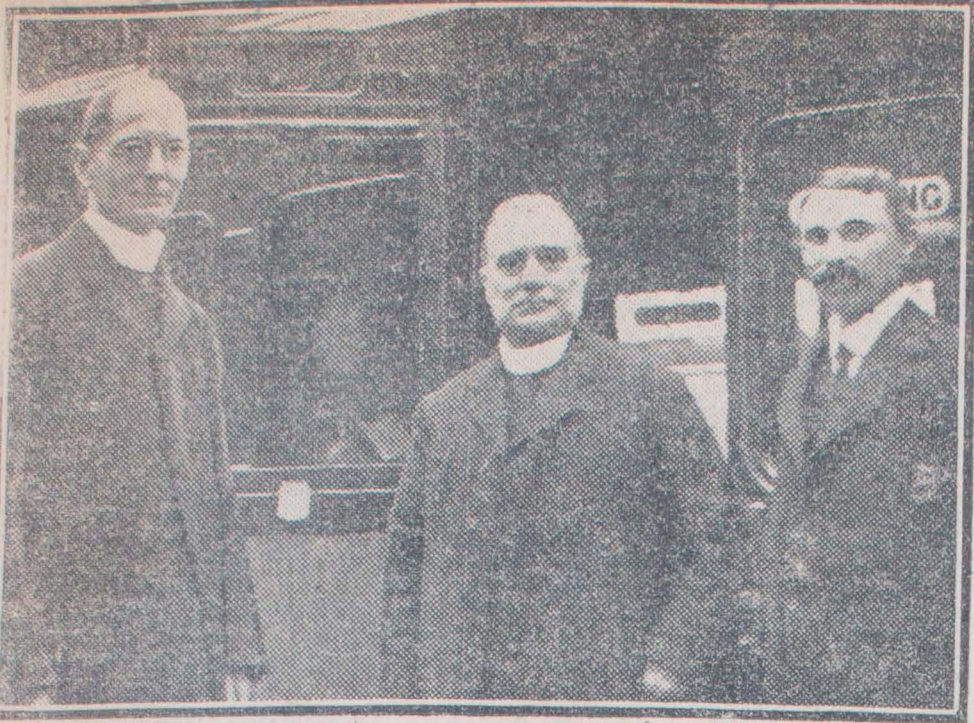
G. J. GIBBS.

And 1927 JUNE 29 at PRESTON

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SOLAR ECLIPSE EXPEDITION.

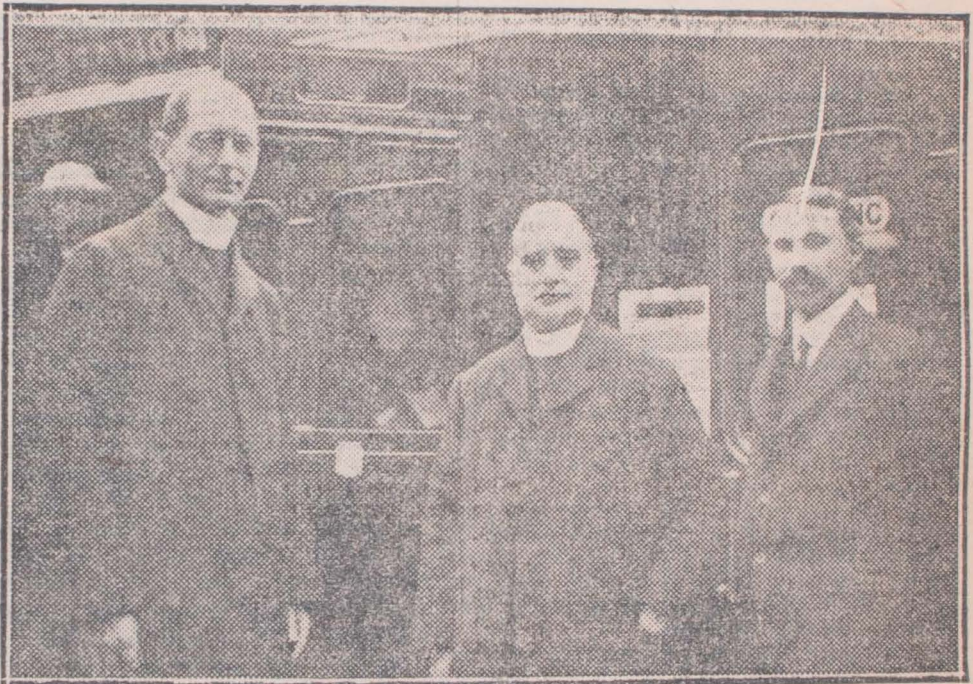
Daily Mail 29. VII. 1914



Father O'Connor. Father Cortie. Mr. G. J. Gibbs.
Yesterday Father Cortie, F.R.A.S., and Father O'Connor, of Stonyhurst Observatory, and Mr. G. J. Gibbs, F.R.A.S., of Preston, left Blackburn for Hull, where later in the day they sailed for Hernösand, Sweden, on behalf of the Royal Astronomical Society to make observations of the solar eclipse of August 21.

[Busby.]

*missed first shot - forgot to
draw shutter of dark slide.*

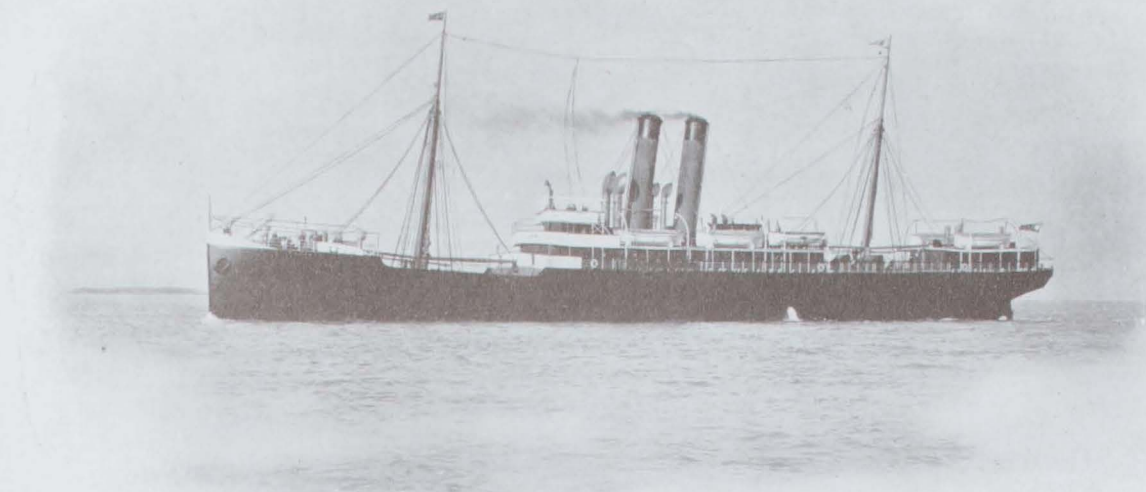


Left to right: Father O'Connor, Father Cortie, F.R.A.S., and Mr G. J Gibbs, F.R.A.S.

Fathers Cortie and O'Connor, of Stonyhurst Observatory, and Mr Gibbs, of Preston, met at Blackburn yesterday, and entrained at 1.50 for Hull, from which port later in the day they sailed for Hernösand, in Sweden. Along with Mr Whitelaw, of Birkdale, they form the Royal Astronomical Society's representatives to take observations of the total solar eclipse on August 21. They go out to pay especial attention to the corona, and are going to take direct photographs of the corona and of the spectrum of the corona, with special regard to the red and yellow regions. Father Cortie is the president of the Preston Scientific Society, and Mr Gibbs the chairman of the astronomical and physical section of the same body. Father O'Connor is well known in Blackburn, and Mr Whitelaw is a prominent member of the Southport learned societies.

Busby, Preston.

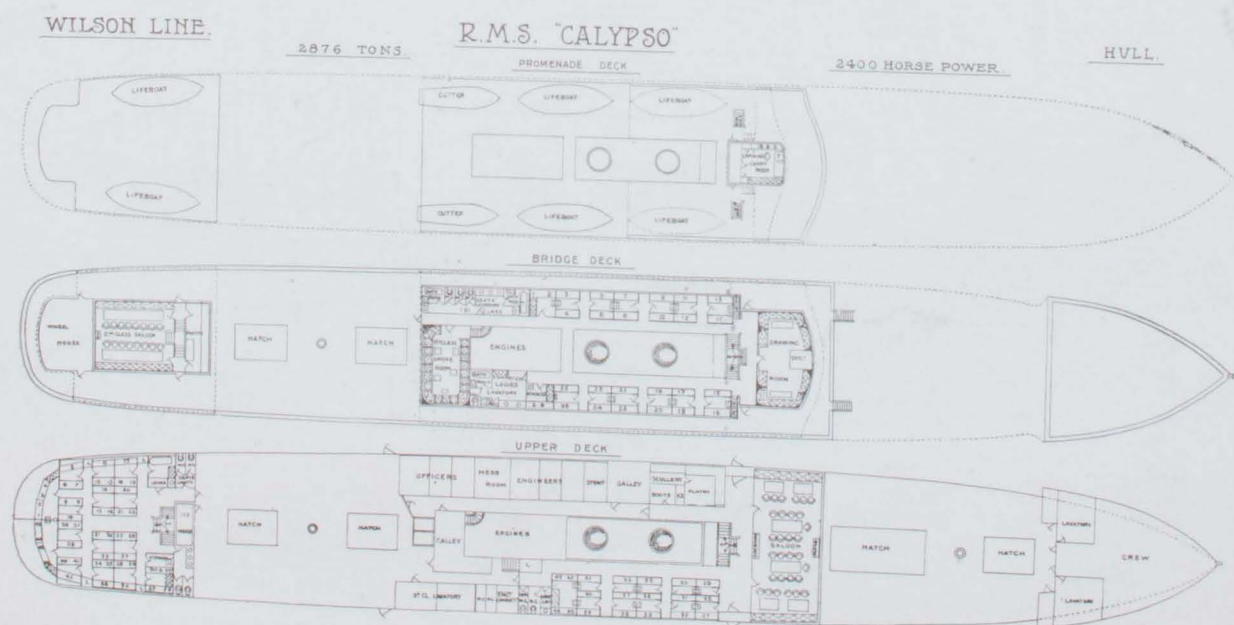
Northam Daily Telegraph 1914. VII. 29



R.M.S. "CALYPSO"

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N.B. - WHERE ONE BERTH IS ABOVE ANOTHER, THE ODD NUMBER IS THE UPPER ONE.



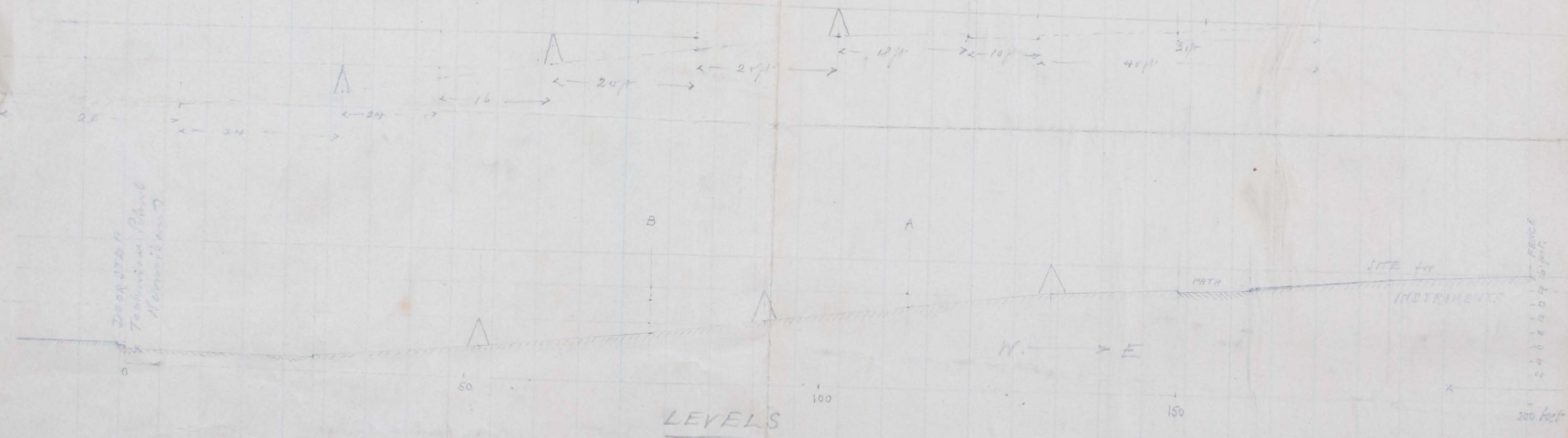




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Hemondant Aug 1914



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H.R.C.

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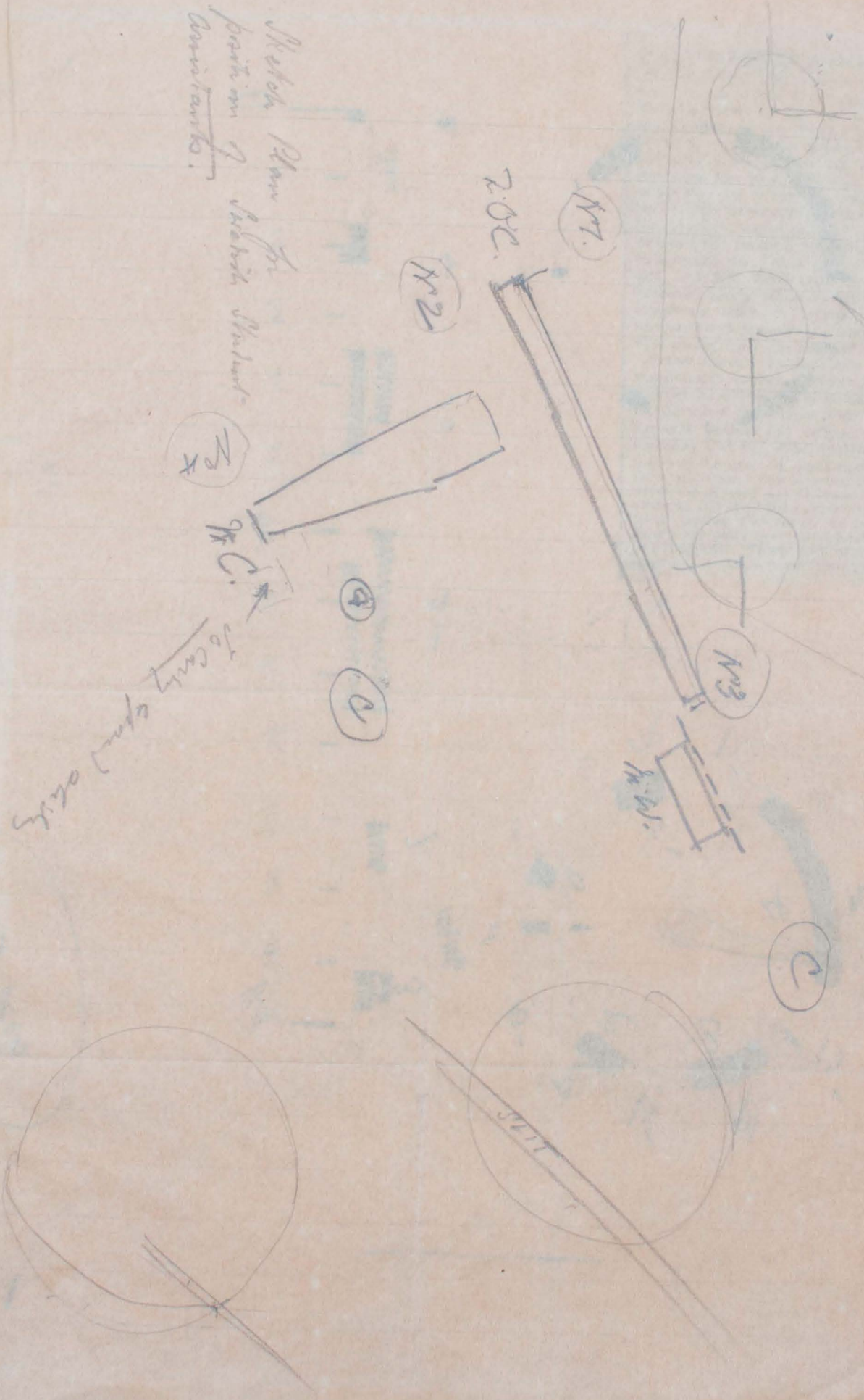
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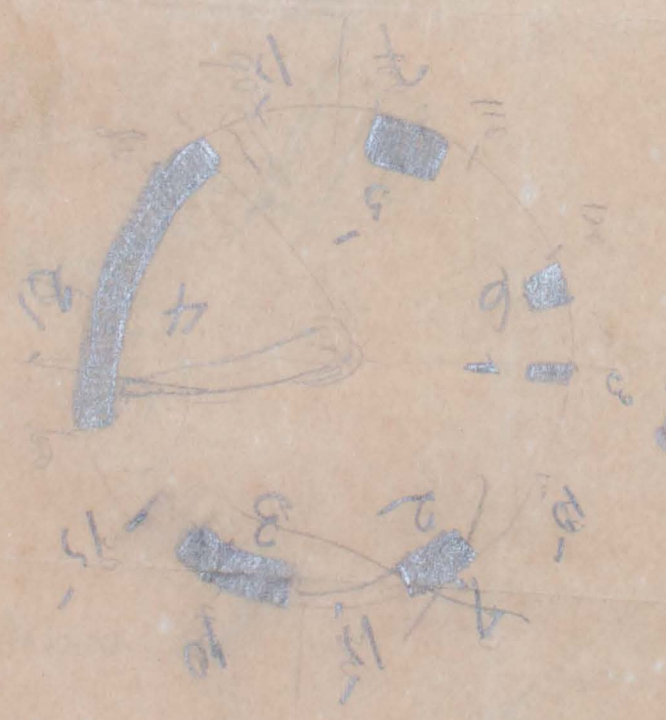
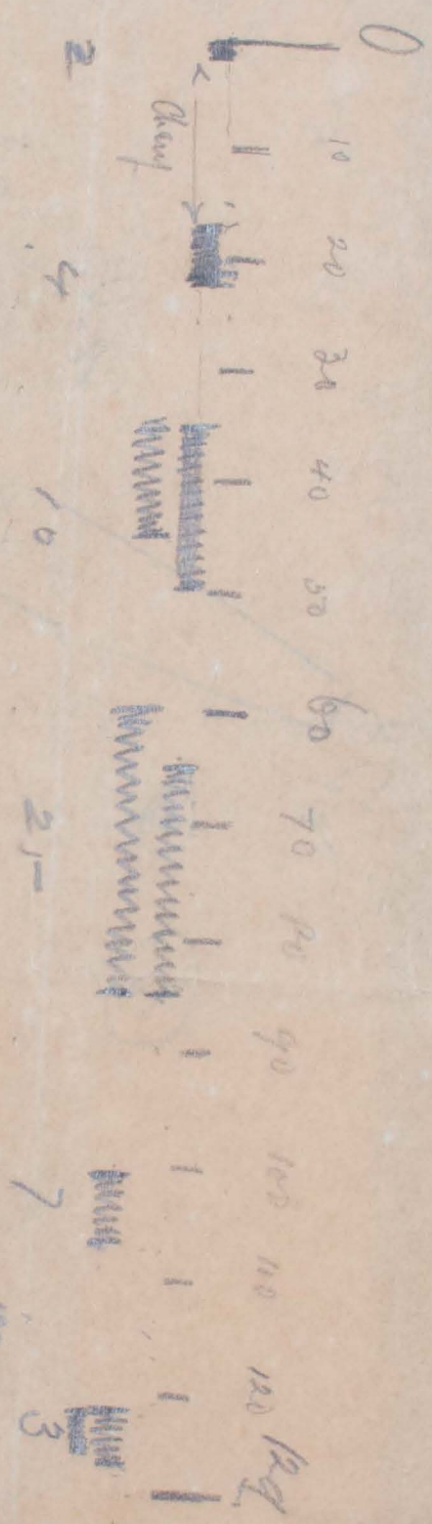
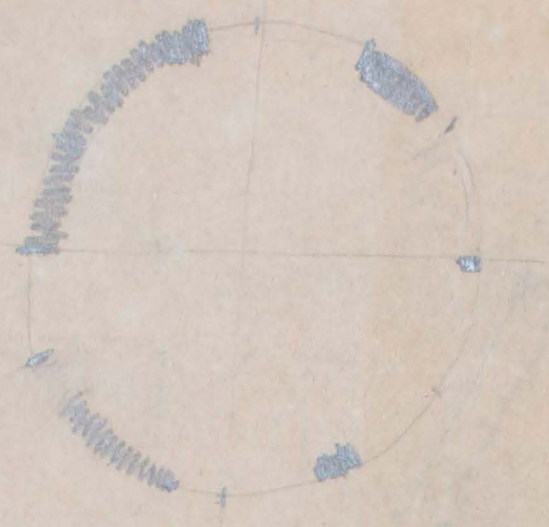
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INTERESTING PRESENTATION.
Father Cortie's lecture on the "Eclipse Expedition" at the Harris Free Library, Preston, on Wednesday evening had an interesting sequel, the members of the Preston Scientific Society taking the opportunity of presenting illuminated addresses to the president and Mr. G. J. Gibbs, expressing the sense of honour the society felt at the selection of those two gentlemen as members of the Government Eclipse Expedition to Hernoand in August and their satisfaction at the success which attended the expedition. Owing to indisposition Mr. Gibbs was not able to be present, and Mrs. Gibbs received the gift on her husband's behalf, whilst Father Cortie, who was completely taken by surprise, being entirely unconscious of the society's intentions until they were sprung upon him, returned cordial thanks.
Father Cortie's lecture dealt with the solar expedition in somewhat greater detail than in his presidential address at the opening of the session. He described the apparatus and their particular purposes during the eclipse, explaining the ingenuity that had to be employed in their erection and the need for mathematical accuracy in their adjustment and arrangement. The slides which illustrated the lecture were of great pictorial and scientific interest, the eclipse slides, taken during the period of totality, showing clearly the polar rays, the fish-tail streamers, and protuberances. There were also some beautiful snapshots of places passed through and visited.

DAGENS NYHETER Torsdagen den 20 Augusti 1914

Den totala solförmörkelsen i morgon.



Englands expedition: Ingenjör Whitelew, prof. O'Connor, prof. Cortie och ingenjör Gibbs.

I morgon inträffar den bebådade solförmörkelsen, århundradets största förutsedda celesta evenemang. Total framträder förmörkelsen i vårt land endast inom ett 17 mil brett bälte över Jämtland, södra Ångermanland, hela Medelpad och norra Hälsingland. Men den partiella förmörkelsen, som omfattar cirka 97 hundra delar av soldiametern, är synlig i hela Sverige. I Stockholm börjar förmörkelsen 8 minuter över 12 och slutar kl. 2.28 e. m.

Den planerade turisttrafiken till orter inom totalitetszonen har naturligtvis måst inställas under denna upprörda tid. Men de svenska vetenskapliga expeditionerna äro på sina poster och ha fått fyra utländska expeditioner i sällskap. Inom de svenska har i sista stund till följd av mobiliseringen måst företas en hel del personalförändringar. Endast en expedition, med Fiskebäckskil som förläggningssort och magnetiska fenomen som studieuppgift, har måst inställas.

Den största stationen är professor Hasselbergs vid Sollefteå, vars uppgift är att huvudsakligen genom fotografering studera solens gashöljen. Kamerans objektiv har en brännvidd av 20 meter. Det jättelika instrumentet är placerat mellan två tillhörande paviljonger. Assistenterna äro prof. Jäderin, d:r Larsén och instrumentmakare Rosén från Uppsala.



Professor Wulf, ledare av en holländsk expedition.

Fr. Cortie 20
9/8.

Fr. Roden.
Inom Dr. Wulf
1. Wulf
från the Jamies College
Valkenburg
Holland



UTLANDSKA VETENSKAPSMÄN HIT ATT STUDERA SOLFÖRMÖRKELSEN

T. v. engelska expeditionens deltagare, t. h. två holländska astronomer. Båda expeditionerna ha etablerat sig vid Härnösand.

VECKO-JOURNALEN

Nr. 34. 324

SÖNDAGEN DEN 23 AUGUSTI 1914

En mil från Sollefteå, vid Långsele, är professor Bohlins expedition i verksamhet. Dess uppgift har blivit studiet av koronans yttre delar. Inom samma socken, vid Forsse, skall prof. Bergstrands expedition studera solljusets intensitet i olika skikt av koronan och har för ändamålet lånat Uppsalauniversitetets stora tripplett-instrument.

Den fjärde svenska expeditionen har uppfört sin anläggning vid Strömstad i Jämtland under ledning av prof. Charlier från Lund samt d:r Zeipel. Dit har också kommit en tysk expedition, som redan anlagt en station vid Riga och vid krigsutbrottet måste kvarlämna sina instrument där.

Härnösand har emellertid blivit samlingsplatsen för de utländska expeditioner som av kriget föränlets att söka sig till Sverige i stället för att upprätta stationer i Ryssland. Där ligga nämligen en engelsk och två holländska expeditioner, fullt rustade med instrument.

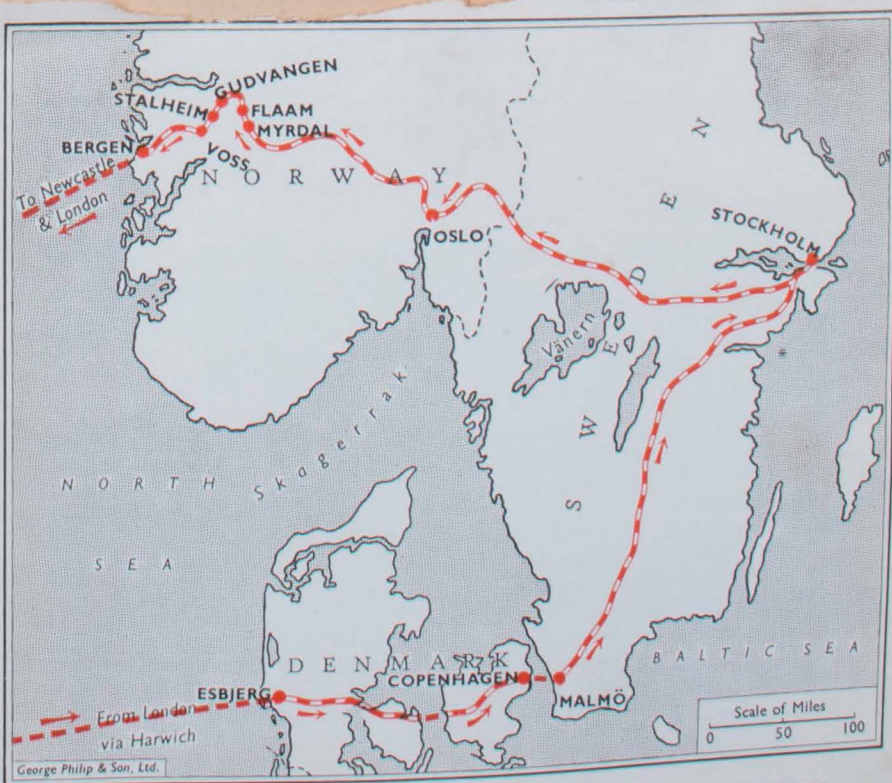
Den engelska expeditionen, som officiellt utsänts av regeringen, ledes av professor Cortie från Stonyhurst College. Den har uppställt sina instrument på Tekniska skolans gård och kommer att uteslutande fotografera solens spektrum samt koronan. Den har till granne på gården den ena holländska expeditionen, ledd av prof. Wulf, och bland assistenterna räknade en spanjor, Louis Rodes från Cortoza. Denna expedition kommer att

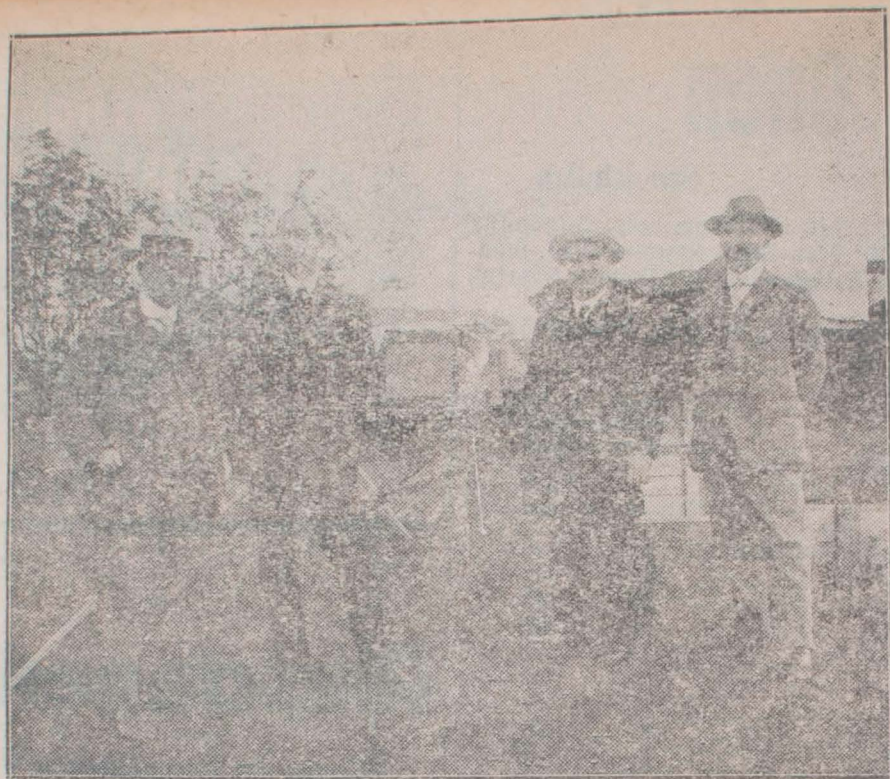
syssla med förmörkelsens tidsbestämningar samt fotografering av koronan. Den andra holländska expeditionen har utsänts från universitetet i Utrecht och ledes av professor van der Bilt. Dess uppgift är att med kamera och andra instrument studera solstrålningen.

Råder mulen väderlek i morgon få varken vetenskapsmännen eller vi andra dödliga se mycket av det celesta skådespelet. Man kommer däendast att få uppleva en skymningsstund mitt på dagen och tycka att himlavalvet är avsevärt nedsänkt. Och inom djur- och fågelvärlden blir det en stämning å la yttersta dagen.

Råder däremot vackert väder med klar luft, utvecklas över totalitetens zon ett praktfullt och intressant skådespel, av vilket man även i bältets närhet kan iakttä en hel del. Den mest effektfulla anblicken erbjuder solens korona, strålkranen kring den mörka mänskivan, och vid molnighet kan det inträffa att molnens färg erbjuder vackra och starka effekter.

En egendomlig anblick erbjudes även av de planeter och fixstjärnor som befinna sig intill mänskivan och som plötsligt bli synliga vid totalitetens inträffande. Denna gång kommer den klart lysande stjärnan Regulus inom koronans strålkrets på ett avstånd av endast två soldiametrar från månens kant. Man bör även kunna se Merkurius med blotta ögat eller med en svag kikare, vilket är sällsynt här i Sverige.





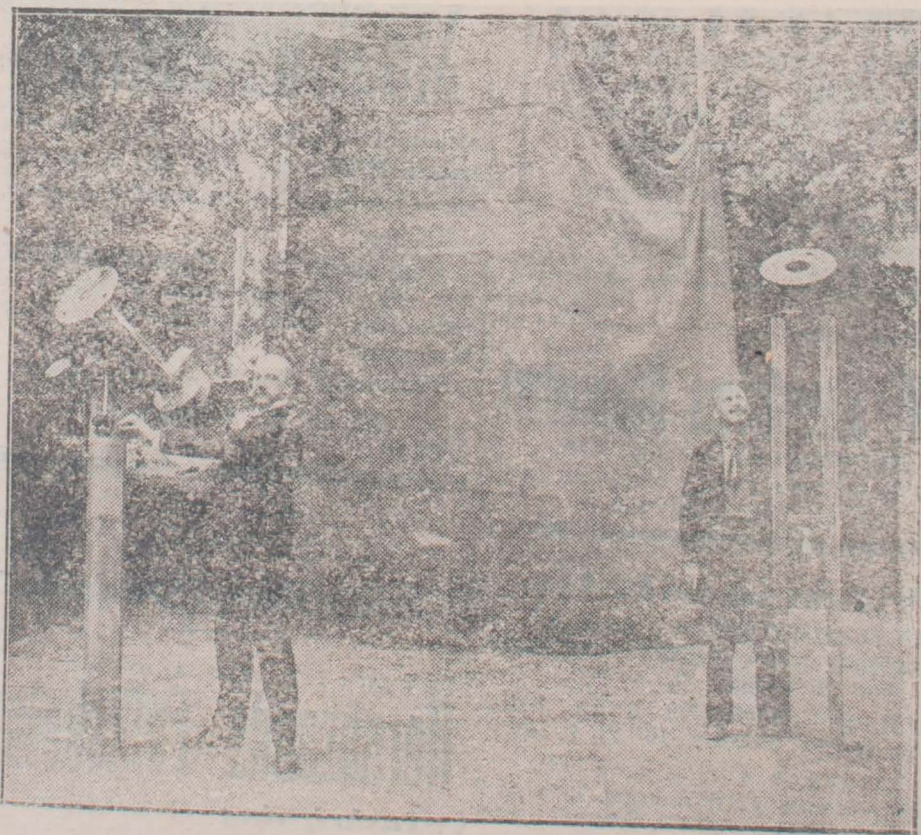
Den engelska expeditionen.

Mannen utan hatt är professor O. Connor. Den tredje mannen från vänster är expeditionens ledare professor A. L. Certie.



Teodor Stefani

hvilken för flera tyska tidningars räkning tog fotografier af förmörkelsen. Hr S. höll till å Folkskolan.

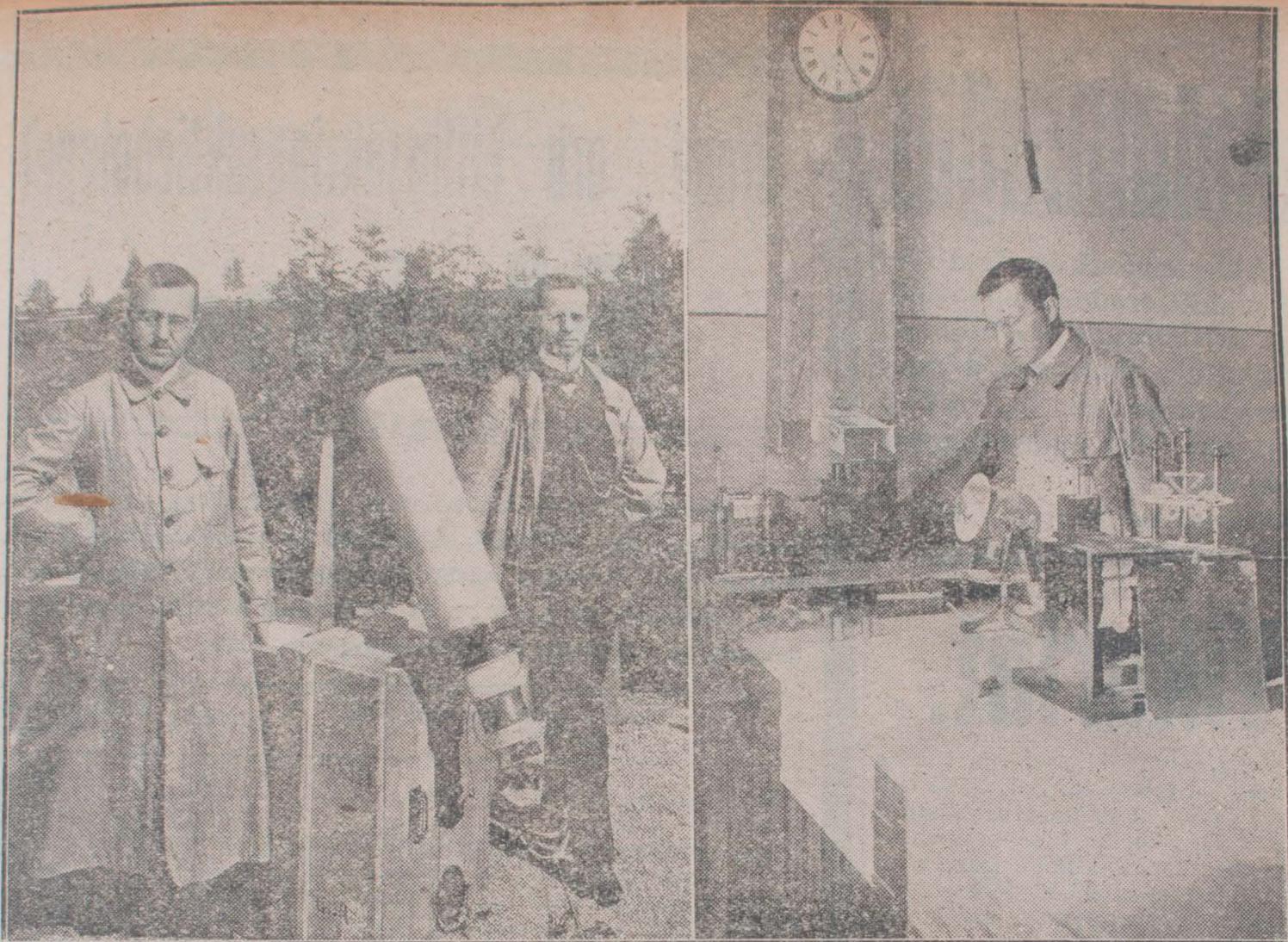


Expeditionen å Sörby.

Dir W. J. H. Moll.

Professor J. Vander Bilt.

From the Observatory Utrecht.



13

Den Wulf-Rodéska expeditionen.

Bilden till vänster är tagen i bersån å Tekniska skolans plan. Till vänster synes professor Wulf och till höger professor Rodés.

Bilden till höger visar professor Wulf vid sina instrument i en af salarna å Tekniska skolans nedre botten.

Hernösands-Posten har lyckats förvärfa ofvanstående fotografier från solförmörkelsen i Hernösand.

Samtliga de här ofvan afbildade vetenskapsmännen ha, utom hvad vi förut meddelat, uttalat sin stora glädje öfver de goda resultat, som vunnits vid studiet af förmörkelsen. Äf-

venså ha de förklarat sig mycket belåtna med det stora tillmötesgående, som visats dem af alla de Hernösandsbor, med hvilka de kommit i någon beröring.

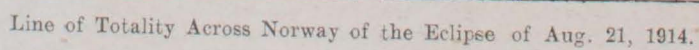
De af dem, som ännu ej afrest, lämna i dagarna vår stad för att bege sig till respektive hemorter. Under de krigiska förhållanden, som nu råda

ute i Europa, torde deras resa ej bli en vanlig turistfärd, utan säkerligen vara fylld af rätt stor spänning och oro. Vi vilja hoppas, att de utan något som helst omak skola komma till sina respektive hemländer och där i lugn och ro få bearbeta de resultat de vunnit under förmörkelsen här i fredags..

STONYHURST AND THE ECLIPSE.

The announcement has already been made that Fathers Cortie (president of the Preston Scientific Society) and O'Connor will be in charge of one of the official parties which will shortly proceed to Russia to view and make scientific observations in connection with the total eclipse of the sun on August 21st. The Stonyhurst party will be stationed at Kiev, and it is hoped to be able to obtain important results. Some of the instruments required for the eclipse operations are being erected on an experimental stage at Stonyhurst Observatory, and Father Cortie is finding the advice and assistance of Mr. G. J. Gibbs (chairman of the Astronomical Physical Section of the Preston Scientific Society) of great value in the engineering difficulties that have been encountered.

To view the total eclipse of the sun to be observed at Hernösand, in Sweden, on August 21st, the astronomers who form the official eclipse expedition sent by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, will sail from Hull on Tuesday. These consist of Father Cortie, of the Stonyhurst College Observatory, who is in charge of the expedition, and will be accompanied, among others, by Mr. G. J. Gibbs, chairman of the Astronomical Section of the Preston Literary and Scientific Society. Mr. Gibbs was Head Boy of the Bedford Modern School some years ago, and is son of Mr. George Gibbs, Victoria-road, Bedford. The program appointed for the astronomers is to take direct photographs of the sun's corona, during totality, on a large scale to show details in the lower corona, and on a smaller scale to obtain the full extension, if possible, of the filmy streamers which constitute the outer corona. They will also endeavour to obtain the spectrum of the corona from the red to the green, and of the envelopes that immediately surround the sun.





Comparisons of Central Lines of Eclipses, March, 1858, and April, 1912.

It is interesting to note that we are now entering on a series of repetitions, after a triple Saros, of some of the most famous eclipses. The Eclipse of 1914 is the counterpart of that of July, 1860, at which the corona was first photographed. The lines of totality are parallel, though that of the 1860 eclipse passed considerably to the south-west, traversing that fortunate country in the matter of eclipses, Spain. The parallelism of the eclipse of this month with the eclipse of March, 1858 is even more striking, and I have made a sketch of the two lines, to illustrate the triple Saros.

The eclipse of 1858 was the last central eclipse visible in England, the line passing about 100 or less miles north-west of London. Like the present eclipse, it was only annular; but I see from the Nautical Almanac of that year that there was just a possibility that it would be total for a short space off Madeira. The mid-totality of the eclipse of this month takes place nearly in the same spot; but in this case there is no doubt that the total zone will extend for several hundred miles on each side of it.

I have questioned a good many people on the subject; but I have only found one non-astronomical person who has any recollection of the 1858 eclipse, and he only saw the partial phase. It would be interesting to read the reminiscences of any present correspondent of "Ours" who was on the central line. Patrick H. Hepburn.

Dr. W. J. H. Moll,
Lector aan de Rijks Universiteit.

Utrecht,
Nieuwe gracht 191.

J. van der Bilt.
Observator voor de Sterrenkunde
an de Rijks-Universiteit te Utrecht.

Van Limburg Struemplein 1

TO-MORROW'S ECLIPSE.

(FROM A CORRESPONDENT.)

As the moon passes from west to east across the sun to-morrow the central line of the shadow strikes the earth in the polar regions of North America, traverses Greenland and penetrates into Europe by the Scandinavian peninsula, crossing from Mosjøen, on the west coast of Norway, to Hernösand, on the east coast of Sweden. Thence it passes over the Aland Isles in the Baltic Sea, and enters Russia near the city of Riga. Pursuing its course in that country, it traverses the cities of Minsk, Kieff, and Feodosia, in which observations will be taken.

The central line of totality will then cross the Black Sea and reach Asia Minor, near the city of Trebizond, whence it will pursue its way into Persia, where the eclipse will be observed by engineer officers of the British Survey. The breadth of the section of the shadow-cone cut by the earth during this passage will be about 100 miles.

It had been arranged by the Eclipse Committee of the Royal and Royal Astronomical Societies that Father Cortie, of the Stonyhurst College Observatory, and president of the Manchester Astronomical Society, with his colleague, Father E. O'Connor, should form part of the official expedition to Kiev. Accordingly an application was made to the Russian Government through the British Foreign Office by the President and Council of the Royal Society that these two Stonyhurst astronomers should be admitted in their scientific capacity into Russia.

But the Russian Foreign Office refused even a reiterated application of the British Foreign Office, on the plea that the law excluding gentlemen who are Jesuits from Russia is categorical. In this respect Jesuits are on the same plane as Jews and gipsies. This entailed a division of the party of observers, and Father Cortie is to set up an eclipse station at Hernösand, in Sweden, accompanied by Father O'Connor, Mr. E. T. Whitelow, of Birkdale, past-president of the Manchester Astronomical Society, and Mr. G. J. Gibbs, the curator of the Preston Corporation Observatory. The greatest possible courtesy has been extended to the leader of this expedition by the Swedish astronomers, in particular by Professor B. Hasselberg, of Stockholm, who will himself conduct an official expedition, also to Hernösand. Dr. Charlier, too, the director of the observatory at Lund, sent a kindly invitation to the British official party to accompany his expedition to Strömsund.

The main object of an expedition to observe a total eclipse of the sun is to obtain a photographic record of the form and dimensions of that wonderful crown of glory, or corona as it is called, which suddenly bursts into view when the moon just covers the sun; for the form of this solar envelope, extending millions of miles into space, changes sympathetically with the variations in the number and size of the spots on the sun. Even more important, as bearing more intimately upon problems concerning solar and terrestrial physics and the ultimate constitution of matter, is the observation of the constituents of the sun's corona by means of its spectrum.

What is this mysterious "coronium" which so far has eluded the grasp of chemists and physicists in terrestrial laboratories? Is it a primeval form of matter from which the substances known to us have been evolved? Before we can attempt to begin to answer such questions we must obtain a more adequate knowledge than we yet possess of its spectrum. We know it is rich in ultra-violet radiations. Accordingly the Greenwich observers will employ a photographic spectro-scope in which the optical parts, prisms and lenses, are wholly of quartz. So far we know hardly anything about the spectrum of this substance in the red and yellow parts of the spectrum.

Father Cortie will employ a spectrograph of the Littrow form, having a focal length of 98 inches, with which he will attempt, in the 2 minutes and 10 seconds of totality, to photograph the spectrum in the red, orange, yellow, and green, or from wave-length 6,800 to wave-length 4,800. This instrument was designed in conjunction with Professor Fowler, and its construction in the laboratory at South Kensington was superintended by Professor Fowler.

For the direct photographing of the corona the expedition will utilise a 4in. Grubb lens with a focal length of about 19ft., kindly lent by the Council of the Royal Irish Academy. A lens of long focal length gives large images at the primary focus, and hence the detail of the regions of the corona immediately surrounding the sun can be photographed. Lenses of shorter focal lengths give smaller but brighter images. Hence it is possible to photograph the filmy extensions of the corona, even to two or three solar diameters from the sun's limb.

Are such rays the stream lines along which the sun's influence—operative in magnetic stones on earth, which reflectively by means of earth currents sometimes affect even our telegraph and tramway services—is conveyed, in the form of electrons, to ionise our upper atmosphere? For the photography of the coronal extensions the eclipse party will employ two lenses, one a Dallmeyer portrait lens of 4in. aperture and 30in. focal length, and a Ross portrait lens of 12in. focus. But in order to photograph the coronal extensions a comparatively long exposure is required. Hence the inner layers are much over-exposed, and it becomes difficult to trace the connection, if any, between the rays of the lower part of the corona and the streamers of the outer corona. Hitherto a series of graduated exposures had to be taken, thus curtailing the time necessary for a long exposure on the faint coronal extensions. Acting upon a suggestion of the late Mr. Thorp, of Manchester, whose loss to local astronomy is greatly deplored, the expedition to Hernösand will use plates bathed in a solution which will render them immune from over-exposure.

A large partial eclipse will be visible in England about midday to-morrow; at Manchester, at the time of the greatest phase, about seven-tenths of the sun's diameter will be obscured.

THE ECLIPSE EXPEDITION IN SWEDEN.

PREPARING FOR THE DAY.

BY THE REV. A. L. CORTIE.

HERNÖSAND (SWEDEN), AUGUST 16.

The town of Hernösand is situated mostly on a small island, the port lying on the strait which separates it from the mainland. Part of the town, including the residential suburbs charmingly placed among pine woods on undulating hills, is on the mainland. Two bridges spanning the strait connect the two portions of the town. The port is a great centre of the timber trade, and large piles of timber are stacked in the yards surrounding the open sound to the north, by which vessels enter the port. In the distance beyond the north sound are ranges of mountains clad with the prevalent pine trees. The atmosphere is of transparent purity, but the surrounding hills are conducive to the formation of clouds. During the two weeks we have been here not a day has passed without some portion of it being cloudy.

Owing to the kind offices of Professor B. Hasselberg, of Stockholm, and to the courtesy and kindness of the Rector, Dr. Thaw, the expedition has been fortunate in securing an excellent site for the eclipse instruments at the Technical School, which is situated on rising ground on the outskirts of that portion of the town which is on the island. Not only have we the site but the liberty to employ all the resources of the well-appointed Technical School, including workshops and photographic dark room. The only restraint on our perfect liberty is that, in common with all other foreigners in the town, we have to report ourselves daily to the police.

Favoured by fine weather, we began the erection of the instruments the day after our arrival, which was on August 4. There are two coelostats, one of 16 inches diameter, which feeds with light three photographic telescopes for photographing the corona, besides a telescope, conveniently placed on the long camera of 20 feet focus, to project an image of the sun upon a disc. This disc is carefully divided into degrees, and by its use the angle subtended at the centre by the two cusps on the partially eclipsed sun can be observed as the moon advances towards the total phase. These observations give the intervals of time still remaining before totality. With the 20ft. coronagraph, which is under the charge of Father O'Connor, six exposures are proposed of varying durations from two to twenty-five seconds. The two other coronagraphs will be employed to photograph the extensions of the solar corona on specially bathed plates which do not solarise even with considerable exposures. These two coronagraphs are under the charge of Mr. Whitelow.

For spectroscopic work we have a very fine instrument especially built for this eclipse and occasion. It will be worked by Father Cortie and Mr. Gibbs. Let me record whence the different parts of the instrument have been gathered together. First there is an 8-inch coelostat built by Grubb, which has been kindly lent by the Royal Irish Academy. The lens, of 5 inches aperture and 7 feet focal length, which forms the image of the sun on the slit, comes from Stonyhurst. The slit belongs to the Royal Astronomical Society. The beam of light from the slit meets a diagonal prism from the Imperial College of Science, South Kensington, which turns the light through a right angle and projects it on a 6in. lens of 98 inches focal length from the Royal Observatory, Greenwich. The parallelised beam of light filling the lens is now refracted and dispersed by a large glass prism of 7 inches edge and 42 degrees, and the coloured band is projected on to a 6½ inches flat mirror. These two pieces of apparatus belong to the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. The beam of light is reflected by the mirror, passes on its return journey through the prism and lens, and forms an image of the spectrum at the mouth of a tube, where is fitted a repeating back which can be loaded with plate holders belonging to the Solar Physics Observatory, Cambridge. With this instrument it is proposed to photograph in the red, yellow, and green portions of the spectrum the spectra of the cusps before totality, the so-called "flash" spectrum a few seconds before totality, and the coronal spectrum during totality. The town electrical engineer, Herr Helenius, is also arranging to furnish us with current, so that it may perhaps be possible to put a companion spectrum of the iron arc on all the plates, if we are so fortunate as to secure success.

There are two other expeditions practically at Hernösand; one in fact is with us at the Technical School. This consists of Father Wulf, and Father Rodés from the College of St. Ignatius, Valkenburg, in Holland. Their object is to obtain the exact times of the beginning and end of totality by means of a photo-electric cell. Quite close to Hernösand also is another expedition from Holland, consisting of Dr. Mollé and Mr. Van der Bilt from Utrecht. Their object is to get direct measurements of the radiation from the corona by means of delicate apparatus containing a very sensitive thermopile.

A few miles further north of Solloftea is Professor B. Hasselberg, from Stockholm, whose main equipment consists of a huge coronagraph nearly 66 feet long. His object is to obtain large-scale direct photographs of the corona and streamers. Given fine weather these various expeditions ought to yield results of great value and scientific interest.

[We published on Saturday a telegram from Father Cortie, despatched from Hernösand on Friday, stating that the weather on the day of the eclipse was perfect, and that all the operations were successful.]

PRESTON SCIENTIFIC SOCIETY.

The vitality of the Preston Scientific Society on reaching its majority was indicated on Wednesday evening by the large attendance and the gratifying reports presented at the 21st annual meeting. The society might very well dispense with much of the formal part of the proceedings at these annual gatherings, but what

it would do without the cheery presence of Father Cortie it is hard to conceive. Both in his references to the eclipse expedition and in his presidential address Father Cortie contributed features of outstanding interest. In connection with the former he paid a tribute to the excellent work of the chairman of the Physical and Astronomical Section, Mr. Gibbs, who has recently been operated upon for appendicitis, and, it is gratifying to state, is on the high road to recovery.

It was originally arranged that the Government expedition of which Father Cortie had charge should proceed to Kieff, but a difficulty arose owing to the objection of the Russian Government to "Jesuits, equally with gypsies and Jews." Application was made for special permits through Sir Edward Grey and the British Ambassador, whilst the Russian Ambassador promised to do his best having regard to the special circumstances, but the necessary papers were refused, and the members of the expedition were forced in July to rearrange their plans. Hernösand, in Sweden, was chosen as the fresh objective, and as matters turned out this was most fortunate, for whilst in Russia the observers were troubled with clouds Father Cortie and his colleagues at Hernösand were favoured with ideal conditions.

Referring to the services of Mr. Gibbs, Father Cortie said: "Owing to the expedition having to be got up rapidly, and the arrangements made at the last moment, I doubt whether we should have got ready in time but for the scientific ability and engineering skill of Mr. Gibbs, who took charge of the erecting arrangements, whilst I took off my hat and coat and worked occasionally as a common labourer." The expedition received every possible assistance from the authorities in Sweden, but before they left they found a strong anti-British feeling springing up owing to the lies circulated by Woolf's Agency.

ECLIPSE OF AUGUST, 1914—FAMOUS ECLIPSES.

[299.]—Mr. T. L. Robins (392, p. 213) asks for particulars as to positions in Norway where the eclipse of Aug. 20-21, 1914, will be total. I send a map showing the line of totality across Norway, plotted from the data given in the Nautical Almanac. The only towns near the central line are Hernösand, on the coast, and Solleftea, inland, at both of which totality will last for over two minutes. Both places are most conveniently reached from Stockholm, either by rail or by water. The river journey from Hernösand to Solleftea is said to be very beautiful. Other routes are via Christiania and Trondhjem.

SCIENTIFIC SOCIETY.—ANNUAL MEETING.

The 21st annual meeting of the Preston Scientific Society was held at the society's rooms, Fishergate, on Wednesday evening, Fr. Cortie, S.J., presiding over a large attendance.

The annual report, presented by Mr. F. Chaderton, showed that the membership had increased from 410 to 468, and there was a balance in hand on the accounts of £5 9s. 8d. The lectures during the last session were of an exceedingly high order. All the sections had carried on their systematic and regular meetings, and had been well attended. There had been three excellent exhibitions, one promoted by the astronomical and physical section in conjunction with the microscopical section, another by the literary section, and the other by the photographic section, whilst the society had had its doors open for papers, lectures, and exhibitions on 92 occasions during the session. The photographic section had exhibited at the Alliance Exhibition and at the Anglo-American Exposition in London.

"It is a matter for pardonable pride for this society," the report proceeded, "that out of the four members of the Government Solar Eclipse Expedition to Hermösand, Sweden, we should have had the signal and unique honour of furnishing two representatives in the persons of our esteemed president, Fr. Cortie, and the chairman of the astronomical and physical section, Mr. Gibbs. We desire to congratulate them most heartily upon their well-earned distinction, and to extend to them a heartfelt welcome home again." (Hear, hear.)

Sectional reports, all showing progress and good work accomplished, were presented, the literary section by Mr. D. Abbott, microscopical and natural history section by Mr. John Abbott, photographic section by Mr. W. Cragg, and the astronomical and physical section by Mr. Ainsworth.

Fr. Cortie was re-elected president.

ECLIPSE OF THE SUN.

To-morrow's eclipse of the sun is an important event in astronomical circles, and elaborate arrangements have been made for observing and recording results along the track of totality, which will be about 100 miles broad, crossing Europe from the north-west coast of Norway to the Crimea, and coming to an end in Persia. In Sweden the central line goes from Alsteno to Haydager, near Hernösand. It enters Russia about 16 miles north-east of Riga.

A large partial eclipse will be seen in Great Britain. In this district it will commence a few minutes before 11 a.m., reach its maximum at 12.5, when about seven-tenths of the sun's diameter will be covered by the moon, and end at 1.15. One of the official eclipse expeditions is accompanied by well-known astronomers, these being Father Cortie, of Stonyhurst, who is in charge; Father O'Connor, of Stonyhurst; Mr. G. J. Gibbs, of Preston; and Mr. E. T. Whitelow, Birkdale.

Total eclipses are rare at any one given locality on the earth's surface. The last one visible in England took place on May 22nd, 1724, and there will not be another until June 29th, 1927, when a barely total eclipse (totality only lasting slightly under three-quarters of a minute) will be seen soon after sunrise in the northern counties situated near the Scottish border. After that there will not be a similar event until August 11th, 1999, when a total eclipse will just be visible in the "delectable duchy" near Land's End.

E: No. 2578.

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LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our Correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, Effingham House, 1, Arundel-street, Strand, London, W.C.

* * In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics; a vice from whence great inconveniences derive their original."—Montaigne's Essays.

THE TOTAL SOLAR ECLIPSE: OTHER MEMBERS OF ITS FAMILY—MAGNETIC CHARTS—THE EQUATION OF TIME—TIDAL FRICTION—LEAST ACTION—THE HATCHET PLANIMETER—AN ASTRONOMICAL SCARE—CHANGE IN THE STAFF AT GREENWICH.

[68.]—The day when this is published will be the day of the Total Solar Eclipse, and to the uncertainty of weather conditions usual on such occasions is added the uncertainty about the location and preparedness of the observers, and the amount of accurate astronomical information that will be obtained from the phenomenon is a very unknown quantity. This is being written on August 15, and the last information received from Major Hills and Professor Fowler, who form the expedition sent by the Joint Eclipse Committee of the Royal Society and Royal Astronomical Societies, came from Copenhagen about a week ago. A message which we got in a rather indirect way about a fortnight earlier said that they proposed to go to Riga and make what observations they could. The later message stated that their objective was St. Petersburg, the idea, no doubt, being to get in touch with the Russian astronomers at Poulkova, who are especially friendly and amiable men. St. Petersburg and Poulkova are at the end of this period the centres of the sun and moon return very nearly to their relative positions at the beginning of the cycle, so that, in general, any eclipse is succeeded by another, eighteen years afterwards, ten or eleven days later in the calendar, according as there are five or four leap-years in the interval, and this series of eclipses is called a "family." The third of a day is important. If the period was an exact integral number of days,

THE RECENT SOLAR ECLIPSE—THE FIELD ROUND & LYRÆ—PARALLAX CORRECTIONS FOR SEXTANT OBSERVATIONS—THE LARGE SUNSPOT—THE RHABDOLOGICAL ABACUS—FERGUSON'S PERCENTAGE TRIGONOMETRY—HAGEN'S ATLAS OF VARIABLE STARS—THE "ASTRONOMISCHE NACHRICHTEN."

[188.]—The two members of the staff of the Royal Observatory who went to Minsk to observe the Total Solar Eclipse returned to England via Stockholm and the North Sea on September 7, after a not very protracted journey considering the circumstances. The greatest risk they ran appears to have been from a mine not far from the English coast, which did its cowardly work and destroyed a fishing-boat within two hours of the time they were in its neighbourhood. They—Messrs. Jones and Davidson—left their instruments at the Poulkova Observatory, to be forwarded when times are less warlike, bringing with them the photographs which form the result of their expedition; their companion, Mr. Hepburn, returned a few days earlier. As is not unusual, the weather predictions have been completely falsified; but, to use a rather trite Irishism, I think it may be said generally about eclipses that the weather was not what it was expected to be, and no one thought it would be. On this occasion the prediction said that Norway and Sweden would be the worst places, and that the weather chances would improve going southward along the line; but, as a matter of fact, the weather appears to have been perfect for eclipse observing on both sides of the Scandinavian peninsula, very good at Riga, where Dr. Backlund of Poulkova was stationed; sufficiently good at Minsk and very bad at Kieff and in the Crimea. At Minsk the run of the weather on the days of the eclipse gave some cause for anxiety, for though it was generally fine, clouds gathered daily in the afternoon about the time of the eclipse; but on the eventful day it happened that though the cloud-bank was present, there was a large area of clear sky through which the eclipse was seen. Professor Campbell, of Lick, was at Kieff; but here it was completely cloudy, and he saw nothing. At Theodosia, in the Crimea, the observing party from the Cambridge University Observatory, and Dr. Perrine, from Cordoba, were similarly disappointed. It is curious how local these conditions were. At Theodosia, people three miles away from the eclipse parties saw the phenomenon quite well, and though the astronomers at the observing station near Minsk, only a mile or two out of the city, got good photographs, the eclipsed sun was not seen in Minsk itself. We now wait for the meetings of the Royal Astronomical Society and British Astronomical Association, when the scientific results will, no doubt, be presented.

OBSERVING AN ECLIPSE.

MR. E. T. WHITELOW'S VISIT TO
SWEDEN.*Southport Guardian**12-21-1914*

AN EVENTFUL VOYAGE.

Mr. E. T. Whitelow, F.R.A.S., of Birkdale, who was one of the British Expedition to Hernösand, Sweden, to witness the solar eclipse on August 21st, lectured before the members of the Southport Society of Natural Science—of which he is past president—on the results of that expedition on Thursday evening, at the Temperance Institute. Apart from the scientific knowledge which is contained the lecture was interesting from the fact that many of their plans were upset on account of the war; but fortunately these did not affect the actual observation, only the curtailment of projected holiday jaunts in and about that interesting country. The British expedition was divided into two parts, and as it happened the other section which was to have observed the phenomenon in Russia was unable to do so because of the war. Dr. F. J. Baidon (president) occupied the chair, and there was a good attendance.

At the outset of his lecture Mr. Whitelow explained what a solar eclipse was, and why it was needful to go so far from home to see it. The best places to see the eclipse that took place on the date given was on a curved line starting in the North of Norway, passing through Northern Sweden, across the Baltic, through Russia and the Crimea, and thence on into Persia. Accordingly expeditions from different countries were organised to transport their instruments and erect them at different stations on that line. Seeing the duration of the total eclipse was only about two minutes, proceeded the Lecturer, and a great number of different observations were required, the principle of division of labour was carried out, and to each expedition was allotted certain definite lines of work. In England there is a permanent committee appointed by the Royal Society and Royal Astronomical Society to manage the work of eclipse observation, and they in the first instance arranged for a single expedition to Kiev, in Southern Russia. Now an eclipse expedition without a veteran eclipse observer like their friend and honorary member, Father Cortie, was unthinkable, and as he and his assistant, Father O'Connor, were Jesuits, and Jesuits were prevented by law from entering Russia, a difficulty arose. Through diplomatic channels endeavours were made to get a relaxation of this law on this occasion. At first it was refused, then reconsidered—judicial matters like armies moved slowly in Russia, but they moved,—and finally, when it was too late to be of any service, permission was given. They had great reason to be thankful for the slowness of Russian movements—it led to the expedition being split into two parties, each with somewhat different programmes of work. Professor Fowler, the secretary of the Royal Astronomical Society, along with then Major, and now Colonel Hill, its president, and their assistants, were appointed to go to Kiev, to the Russian station, while Fathers Cortie and O'Connor were sent to Hernösand, a little place in the northern portion of the Baltic, some 250 miles north of Stockholm.

A LANCASHIRE EXPEDITION.

He (the Lecturer) and Mr. Gibbs, the chairman of the Astronomical Section of the Preston Science Society, went with them as helpers—so that the expedition was recruited entirely from Lancashire. Father Cortie was leader of the party; Father O'Connor was the mathematician, and worked the large coronagraph; Mr. Gibbs was the engineer directing the navy work and the preparation of the foundations and support for the instruments, and aided Father Cortie at the spectrographs; while he had charge of two small coronagraphs, undertook the test exposures for determining the best focus of the coronagraphs, served indifferently as interpreter, as errand boy to do any shopping—(laughter)—and general factotum. They left Hull and the world all at peace on July 23rd, arriving at Gothenburg early on July 30th, and the same night they reached Stockholm by train. Although they had been informed that they would have a wireless installation provided on the ground, he thought it well to take a reliable chronometer, and this turned out a lucky provision, since, owing to the political state of affairs, all wireless telegraphy was forbidden before they reached their destination, and they were practically dependant on their own resources for getting and keeping accurate time. As they had a considerable amount of work to do in the way of preparing and adjusting their instruments, they spent as little time as possible in Stockholm on their outward journey—their idea was to have a little holiday there on their way home, and to return from Stockholm to Gothenburg in a leisurely fashion along the canals and great inland lakes of Sweden. They did have a short trip among the beautiful scenery, thanks to Father Johnsey, a colleague of Father Cortie, and on their return to Stockholm in the evening they found they were entering stirring times. The main square, near the Opera House, was crowded with people reading the telegrams posted outside the offices of the principal newspapers. They learned that owing to the interruption of the railway traffic no English or German newspapers had arrived for some days; no mails had come in, and consequently none of them received letters they were expecting from home. The wildest rumours were afloat, and the British Minister was advising all tourists to return home as quickly as possible. As for themselves, he saw no present necessity for them interrupting their work, and arranged to communicate with them if he thought it advisable to “git”—in which case he advised them to cross the frontier and make for the Norwegian coast. The next morning the Swedish papers contained news of the proclamation of war by Germany against Russia, and the proclamation of neutrality of Sweden and the proclamation of the embargo on the export of foodstuffs was posted in the town. A party of seven Russian tourists in their hotel who had been intending returning home via Germany were wondering how they were going to get home, as all steamers from Finnish and Russian ports were held up in Stockholm harbour. At 11 a.m. on Sunday, August 1st, they sailed for Hernösand. As fellow-passengers they had two astronomers from Holland, Professors Wolff and Rodes. They called them there Dutchmen, although, as a matter of fact, one was a German and the other a Spaniard. They

like themselves, were going to Hernösand to observe the eclipse, and their chief topic of conversation was naturally what was likely to be the fate of those expeditions that were going to Russia. During the night, when they were off the Åland Islands, they heard distant booming noises, and when they arrived at Sundsvall in the afternoon were informed that news had come by telephone that there had been a running fight between two German cruisers and a Swedish cruiser, which had been driven into a Finnish port. Later they learned that was not correct, but that the noise came from the destination of a harbour on the Finnish coast by the Russian commandant, who had misunderstood a telephonic order—and had blown up all the harbour works to prevent the Germans making use of them. Splendid arrangements had been made for them at Hernösand on the grounds of the excellent technical school, in an elevated position above the town. The school itself, a fine establishment, was placed at their disposal because the school holidays were on. Several professors also assisted them.

AN INDIGNANT AMERICAN LADY.

In their hotel shortly after their arrival they found a party of American tourists, who had just come in by steamer. They had left Stockholm for Riga before the latter port was closed, but were stopped by a German torpedo boat, and ordered to change their course for Finland. On their arrival there they found war de-

clared and all traffic stopped, and their Consul directed them to get away to the nearest Swedish port, which happened to be Hernösand. One American lady was very voluble at the indignity they had been subjected to. "Fancy," she said, "we United States citizens had guns pointed at us." (Laughter.) Although Sweden was neutral, they found the war was almost as bad for her as actual hostilities. The army was mobilised to defend her neutrality, and owing to lack of men the great industries were wholly or partly stopped. Armed sentries were at every landing place and on many roads. They had to register and report themselves daily at the chief police station. Personally, they received at the hands of the Swedes the greatest kindness and assistance everywhere, and they left their country with very grateful memories. Politically, they found the atmosphere to be rather anti-Russian than pro-German. Hernösand is very near Finland, with which country there was frequent communication, and the history of what Finland had suffered at the hands of Russia explained their attitude, and they could not understand English civilisation allying itself with what they called Russian barbarism. Perhaps if he had foreseen what was going to happen in Belgium he would have told them what he thought of German culture. But, as a matter of fact, until quite near the end of their three weeks' stay in Hernösand they were cut off from news from England, and only by telegraph could he and his wife communicate with each other. All the news and telegrams in the local papers were from Berlin. Nothing or merely a few second-hand scraps of belated English news appeared. A reporter connected with a local paper, who came occasionally to interview him for copy about their eclipse work, frankly explained the reason, which was that they got Berlin telegrams for nothing, and they had to pay for English telegrams. "besides," said the reporter with half a smile, "we are assured that the Berlin telegrams are all true." (Laughter.) Between meals, which were many and heavy and at unusual hours in Sweden, they spent their time setting up and adjusting their instruments. Some of the senior students of the school who lived in the town volunteered their help. Some

of them could draw very well, so in case of mishap with photographic operations Father Cortie took four of them in hand and drilled them to make rapid freehand drawings of the sun's surroundings, giving each a single gradient to attend to, and very well they did their work. When their sketches were subsequently completed they formed an excellent record of the naked eye over the phenomenon. On the day of the eclipse a brilliantly clear sky was overhead, and not a trace of cloud was to be seen. A considerable number of the people of Hernösand came up to the ground to see the eclipse. Expecting that, they took the precaution of roping off themselves and their instruments so as not to be disturbed by intruders. The people behaved very well. Some of the students and teachers of the school went among them from the moment when the second whistle was blown (ten minutes before totality) to be good enough to preserve perfect silence—which they did, they could hear their clocks tick. (Applause.) He was not very favourably situated for seeing the eclipse. To work his own instruments he had his back turned to the sun, but during one long exposure he had about 30 seconds during which he could turn round and look through an opera glass.

A MAGNIFICENT SPECTACLE.

As a spectacle it was magnificent and well worth the long journey to see. But mere visual observations were not what they had gone for. He proceeded by the aid of lantern views to show the instruments used and the results. In connection with the latter he explained the technicalities of the exposure, the size and length of the lens, the focus, and a hundred things of interest to photographers and astronomers and scientists in general. Proceeding, he asked why and what was the good of that work, and replied that that was the last question a scientific investigator dreamed either of asking or answering. It was sufficient for him to know that he was extending the bounds of human knowledge, and it was for others to put the increased knowledge, which he placed at the service of the world, to what superior people were pleased to describe as practical use. Sooner or later every scrap of increased knowledge became in some way or other useful to the common uses and needs of humanity. He instanced the story of Radium, of Helium, and radio-activity. The Lecturer went on to tell of how they fared after the eclipse proper. They first developed and dried their negatives, and then considered ways of getting home. There was a state of war between Germany and England, the whole of the coast traffic in Sweden was in a state of chaos. The coast lighthouses had been extinguished, and some of the sounds they would have to pass through were mined. They had had a letter from Professor Fowler from Copenhagen, telling them that the other expedition to Kiev had been abandoned, after being shut up in Riga for a week without letters or telegrams, and no chance of getting into the interior of Russia, as the railways were exclusively occupied with military transport. They left their larger instruments in Riga with a shipping firm, with instructions to despatch them to Stockholm for them to dispose of. Fortunately, Professor Fowler and Col. Hill were able to get through by a steamer to Copenhagen. Col. Hill was recalled for military duty, and managed to catch the last steamer which sailed for Harwich, and Professor Fowler, with the smaller instruments, got back to London via Gothenburg, Norway.

and Newcastle. They wondered what their fate would be. On August 25th they were fortunate to get a steamer, as the coast lights had been just re-established, and at their first place of call they had a telegram from the British Minister in Stockholm saying the captain of the steamer had come in to say he dare not bring their colleagues' instruments from Riga, as Germany had declared telescopes to be contraband of war. (Laughter.) About seven hours from Stockholm they were met by an armed pilot boat, which

CONDUCTED THEM THROUGH THE FIRST MINE FIELD

they met, and nearer Stockholm the same duty was performed by a torpedo boat, as though they wanted to touch their mines. (Laughter.) On their arrival they interviewed the British Minister, and were pleased to see in the Embassy English papers as late as August 20th. On the advice of the Minister they abandoned their return tickets via Gothenburg, as mines were laid in the path of steamers from Gothenburg to Hull, and several vessels had been destroyed by them. They also abandoned their intended holiday jaunt, and on Friday, August 28th, they started on the long railway journey across Sweden to Christiana, and thence by the famous mountainous railway over the backbone of Norway to Bergen. Here they caught the steamer in which they had fortunately secured their berths by wire before leaving Stockholm—otherwise they would have had to wait for some other opportunity of getting home on account of the crowd of people waiting to cross. They left Bergen by the Norwegian mail boat on Saturday evening (August 29th) for Newcastle. The last piece of news they received just as they left was a telegram telling of the naval fight in the Bight of Heligoland. About 6.30 on the Sunday morning the steamer stopped, and they went on deck to see what was the matter, and found a British cruiser standing near them. A boat brought some officers on board, who entered the captain's cabin, and examined the ship's papers. The middy in charge of the boat, who remained on deck, asked if they had any newspapers, as they had had none for nearly ten days. A rapid collection of all the newspapers on board was made, and he tied them up and dropped them into the boat. They agreed among themselves that the object of the visit was a raid for newspapers—(laughter)—but they soon found it was rather more serious than that. This was the first Norwegian boat that had been stopped, and the captain quietly told a few of them that a German

boat of some kind had been sighted within fifty miles of the Tyne, and it was strongly suspected that mines had been laid on the route from Bergen to Newcastle. The captain was advised to make for Peterhead, where he would be met again, and advised what course to take. About 3 o'clock they noticed smoke on the horizon, and soon made out a warship of some kind following them at full speed. In three-quarters of an hour it came abreast. Without either vessel stopping signals were exchanged with what turned out to be a British cruiser, much bigger than the first they had seen. Their wireless apparatus was taken down, evidently in response to signals from the warship, which then turned with marvellous rapidity, almost in its own length it seemed, and steamed back at full speed. In 25 minutes the

cruiser and its smoke had entirely disappeared. They learned that the light-houses on the Scottish coast were extinguished, that torpedo boats here and there were doing lightship service, and they were to steam down as close as possible to the Scottish coast until off Berwick, that the Tyne was closed to all vessels in the night, and they could not enter until 8 o'clock next morning. Nobody said very much, but they noticed things. Those members of the crew who were not on the night watch did not go to sleep in the fore part of the ship, but curled themselves up aft in corners and under seats. They also noticed that the lifeboats, instead of being slung in the usual positions, were lying loose on the bridge and the decks, and that their oars were tied with cords to the rowlocks; that they contained water barrels and tins of biscuits, and he dared say that some of them wondered what it would be like to have to scramble in the dark after a seat in one of those boats. Torpedo boat destroyers and small steamers of different kinds seemed remarkably plentiful during the night. About six o'clock next morning they anchored in quite a crowd of ships of various sorts outside the Tyne, and were boarded by a pilot from an armed pilot boat. As they carried the mails they were given first turn in. All passengers were ordered to be locked below—a precaution, no doubt, to prevent anyone learning the way into the Tyne. Anyhow, they arrived at Newcastle Quay without mishap, landed on what an old lady once described as dear old "terra cotta"—(laughter)—and were able to despatch telegrams to their friends, advising them of their safe return. (Applause.)

SUGGESTED CINEMA SUBJECT.

The President thought they would all desire to congratulate Mr. Whitelow on the successful termination of his visit to Sweden. They did not pass formal votes of thanks to their own members, but he was sure the members desired him to thank Mr. Whitelow for the very delightful lecture.

Mr. D. E. Benson added his tribute, and said the lecture was all the more interesting because he happened to have seen a similar phenomenon. They were possibly better off, because he believed they were entitled to three and a half minutes. Their calculation went wrong, and he thought they got three and a quarter minutes—(laughter)—and they had a very exciting time. He must congratulate Mr. Whitelow on the success he had achieved in the photographs. (Applause.) The photographing, to his mind, was comparatively simple work, but the thing that pleased him most was the experiments he made with those plates they could not over-expose. The extension of the corona he showed there was really astonishing for a corona of that type. But no lantern slide or photograph he had ever seen could convey that beauty of a solar eclipse. They saw the sun, and suddenly it disappeared, and they had the corona of that pearly green light flashed out. It was one of the most beautiful sights they ever saw in their lives.

Mr. D. K. Simpson asked the Lecturer if the cinematograph had ever been tried in photographing the corona.

Mr. Whitelow said there was no advantage to be gained by the cinematograph,

because there was no movement such as was required to make a successful cinema picture. The view at the beginning of the eclipse and at the end would be precisely the same. The best reproduction had been given by Professor Turner in one of his lectures. He had a double lantern. They saw the sun shining very brilliantly, and then it was eclipsed. The whole thing was done very cleverly, and no cinematograph could do it so well.

Mr. Simpson instanced the cinetography of the growth of flowers, and thought something of the same might be done.

Mr. Whitelow said it would have to be the reverse order with an eclipse, because the cinematograph did not deal with sudden things, as the sun being suddenly darkened and as quickly made light, but only slow moving things.

Mr. Benson said the most satisfactory reproduction so far was that of Professor Turner, but even there they did not get the beautifully coloured corona.

Solförmörkelsen.

Gårdagens stora evenemang — den totala solförmörkelsen — blef tack vare ett utomordentligt gynnsamt väder, att skådespel af oförgätlig prakt och storslagenhet.

Den stora bemärkelsedagen ingick med strålände solsken och blef äfven i fortsättningen hvad den från början lofvat. Det blef en af dessa strålände klara höstdagar, som med sin högblå, kyliga luft och sin sällsamt betagande friskhet göra alla människor till soldyrkare. Det var, som om solen just nu, då den för några korta minuter skulle försvinna ur vår åsyn, ville visa sig i all sin glans.

Under hela tiden förmörkelsen var och öfverväldigande majestät. Inte rade var himlen alldeles klar. Inte ens den allra minsta molnslöja skymde solen; och de magnetiska stormar, man fruktat skulle störande inverka på iakttagelserna, uteblefvo alldeles.

«Vi ha haft det mest idealiska observationsväder man kan tänka sig — förklarade de i Hernösand församlade vetenskapsmännen samfälligt för en af Hernösands-Postens medarbetare, omedelbart efter förmörkelsen. Och alla förklarade med en mun, att allt har gått efter deras mest sangviniska beräkningar. Ingen solförmörkelse, som någon af dem hittills varit med om, hade varit så lyckad som denna.

Naturligtvis är det ännu omöjligt att få några närmare underrättelser om de olika observationernas förlopp. Först om veckor eller månader säga vetenskapsmännen sig själfva kunna värdesätta resultaten af de nu gjorda iakttagelserna.

För solförmörkelsens studerande ha icke mindre än åtta svenska och utländska expeditioner varit placerade på dylika trakter af Norrland. Enligt hvad Hernösands-Posten erfarit, har man vid samtliga stationer gjort synnerligen värdefulla observationer och öfverallt har man uttalat sin tillfredsställelse med de vunna resultaten.

1 Hernösand

hade — som vi förut omnämnt — förlagts tre utländska vetenskapliga expeditioner, af hvilka två, en engelsk och en holländsk, förlagts vid Tekniska elementarskolan samt den tredje, en holländsk, ute vid Villa Sörby.

För att ordentligt kunna utnyttja de två minuter, för hvilkas skull respektive vetenskapsmän anträdt sin långa och besvärliga resa, hade dessa bedt att få vara fullständigt i fred med sina instrument, hvarför åtgärder vidtagits för detta ändamål. Sålunda hade man inhägnat området ofvanför Tekniska elementarskolan, där de båda expeditionernas olika instrument uppställts, och vid Villa Sörby hade militär utkommanderats för att hålla allmänheten på vederbörligt afstånd.

Trots det större delen af de främlingar, som anmält sin afsikt att resa hit för att åse det exceptionella evenemang, till följd af kriget uteblifvit, var det synnerligen stora folkmassor, som vid tiden för förmörkelsen voro i rörelse här i Hernösand. Utanför de båda experimentalfälten samt uppe på Vårdkasberget samlades massor af skådelystna, hvilka till fullo fingo sitt lystmäte af det storslagna skådespelet.

Emellertid närmade sig klockan 12. Några minuter härefter se vi genom våra sotade glas en liten nära nog omärklig skäring — en svart punkt i solskifvans öfre kant. Den växer och växer och redan efter cirka 30 minuter har mer än halfva soldiametern försvunnit för våra blickar. Nu börjar också en märkbar förändring märkas i traktens utseende. En stilla skugga sändes ut öfver nejden. Genom glasen se vi, att solen allt mer och mer förmörkas och hur den genom våra tittglas numera blott ter sig som en smal halfmåne, som för hvarje minut blir allt mindre och mindre. Himlens färg går allt mer och mer i blått och vattnets yta mörknar. Det börjar blåsa en ganska kylig vind. Och skymningen faller. Människornas ansikten se spökligt bleka ut i den underliga belysningen.

Till slut återstår så blott en liten, liten lysande strimma af solen. Och så, precis kl. 1,12, går det ett dämpadt sorl genom skaran. Den sista glimten är försvunnen.

Det har blifvit höstkväll. Och däruppe på himlen ser man nu i stället för solen — coronan, som brinner med ett sken af blåaktig art.

Den totala förmörkelsen har emellertid inte försatt oss i något ogenomträngligt mörker. Det är väl coronan och ljuset från de icke förmörkade delarna af vår planet, som sörjt för, att det inte blifvit alldeles mörkt.

I få underbara oförgångliga minuter varade den totala förmörkelsen — minuter som man säkerligen aldrig skall glömma. Det är tyst och stilla. Dagar och skuggor växla. Stjärnorna börja skönjas. En efter en blänka de fram, försvinna och synas åter. En kall vind far fram öfver platsen och temperaturen, som från att kl. 12,25 ha varit 18 grader i skuggan, har kl. 1 sjunkit till 13 1/2.

Öfver staden råder en förtrollande skymning. Den sveper in staden i en underlig dager, kall och mystisk, i hvilken alla föremål få överkliga och fantastiska former. Hela staden är som ett feeri, till hvars dämpade färger och stämning endast finna en ringa motsvarighet i en eller annan sagomålning af en mästareshand. Allt ljud förstummas i detta skymningens hemlighetsfulla ögonblick. Man hör ingenting. Det är som om staden för en flyktig sekund upphörde att andas och man lyssnar begärligt på oändlighetens tysta hviskning.

Så med ens lyser en strålande strimma åter fram, just när vi som bäst voro på väg att glömma bort, att eklipstikan fordom hade en högt lysande brännpunkt kallad Solen. Man ryckes åter till verkligheten. Ett välsignadt solskens väller åter ner öfver staden, och lyser med ett förklaradt skimmer öfver onda och goda. Med kisande och ovana pupiller skåda man åter upp mot den klara himmelsglansen. Folkmassorna skingras. Och så är förmörkelsen ett minne blott...

Effe.

De vetenskapliga observationerna.

Intervjuer med vetenskapsmännen.

Det var med glädje man i går morse konstaterade, att vädret skulle blifva det allra bästa för solförmörkelsens observerande. Och det blef allt bättre och bättre, ju mera tiden led, och då stunden för förmörkelsen nalkades, var hela himlen fri från moln, högblå och klar.

Särskildt glada voro vetenskapsmännen — de hade länge gått och varit oroliga för att vädret ej skulle bli så bra, att det tillåte några observationer. Och nu, nu hade de det bästa de kunde önska sig.

Det var med en nervös noggrannhet de före förmörkelsen undersökte sina apparater för att se, om allt fungerade som det skulle. Var kameran riktigt inriktad? Var kikaren rätt ställd? Ingenting är väl i olag? Medan de så för tionde eller tjugonde gången öfversågo allt, nalkades det stora ögonblicket mer och mer. Det hvilade öfver vetenskapsmännen en mycket nervös stämning. Nu skulle lönen för alla deras ansträngningar komma, nu skulle iakttagelser göras, hvilka skulle ge dem ett namn, kanske ett odödligt. Nu skulle vetenskapen riktas med nya rön.

Och allt, allt gick bra. Ingenting mankerade, utan alla instrument, alla redskap fungerade till största belåtenhet. Så sade åtminstone samtliga de i Hernösand varande vetenskapsmännen, hvilka intervjuats af Hernösands-Posten. Samtliga lämnade med största tillmötesgående de af vår medarbetare begärda upplysningarna. Visserligen gingo intervjuerna en och annan gång litet trögt, då naturligtvis språket lade sitt hinder i vägen, men allt gick bra.

Den engelska expeditionen.

Ledaren för den engelska expeditionen, professor Cortie, formligen strålade af belåtenhet, då allt gått mycket bra. It's all right. Very succesfull, most successfull och andra superlativa uttryck räckta knappast till för honom att förklara den ovanliga tur han och hans expedition har haft. — Jag har, sade han, varit med i tvänne solförmörkelseexpeditioner förut, år 1905 i Spanien och år 1911 å Fidschiöarna, men de gynnades icke af lika fint väder som denna, och ändå gjordes där mycket goda observationer. Hur bra skola då ej observationerna i dag ha lyckats, då vädret varit så härligt! Och professorn strålar ånyo af förtjusning och glädje.

Professor C. meddelade vidare, att coronan, d. v. s. den pärlemoskiftande strålkran, vi vid totaliteten i går sågo omgifva den solen förmörkande månen, är mycket oregelbunden till formen och växlar från den ena förmörkelsen till den andra. Astronomerna skilja därför på maximumcorona, medelcorona och minimumcorona. Den, vi sågo i går, var medelstor. Coronans strålar aftaga hastigt i ljusstyrka, så att de på en solradies afstånd från solskifvan lysa med ett 64 gånger svagare sken än densamma.

De stjärnor, som vid förmörkelsen syntes i solens närhet voro Mercurius och Venus. Regulus var det däremot ingen af vetenskapsmännen som hade kunnat observera.

Några närmare detaljer om observationernas resultat kunde professor C. ännu ej lämna, och det tar, sade han, en lång tid för honom att få alla utarbetade. Denna förmörkelse hade gifvit honom arbete för ett helt år framåt. Och professorn skyndade åter till sina instrument, för att se till, att ingenting förstördes vid nedpackningen.

Den Wulf-Rodéska expeditionen.

Å Tekniska elementarskolan arbetade utom den engelska expeditionen äfven, som förut nämnts, en holländsk. Denna bestod af professor Theodor Wulf, Valkenburg, Holland, och professor Luis Rodés, S. J., Kortora, Spanien.

Professor W. var, också han, mycket glad öfver de lyckade observationerna. «Alles ist ganz ausgezeichnet» förklarade han. Allt hade gått efter beräkning och så bra man kunde vänta. Hans observationer gingo ut på att beräkna när totaliteten började och slutade. Han hade genom en alldeles ny, fotografisk metod och med nykonstruerade instrument beräknat tiden synnerligen noga.

Han hade från början ämnat att medelst trådlös telegraf från Eiffeltornet i Paris få veta den exakta tiden. Genom kriget hade detta omöjliggjorts, men han hade i stället fått den exakta tiden från Stockholm. Visserligen kunde det hända, att denna ej var fullt korrekt, men felet kunde knappast uppgå till mera än någon bråkdel af en sekund. Detta skulle han också kontrollera senare, så att ett eventuellt tidsfel skulle blifva rättadt.

Vid dessa observationer begagnade han sig af ett ljuskänsligt papper, på hvilket automatiskt uppritades kurvor, utvisande när totaliteten började och slutade. Med ett triumferande leende visade han H. P:s medarbetare den fotografi, som tagits under förmörkelsen. Äfven en icke fackman kunde lätt, efter att ha tagit reda på, när fotograferingen började, beräkna när den totala förmörkelsen började, huru länge den varade och när den slutade.

Professor Rodés förklarade, att allt varit «grossartig» och «wunderschön» och sade, att «alles var sehr gut gelungen».

Han hade tagit en hel mängd fotografier under förmörkelsen. Bl. a. hade han tagit två fotografier af coronan under den totala förmörkelsen, samt en strax före o. en strax efter totaliteten. De flesta fotografierna hade han tagit under den partiella förmörkelsen. Då han, när intervjuen gjordes, ännu ej framkallat några af plåtarna, kunde han ej säga, om de blifvit goda eller ej, men han hade

ingen som helst anledning att befara, det de skulle på något sätt misslyckats, då omständigheterna varit de allra gynnsammaste.

Medelst en teadolit, ett slags

vinkelmättningsinstrument, som hufvudsakligen består af en vridbar tub, försedd med ett hårkors, och en kronometer hade han iakttagit, att den totala förmörkelsen, som enligt beräkning i Hernösand skulle ha börjat klockan 1 timme 12 minuter och 46,7 sek., i stället hade börjat något senare eller 1 t. 12 min. och 54 sek. Då det är omöjligt att riktigt exakt bestämma tiden, kommer professor R. att jämföra sina observationer med dem, som i går gjordes af de öfriga vetenskapsmännen i Hernösand. För att få allt tillförlitligt tages medeltalet af de olika tiderna.

Han hade också iakttagit, att temperaturen under förmörkelsen i skuggan sjunkit med ungefär 4 grader.

För öfrigt var han mycket glad öfver, att ingen vind blåst under förmörkelsen och att atmosfären varit så ovanligt lugn. Detta hade inverkat synnerligen fördelaktigt på observerandet af det ovanliga fenomenet. Innet af de känsliga instrument, han använde, hade varit utsatt för den allra minsta darrning eller skakning, något som var af mycket stor betydelse för uppnående af ett godt resultat.

Professor R. beklagade mycket, att på grund af de nu pågående krigen en hel mängd planerade vetenskapliga expeditioner till olika delar af världen måst inställas. Vetenskapen hade härigenom, framhöll han, lidit mycket stora förluster. Dock hoppades han, att de utomordentligt gynnsamma förhållanden, som varit rådande under observationstiden, skulle bidra till att resultatet ändå blefve det bästa möjliga. Han framhöll som bevis på, att tiden användts väl, att endast vid tekniska skolan icke mindre än sex kameror varit i oafbruten verksamhet.

Professor Rodés, hvilken, som förut omtalats, är anställd vid Observatorio del Ebro i Kortosa, afreser icke dit, utan till Holland, där han vistats de två senaste åren och där han önskar stanna ännu ett år. I Holland ämnar han bearbeta de observationer, han gjorde här i går.

Den Moll-Biltska expeditionen.

Ute å Villa Sörby vajade i går den holländska flaggan till tecken på, att tvänne holländska vetenskapsmän då voro «herrar på täppan», nämligen de af H. P. förut omtalade dr W. J. H. Moll, lektor der Physik an die Universität Utrecht och hans medhjälpare professor J. Van der Bilt, observator vid observatoriet i Utrecht.

Dr Moll, som vid vår intervju med honom i förgår var mycket ängslig och orolig, då vädret såg mycket hotande ut, var i dag synnerligen förtjust. «Alles ist sehr gut gelungen, absolut gelungen» försäkrade också han och gaf sin förtjusning luft i kraftord sådana som «prachtvoll» och «wunderschön».

Denna expedition hade lyckats medelst en monokromatisk strålmätare, konstruerad af dr Moll, mäta strålningsintensiteten under förmörkelsen. De hade medelst en «Thermosäule», d. v. s. thermospelare, samt ett för ändamålet af dr Moll efter månads-långt arbete särskildt konstrueradt ljusfilter, «Farbenfilter», hvar femte sekund mätt strålningen. Dessa filter voro s. k. monokromatische Flüssigkeitsfiltern. Hvarje filter är en cm. tjockt och innehåller en vätska inom glasväggar — af dr Moll framställd. De genomsläppa endast det slags strålar, som önskas. Första och andra filtret äro infraröda, det tredje rött, det fjärde grönt, femte blått och det sjätte ultraviolett. Apparaten registrerar automatiskt strålningen.

Professor Bilt hade under förmörkelsen ett mycket ansträngande och kräfvande arbete. Med ledning af en kronometer öppnade och slöt han hvar femte sekund under mer än två timmars tid. Orörlig satt han vid stativet med blicken skarpt fäst på kronometern. När temperaturen sjönk fick en af de få närvarande lägga öfver honom en ulster, han själf hade ej tid ens att resa sig från stolen.

Medelst en kronograf mättes samtidigt koronans strålning. Denna kronograf var delvis gjord i — Hernösand. Af en eller annan orsak hade de båda vetenskapsmännen ej fört med sig en tub, som var nödvändig för en del af deras experiment. Häröfver voro de nästan otrosliga, då de ej visste hur de skulle bära sig åt för att få en ny. Efter deras ritningar lyckades det emellertid plåtslagaren Alvéén härstädes att tillverka en tub, som var till deras fulla belåtenhet.

I ett särskildt uppbyggt träskjul hade de båda vetenskapsmännen en mängd instrument inrymda. För observationerna var det af största vikt, att temperaturen i detta skulle vara så jämn som möjligt, och det hade också genom särskilda anordningar lyckats dem att få den fullt konstant. Bland de många instrumenten i detta skjul märktes särskildt en af dr Moll konstruerad, mycket känslig och snabbt och noggrant registrerande galvanometer, hvilken vid observationerna varit af stor nytta.

Det var med ett triumferande leende dr M. visade oss ett papper hvarpå en hel del kurvor voro uppritade. En icke «förstå-sig-påare» kan naturligtvis icke yttra sig om deras värde, men de båda vetenskapsmän-

nen försäkrade, att det var första gången, som deras metod att upprita koronor på det sätt, de gjort. De väntade sig för öfrigt ett mycket stort utbyte af sin expedition. Men mycket arbete vore kvar, innan allt var färdigt.

Ett par småsaker från deras observationer äro att anteckna:

Under förmörkelsen hände det inte bättre, än att en skruf lossnade å det instrument, vid hvilket prof. Van der Bilt satt. Denne såg det, men kunde på inga villkor lämna sin plats, ty då hade allt gått om intet. Då ingrep källarmästare Jönsson, hvilken biträdde som assistent, och klarade det hela. De båda vetenskapsmännen försäkrade, att hr J. vore född till vetenskapsman!

Då observationerna utfördes, voro fyra poliser beordrade att hålla noggrann vakt, så att ingen obehörig skulle slippa dit.

Professor Hasselbergs expedition.

I Sollefteå utförde professor Hasselberg sina observationer. Han hade, som bekant, först ämnat sig till Hernösand, men han ändrade sig. Hvarför? Jo, «på grund af Hernösands farliga läge under nuvarande förhållanden, som inträdt genom kriget!» — Det är bokstafligen sant!

Hvad hans observationer beträffar, lyckades de utmärkt, enligt hvad han har förklarat för Hernösands-Posten. Han hade fotograferat solkoronan med en stor kamera och hyste de bästa förhoppningar om resultatet.

Ja, detta såde vetenskapsmännen. Och alla voro, som sagdt, mycket glada öfver de lyckade resultaten. Vi äro förvissade om, att deras glädje delas af alla.

C.—M. L—g.

Observationerna från Navigations- skolan. 4

Då gårdagen inleddes med klar himmel och strålade solsken, var det säkert mången som frågade sig: skall detta härliga väder fortifara till tiden för solförmörkelsen?

Visserligen hade de närmast föregående dagarnas meteorologiska observationer visat sannolikhet för vackert väder, men så här sent lidet på sommaren är vädret ostadigt och öfvergången från klar till mulen himmel kan ske på en kort stund. Emellertid voro vädrets makter blida och först inemot slutet af förmörkelsen mellan kl. 2 och $1\frac{1}{2}$ 3 dansade lätta molnslöjor öfver solskifvan. De expeditioner, som med stort besvär ta-

git sig upp i dessa trakter och haft långa förberedelser, ha sålunda haft lön för sin möda. Vetenskapsmännen äro också i allmänhet särdeles belåtna med sina observationsresultat.

Mycket folk var på benen i går middag för att skåda det sällsynta fenomenet. Då det närmade sig tiden för totalitetens början, voro allas blickar riktade mot solen. Först inemot halfva tidsförloppet mellan första och andra kontakten kunde man varseblifva någon nämnvärd minskning af solljuset. Luften syntes blifva grådisig och dyster och isynnerhet under totaliteten antogo träden en egendomlig färg. Om man, då hela solskifvan lyser, iakttaga de ljusa fläckar, som bildas på marken i ett trädskugga och som bildas af det genom löfverket genomträngande solljuset, så ha fläckarna något oval form, men då solen är partiellt förmodrad, antaga fläckarna former af utskurna elipser, vända samma väg som den lysande delen af solskifvan. Detta märkvärdiga fenomen kunde man i går lätt iakttaga. «Flygande skuggor», hvilka likt horisontala eller snedt gående krusiga band jaga efter hvarandra, kunde däremot ej upptäckas.

Då solljuset försvunnit, kunde man se alla de större stjärnorna, något ost och syd varseblef man planeten Venus.

En vacker anblick erbjöd den pärlmoglänande coronan och den närmast solen omgifvande kromosfären. Det skönjdes att i den senare eruptioner äga rum, protuberanser, som, ehuru mycket små i förhållande till solens storlek, i verkligheten ha en höjd som räknas i 100,000-tals kilometer.

Beräkningarna för kontakterna med solskifvan, slå ofta något fel, hvarför man bemödar sig om att iakttaga tiderna för dessa mycket noga. Detta kan ske tämligen bra med simpla hjälpmedel. Från navigationsskolan har den lifligt intresserade föreståndaren, löjtnant C. W. Pettersson, benäget meddelat oss de tider, som observerades där, jämte några andra iakttagelser.

Första kontakten (den svåraste att passa) förlorades. Andra kontakten ägde rum kl. 1.12.58, tredje 1.15.7 och den sista 2.21.27. Alltså inträffade den totala förmörkelsen något senare än beräknadt var, dock med reservation för någon sekunds fel i tidsbestämningen. En på solskifvan belägen, tämligen stor fläck, passerades af skuggan första gången 12.24.21. och andra gången 1.33.30. Kl. 12 var vindstyrkan 1 enligt Beauforts skala, vinden sydlig. Små cumuli-moln i WNW. Kl. $\frac{1}{2}$ 3 vindens riktning densamma, styrka 2. Himlen var ungefär till sju tiondelar molnbäckt.

I öfrigt gjordes följande meteorologiska iakttagelser:

Kl.	Barom.-stånd	Vidfäst term.	Psykometer	
			torra term.	våta term.
11 f. m.	763,5	+ 17,5	+ 14,6	+ 11,4
12 t. 4 m. em.	763,3	+ 18,6	+ 15,2	+ 11,5
1 t. 13 "	763,3	+ 18,6	+ 13,0	+ 10,8
2 t. 2 "	762,8	+ 18,8	+ 15,6	+ 11,8

För iakttagande af kontakterna betjänade man sig i navigationsskolan af en tämligen stark tub, försedd med skynglas, hvilken riktades mot solens spegelbild i en artificiell horisont.

I Långsele.

Professorerna Bohlin och Bergstrand ha — enligt telegram till H.-P. — lyckats synnerligen väl med samtliga observationer. De ha förklarat sig vara mycket belåtna med det goda vädret, som varit det bästa tänkbara.

I Häggdånger

voro alla — enligt meddelande till H.-P. — synnerligen intresserade af förmörkelsen. På hvarje gård syntes människor, som betraktade det ovanliga skådespelet. Särskildt voro de i orten förlagda landstormsmännen mycket intresserade.

I Strömsund

hade tre af de svenska expeditionerna slagit sig ned under ledning af professor Charlyer, observatorn E. H. von Zeipel och d:r B. R. Rolf samt två utländska med 14 vetenskapsmän.

Enligt meddelande till H.-P. från nämnda expeditioner ha observationerna äfven där gynnats af det bästa väder.

I Sundsvall

kunde den totala solförmörkelsen i går iakttagas under synnerligen gynnsamma förhållanden.

Vid tiden för förmörkelsens början var himlen så godt som alldeles molnfri och förblef så ända till förmörkelsen kommit ett stycke på återgång.

Allt under det förmörkelsen skred framåt sjönk temperaturen rätt väsentligt. I det ögonblick den blef total voro åtskilliga stjärnor synliga för blotta ögat. Belysningen var då så stark som vid tiden för gatubelysningens tändande och i åtskilliga affärslokaler tändes det elektriska ljuset under de minuter det erfordrades.

Det säregna fenomenet följdes öfverallt med största intresse — meddelas H.-P.

STADSHOTELLET

Hernösand.

(Innehafvare Bernhard Jönsson.)

Nota den

29/8

1914

Rum N:o

29

Transport

69.35

port. Kaffe eller Té med Smör & Bröd

d:o Chokolade " " " "

d:o Mjolk (Lait) " " " "

Ägg (Oeufs)

Smörgås

st. Cigarrrer

st. Cigarretter

kopp Kaffe (demi-tasse)

glas Likör

" Cognac (Brandy)

" Whisky

" Punsch

fl. Mineralvatten

" Öl (Bière)

" Porter

Logis för rum med säng, inberäk-
nadt elektr. ljus och uppvärmning

8.50

Utlagdt för (debourse)

" " Skjuts (voiture) (carriage)

Papper och Kuverter (Papier et En-
veloppes)

Porto (Postage)

Tidningar

Telegrammer

Telefon

Tvätt (blanchissage-washing-Wäsche)

Stadsbud

Frakt

Kvitteras

Stadshotellet den

25 AUG. 1914

Bernhard Jönsson

Summa Kr.

70.85

Till undvikaande af misstag ämnas rikning för hvarje dag. Likvid emotes för hvarje vecka.
Um Missverständnissen vorzubeugen wird täglich Rechnung präsentiert. Die geehrten Reisenden werden höflichst ersucht, jede Woche Ihre Rechnung auszugleichen.
To avoid mistakes bills are given daily. Visitors are respectfully requested to pay their bills every week.
Pour éviter des erreurs on donne la note tous les jours. Messieurs les voyageurs sont priés d'acquitter leur Note toutes les semaines.

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18
100
70.85
37.15

30

G. J. Gibbs. ENGINEER. PRESTON
ENGLANDSolförmörkelsen.
Engelsk Officiel Expedition
Instrument.Hernösand, Sverige.

Ny expresslinje

Ny expresslinje

ÅNG. ÅNGERMANLAND

(Kapt. John Abrahamsen).

Elegant! Snabb! Utmärkt restauration!

Trafikerar från och med den 21 maj under hela sommaren routen

Stockholm—Sundsvall—Luleå

samt vice versa enligt följande turlista:

Från Stockholm torsd. kl. 12 midd.	Från Luleå lörd. kl. 5,30 em.
Ank. till Sundsvall fred. morg.	» Sundsvall sönd. » 6 »
Från » » 9 fm.	Ank. till Stockholm månd. » 12 midd.
Ank. till Luleå lörd. » 7 »	

OBS.! Hela resan Stilm—Luleå tager endast ca 43 timmar i anspråk. Ångaren står i god anslutning till flera andra linjer, exempelvis:
i Luleå med ångare till och från hamnarna norr därom
i Sundsvall med ång. Carl v. Linné från och till Wasa
i Stockholm med expressång. Nya Westerbotten (bästa lägenhet för besök vid Baltiska Utställningen i Malmö).

1914

Stockholms Rederiaktiebolag SVEA.

K. B. BOSTRÖMS BOKTR., STOCKHOLM.



Solförmörkelsen.

G. J. GIBBS.

BERGEN

for

NEWCASTLE Station Hotel

per

S.S. RAGNVALD JARL

STOCKHOLMS NYA SPÄRV. A. B.

Kvitto 10 öre

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Ser. 2394

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NORDISK RESEBUREAU.
Stockholm—Charlottenberg Gränsen.
Serie 20.

Passagerare-Biljett

Ång. Express

Kr. 1: 50 860

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Biljett-Häfte Nr 8934

Innehafvarens namnteckning.
Unterschrift des Inhabers.

NORDISK RESEBUREAU

STOCKHOLM:
Operahuset.

MALMÖ:
Östra Hamngatan 2.

GÖTEBORG:
Palace Hôtel.

S:T PETERSBURG:
Bolschaja Konjuschennaja 19.

Får ej öfverlåtas. — Nicht Übertragbar.

Datumstämpel:

Form. Nr 1.

NORDISK RESEBUREAU

Telegrafadress: RESEBUREAU.

GÖTEBORG: Palace Hôtel.
Rikstelefon: 41 94.

MALMÖ: Stortorget 13 A.
Rikstelefon: 32 26.

STOCKHOLM:
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Exp.	Datum	Kr.	öre
4 1/2	15/10	60	40
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Telegram			
Porto (Postage)			
Kr.		60	40

Namn: Ragnvald Jarl

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Serie 203.

Inlämningsbevis

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Anspråk på ersättning för inlämningsbevis (försändelse) skall ställas inlämningsbeviset hos Kongl. Generalpoststyrelsen: inom ett år efter försändelsens afgifvelse till postverket, därefter den närmaste lördagen i oktober, om försändelsen ankommit i skedd skick. I fråga om ersättning för försändelse till utlandet gäller hvad därom i särskilda fall stadgas.

Beskaflenhet.	Bref
Inlämningsnummer.	281
Adressort.	Buckingham
Adressat.	Mrs Gibbs
Assuransbelopp.	1000
Anmärkningar.	
Vikt för assurerad försändelse.	
Erlagda postafgifter.	34



(Vederbörande posttjänstemans underskrift.)

Blankett nr 301.
(September 1899.)

№ 89

Kvitto å inlämnat Privat-telegram.

Telegram till *Gibbs* och *Buckingham* stationär betalt med *3* Kr. *—* öre, varav 5 öre för detta kvitto.Telegrafverkets station i *27* den *14* 1914, kl. *14**Am*

Stockholm 8.30 a.m. Friday
 Chertown 10.27 p.m.
 D.H. * 10.52
 Berge 11.0 P.M. Sat. 1 p.m.
 Steamer 1.0 P.M. Sat. 6 p.m.
 Chertown 4.0 p.m. Sunday 9.30 a.m.

151.10 2nd Rail
 1st Boat

Boat Ragnvald Jarl

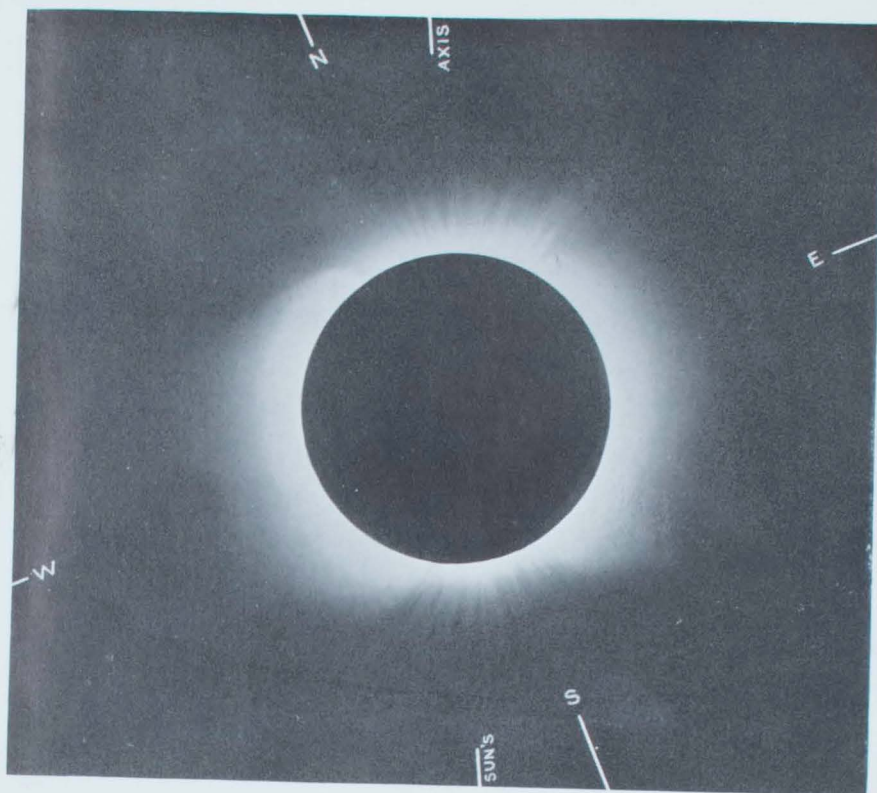
Receipt on page 31

+ (B) C W
 7/A
 + (C) R

31. Aug. 1914

[Flag] Blue & White
 [Flag] Red & Yellow
 [Flag] Yellow & Red
 [Flag] Red & White

SIGNAL given by
 BRITISH CRUISER
 (7 p.m. SUNDAY 31. VIII. 1914)
 to "RAGNVALD JARL"



The Solar Corona by the 20-ft. Coronagraph.
Exposure, 10 secs.

This illustration is 7/10ths size of original photograph.

See STONYHURST REPORT page 36

35 5

Reprinted from the MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY,
Vol. LXXV. No. 3.

PRELIMINARY REPORT ON THE TOTAL SOLAR
ECLIPSE OF 1914 AUGUST 21. (OBSERVED BY
THE EXPEDITION OF THE JOINT PERMANENT
ECLIPSE COMMITTEE TO HERNÖSAND, SWEDEN.)

(Plates 9-12.)

BY

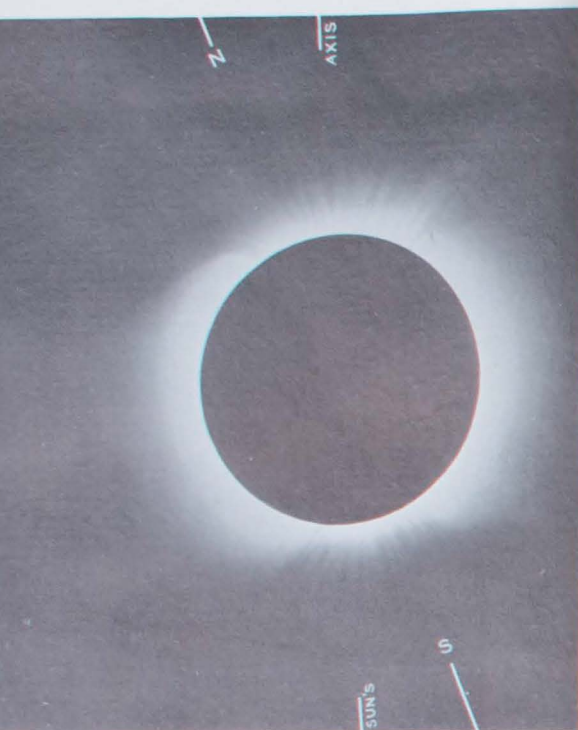
THE REV. A. L. CORTIE, S.J., F.R.A.S.

(Communicated by the Joint Permanent Eclipse Committee.)

1. General Arrangements.

The expedition was one of those organised by the Joint Permanent Eclipse Committee of the Royal Society and of the Royal Astronomical Society, the expense of the expedition being defrayed by a grant made by the Government Grant Committee.

It had been arranged that Father Cortie, with Father O'Connor as a volunteer observer, should form part of the expedition to Kiev with Professor Fowler, Major Hills, and Mr. Curtis. But owing to the refusal of the Russian Government, communicated by the Foreign Office, to allow the two Jesuit Fathers to enter the Empire, it was decided to divide the expedition originally intended for Kiev, and that Father Cortie should lead an expedition to Hernösand, Sweden. Since our return we have learned that Dr. Backlund, the Imperial Astronomer at Pulkovo, obtained permission for us to go to Russia—a permission which fortunately, as events proved, was not communicated to us. Hernösand had not been chosen as a station for observation of the eclipse in the original scheme of the British expeditions, on account of the average weather conditions in August not being so favourable for clear skies as at the stations in Russia. As has not unfrequently happened, prognostications founded on meteorological results were of very little use as a guide in the selection of the eclipse stations.



The Solar Corona by the 20-ft. Coronagraph
Exposure, 10 secs.

Illustration is 7/10ths size of original photograph.

Besides Father Cortie, the eclipse party consisted of Father O'Connor of the Stonyhurst College Observatory, Mr. G. J. Gibbs of Preston, and Mr. E. T. Whitelow of Birkdale, Southport. We left Hull by the s.s. *Calypso* on July 28, and arrived at Gothenburg on the morning of July 30, and thence by rail to Stockholm, arriving the evening of the same day. The time had been short for making preliminary arrangements as to a possible site for the instruments at Hernösand. It happened fortunately that Father Wulf and his assistant Father Rodés of St. Ignatius College, Valkenburg, in Holland, had arranged to observe the eclipse at this station, and through their kind offices we were put into communication with Professor B. Hasselberg of the Academy of Sciences, Stockholm, the chief of the Swedish Commission for the observation of the eclipse. We owe it to his great kindness and courtesy that we were enabled to secure an excellent site at the Technical School at Hernösand, and that our instrumental equipment was admitted duty-free into Sweden, the officials of the Custom-house having also received instructions to expedite their despatch in every possible way. We left Stockholm by boat on August 2, and arrived at our destination on August 3. We found our instruments, which had been sent from Hull in the middle of July, safely stored in the Custom-house. They were delivered next morning and transferred to the Technical School. After a merely formal examination by a Customs official, we immediately commenced with their erection. Everyone was exceedingly kind and most anxious to do all in their power to assist us. As war had been declared, and the Swedes, though neutral, had mobilised, the only drawback on our perfect liberty was that, in common with all other strangers in the town, we had to present ourselves every day of our stay to the police.

2. Erection of Instruments.

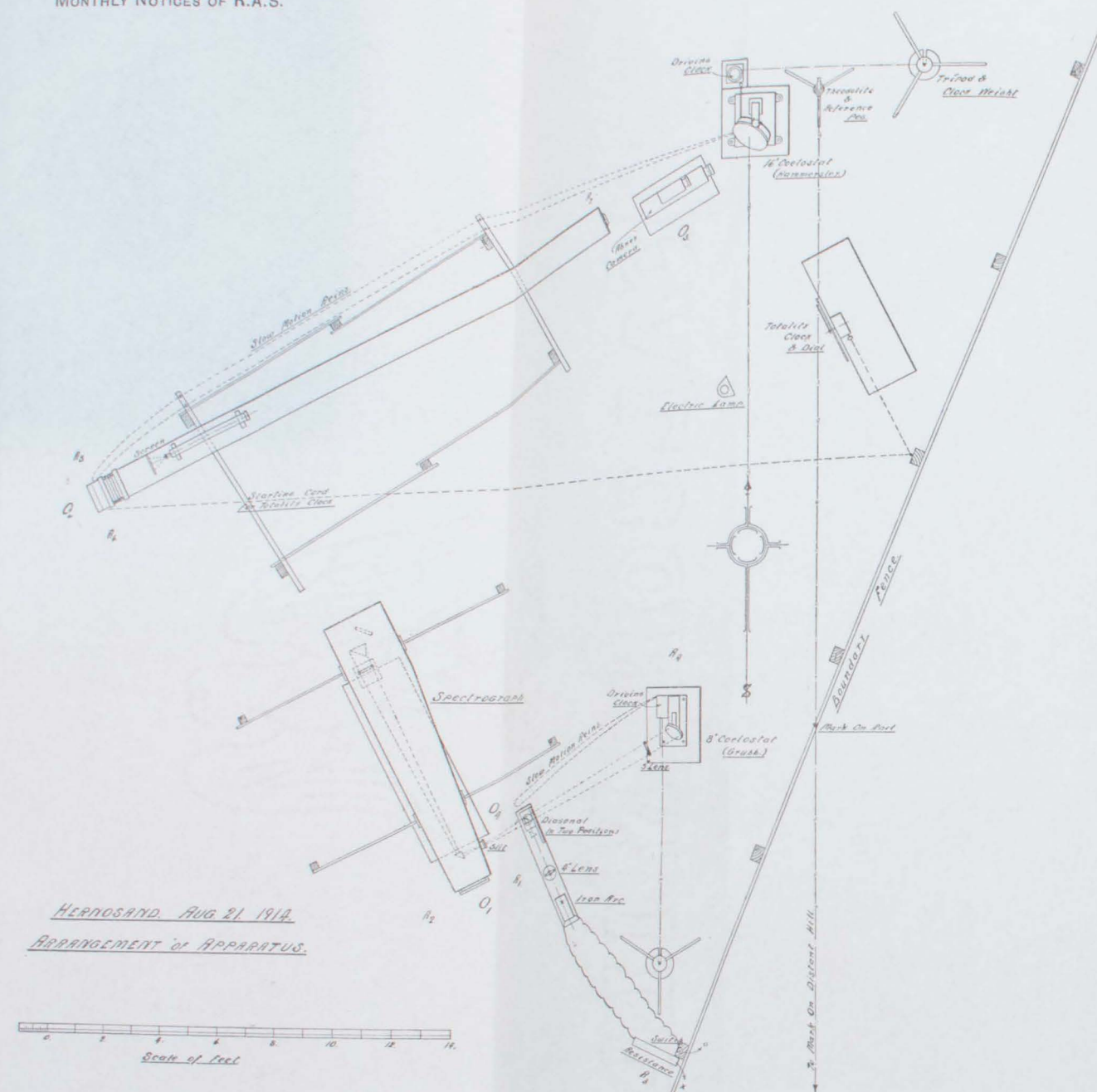
We cannot be too grateful to Herr Recktor Tham for placing the Technical School practically at the entire disposal of the British party and of that from Valkenburg for the observation of the eclipse. The school contained well-appointed laboratories, mechanic's and carpenter's shops, dark room, and a complete electrical plant in connection with the town mains; in fact, every convenience an eclipse party could desire. The town of Hernösand is situated partly on the mainland and partly on an island, the two portions of the town being separated by a strait on which is the port, the strait being spanned by two bridges. The Technical School is on the island, and its co-ordinates, as given me very kindly by Professor B. Hasselberg, are:—Latitude $62^{\circ} 38' 8.8''$ N., and longitude $17^{\circ} 57' 32.25''$ E. of Greenwich. The field at the back of the school in which we elected to set up our instruments has a gradual rising slope, and in addition the school itself stands on rising ground, so that the altitude of the station was about 300 feet above sea-level. The meridians and azimuths of the

STATION, PLATE II.



Not on same
been changed
I should have
the true
had been
a good deal

See STONYHURST REPORT page 36



HERNÖSAND, AUG. 21, 1914.
ARRANGEMENT OF APPARATUS.

Jan. 1915. *Total Solar Eclipse of 1914 August 21.* 107

instruments were determined by Father O'Connor with the theodolite. We were indebted to the energy and engineering skill of Mr. Gibbs for the rapid and efficient mounting of the equipment. No concrete bases were built, the cœlostats being mounted on their packing-cases, loaded with earth and stones, and partially sunk in the ground. Nor were any covering huts for the instruments erected, as experience in heavy rains at Stonyhurst had shown that they could be entirely protected by heavy tarpaulins. These same tarpaulins were utilised at Hernösand, in addition to coverings of waterproof material purchased in the town. The general plan of the positions of the various pieces of apparatus is shown on Plate 9.

The Cœlostats and Coronagraphs.—The 16-inch cœlostat belonging to the Royal Astronomical Society supplied light to three coronagraphs, and to a telescope for projecting an image of the sun on to a screen of ground glass. Much trouble had been experienced with the driving clock of this cœlostat in the expedition to Vavau in 1911. The brake mechanism had been altered by Mr. Gibbs before leaving England, and accordingly it ran much more smoothly. But the driving screw for the sector has a periodic error of one minute, which caused a shift of the solar image projected on the ground glass of the camera about every half-minute, the image then returning to its original position. These errors we thought we had adjusted, as on the day preceding the eclipse, and on the morning of the eclipse day itself, the solar image remained perfectly steady for a period of fully half an hour. But our adjustments of the errors in driving and in the screw were completely upset by the drop in temperature during the eclipse. Luckily the photographs are not seriously marred by this unevenness in driving, but on the longer-exposed photographs there is a slight second image. Mr. Gibbs furnishes the following notes on the cœlostat driving clocks:—

"The driving clock of the 'Hammersley' 16-inch cœlostat has from time to time given considerable trouble. The trouble has been traced to two principal causes:

- (a) Excessive and variable internal friction.
- (b) Great slackness in all pivots and joints in the governor.

The former defect arises from weakness in the jointing of the frame or casing of the clock, the securing together of the various parts being not sufficiently definite and rigid. The stresses due to rewinding are occasionally sufficient to disturb the joints and consequently the relative positions of some of the working parts. The latter defect, (b), was really the more serious, because the rate of the clock depends on the definite invariable vertical dimension measured from the bottom pivot which supports the weight of the governor to the brake ring or surface: all the joints in the governor and brake levers are much worn and very slack, so that the parts occupy different relative positions from time to time whereby the clock varies its rate so much as to be quite unreliable. The major portion of this difficulty was at Hernösand

obviated by the temporary elimination of those parts of the brake mechanism which were most slack in the joints.

"At Hernösand, after having succeeded in getting the clock to maintain a fairly steady speed, the image of the sun on the ground-glass screen of the 20-foot camera was found to be unsteady, wandering at intervals from the position occupied for the greater portion of the time. This wandering was traced to a defect in the large tangent screw driving the cœlostast polar axis. Observation of the movements of the image disclosed a large temporary disturbance at intervals of one minute, with a smaller temporary disturbance exactly midway between the larger disturbances. It was found that the tangent screw driving the cœlostast made one turn per minute. Careful adjustment to eliminate end-play of the screw failed to cure the trouble, which was finally attributed to some defect of the screw itself, probably a bend. The negatives Nos. 2, 3, and 4 show the effect of these temporary disturbances.

"The driving clock of the 'Grubb' cœlostast also gave some trouble. Inside the barrel of this clock is provided a maintaining gear, but without means for lubricating the internal parts. In consequence, and during the afternoon of August 20, immediately preceding the day of the eclipse, this clock refused to turn at all. Quite a long and tedious examination was necessary before the trouble was traced to the interior of the barrel. The amount of time expended in getting these clocks to work properly was seriously detrimental to the work of the expedition. The advancing or retarding of the cœlostast mirrors by means of slow-motion gear and endless cords or reins is by no means satisfactory, because it requires the use of both hands on the part of the observer. In the case of the 'Hammersley' cœlostast the slow-motion apparatus consisted of a secondary screw and sector operated by means of the endless cord quite independently of the clock-drive, which was therefore not disturbed by the working of the slow-motion gear, and there was no fault to be found in this respect. On the other hand, in the case of the 'Grubb' cœlostast, the slow-motion mechanism, being of the 'mouse-wheel' form, is an integral part of the main driving gear and the 'back-lash' entailed much lost motion, which, moreover, was very unequal in the two directions. Any working of this gear for the purpose of adjusting the 'hour angle' of the mirror disturbed the drive.

"When any adjustment of this mirror amounting to, say, one-fifth of a degree was necessary, it was found better for the observer to go to the clock, throw the mouse-wheels out of gear, and make an approximate adjustment by hand, after which the mouse-wheels had to be replaced in gear before returning to position at the far end of the reins, whence the final adjustment had to be completed.

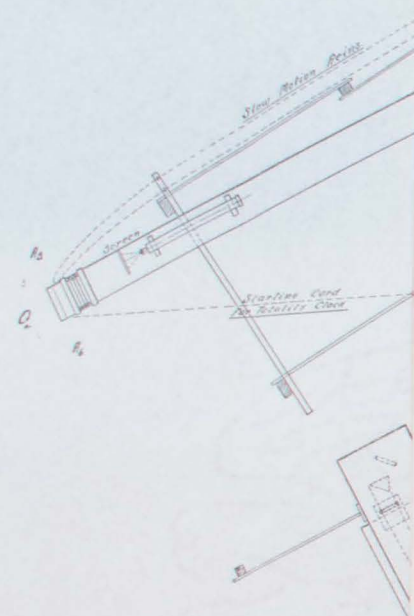
"It is therefore suggested that for such short runs as are required for eclipse work an electric motor drive would give the most satisfactory results.

"The power required is very small indeed, and small electro-motors are now made to be very reliable and quite reasonably

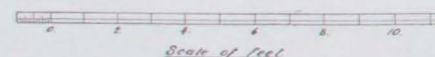
efficient. A rough calculation of the power may be made as follows:—A weight of 20 lbs. falling 3 ft. in 20 minutes will drive a clock and cœlostast mirror, the rate of power expenditure in this case being 3 ft.-lbs. per minute. It is therefore obvious that a very small motor and battery would suffice. The battery would probably consist of, say, half a dozen small accumulators, and the motor would be geared to the cœlostast polar axis through a train of worm gears. The observer would control the motor from his position at any distance by means of a starter and speed-controller. He would also have by him a speed indicator. The space occupied during transport and the total weight would be considerably less than that of a clock-driving equipment with its weights and tripod for supporting them. The charging of the battery would probably be a matter of no difficulty under any conditions of actual service, and in any case the total running time of the motor (practices included) in the field would probably be well within the capacity of the battery without recharging.

"In case great refinement of speed regulation and checking were deemed necessary, then a speed-checking device could easily be arranged on the following lines:—A dial is provided round which a finger travels. The finger is driven at a known rate by pendulum-controlled clockwork. The dial is driven at the same rate from some convenient part of the cœlostast driving gear when that gear is running at the normal speed. Thus the observer would have a rotating dial and a rotating finger in view, and so long as the motor speed corresponded accurately to the pendulum rate there would be no relative motion of the finger and moving dial, and departure on the part of the motor from the speed as determined by the pendulum would be promptly signalled to the observer by a change in the position of the finger in relation to the dial, which would be provided with marks or divisions for the purpose."

The lens of the 20-foot coronagraph is 4 inches in aperture, and was made by Sir Howard Grubb for the eclipse of 1900, for the Royal Irish Academy. It has been very kindly lent to me by the Council of the Academy—to whom I desire to tender my sincere thanks—for the eclipses of 1905, 1911, and the present eclipse. Exact focussing of the lens was secured by photographs of the fine sun-spot on the sun on the days preceding the eclipse. The sharpest image of the sun corresponded with a diameter of the image of $2\frac{1}{2}$ inches. The camera tube, made under Mr. Gibbs' supervision, was constructed of well-seasoned wooden planks in convenient sections, blackened on the inside, which could be screwed together and held in position by cross battens over the joints. The lengths for the top and bottom of the camera tube were flanged, the sides being screwed into the flanges. It was extremely rigid. A camera bellows with rack-and-pinion motion was fitted at the end of the tube, carrying plate-holders 10×8 inches. In order to secure adjustment of the camera in the azimuth of the sun's image on the days preceding the eclipse, the tube was mounted on stout wooden hurdles, so that it could be moved bodily longi-



HERNÖSAND, AUG 21, 1914.
ARRANGEMENT OF APPARATUS.



tudinally. The uprights of these hurdles were sunk in the ground, and additional stability was secured by strong cross battens. The white waterproof covering over the whole instrument acted as a reflector to the sun's rays, and prevented any internal convection currents due to unequal heating. The coronagraph was under the charge of Father O'Connor, assisted by three students—one to hand plate-holders, the other to receive them after exposure of the plates, and the third to make the exposures. A light cord was attached to the wrist of this gentleman, led through staples driven into the side of the camera tube to the observer. He uncovered and covered the lens when the cord was pulled. The following programme for exposures was arranged:—

Number of Slide.	Time by the Eclipse Clock.	Exposure Seconds.
1	128-126	2
2	111-107	4
3	92-82	10
4	67-42	25
5	27-20	7
6	5-2	3

The plates were Ilford Special Rapid, backed, with a speed number (H. & D. scale) 400. All the exposures, except the first, were successfully made.

The two coronagraphs of shorter focal length, namely, the "Abney" camera with a Dallmeyer portrait lens of 4 inches aperture and focal length 34 inches, and the Ross camera, aperture 3.5 inches and focal length 12 inches, were mounted one above the other, *en échelon* with the 20-foot coronagraph. These two cameras were operated by Mr. Whitelow. Four exposures were made with the "Abney" coronagraph, of 10, 50, 15, and 5 seconds respectively, the first two on Ilford Monarch plates, speed number H. & D. 525, and the last two on Ilford Panchromatic plates, speed number H. & D. 400. These four plates were from batches which had very kindly been bathed for me by Mr. Crowther of Carlisle with a special solution to render them impervious to solarisation by long exposures. Hence no over-exposure of the lower parts of the corona relatively to the filmy extensions should be possible. In the Ross camera one long exposure of 95 seconds was made on a Paget "Hydro" plate, which also was unsolarisable by over-exposure. Mr. Whitelow carried out his programme exactly, and in addition made two exposures at 30 seconds and 1 minute after totality, with a Zeiss single "Protar" lens of 14 inches focus working at $f/16$, also on Paget "Hydro" plates. This camera was mounted on a wedge head cut to the latitude of Hérnösand, and pointed directly at the sun. These two plates are very interesting, as they show the whole disc of the moon projected on the background of the solar corona.

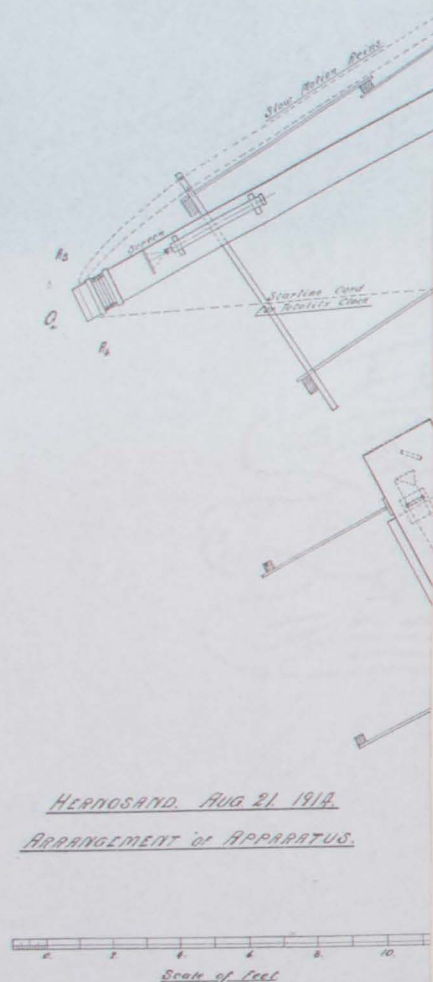
The Spectrograph and Associated Instruments.—These instru-

ments were under the charge of Father Cortie and Mr. Gibbs, assisted by Herr Askling, the master of mechanical science at the Technical School, Herr Wiberg, the mechanic, who stood by the cœlost, Herr Helenius, the town electrician, and a student to hand plates. The spectrograph was of the Littrow form, and was put together and adjusted at the Imperial College of Science under the supervision of Professor Fowler. The slit, $\frac{7}{8}$ inch long, belongs to the Royal Astronomical Society; the diagonal prism to the Imperial College of Science. The beam of light, after total reflection at the face of the diagonal, traversed a 6-inch O.G. focal length 98 inches, kindly lent by the Astronomer Royal, and passed through a fine prism of dense flint glass 7 inches edge and refracting angle 40° , made for the Joint Committee by Sir Howard Grubb for the eclipse of 1905. The light after dispersion by the prism was reflected by a 6.5 inches flat mirror, made by the late Dr. Common, and belonging to the Committee. After reflection it passed back through the prism and object-glass, and the spectrum was received on plate-holders placed in a repeating back with rack-and-pinion motion. The plate-holders were kindly lent by Professor Newall. The prism was placed at the angle of minimum deviation and the mirror adjusted so that the red end of the spectrum fell about the middle of the plate, the length of spectrum from $\lambda 6700$ to $\lambda 4800$ being 4 inches, and the deviation for H_β being approximately 28.5° . The slit width employed was determined by the method of diffraction bands, which were two in number in the region $\lambda 6700$, corresponding to a width of 0.0017 inch. The purity of the spectrum was such that the iron line at $\lambda 5270$, with components differing by $\lambda 0.819$, was just split.

Hence $\frac{\lambda}{d\lambda} = p$ was approximately 6400.

To form an image of the sun on the slit, a Grubb cœlost, kindly lent by the Royal Irish Academy, with mirror 8 inches diameter, was mounted so that the levelling screws were supported on iron battens fixed to a packing-case firmly embedded in the ground and filled with stones. The cœlost could therefore be very easily shifted longitudinally out of the meridian. This was necessary, as the heavy spectrograph mounted in its packing-case, with removable panels over the optical parts, was placed once for all in the azimuth of the sun's image at the time of totality. Therefore, in the days preceding the eclipse, we had to shift the cœlost bodily out of the meridian towards the east, to obtain a horizontal beam of sunlight on the slit. The cœlost slid along the iron supporting battens, until on the day of the eclipse it lay with its axis in the meridian. An Alvan Clarke lens of 5 inches aperture and 7 feet focal length, belonging to the Stonyhurst Observatory, gave an image of the sun on the slit plate $\frac{1}{8}$ of an inch in diameter. The lens was placed just in front of the mirror in the prolongation of the azimuth of the sun's image at totality. It was adjustable in azimuth.

The Comparison Spectrum.—A novel feature in eclipse opera-



In addition to this photograph six exposures on the tip of the southern cusp on the sun's east limb were commenced 7 minutes before totality, a seventh and middle exposure being made on the iron-arc. A precisely similar set of exposures were made 5 minutes after totality, but this time on the tip of the south-west cusp. The exposures were about 1 second each, at intervals of about a second, the slit being covered and uncovered by a shield of zinc.

The Eclipse Clock.—This consisted of a set of spring-driven clockwork with a fan governor, which permitted of a sufficiently accurate adjustment of the rate, so that one revolution of the projecting arbor was made in the estimated number of seconds of totality. The arbor carried a hand about 12 inches long, and a dial with a divided circle two feet in diameter was arranged in appropriate position so that all observers could conveniently see it. The dial was illuminated during the eclipse by means of an incandescent electric lamp.

The circle on the dial was not divided into equal spaces, neither were the divisions numbered; the system employed was a series of dark segments of various lengths alternating with blank segments. The passage of the hand over each of the dark segments indicated the commencement, duration, and end of each exposure made with the 20-foot coronagraph. The passage of the hand over each of the blank spaces indicated the time reserved for slide-changing and the preparations for the succeeding exposure.

The clock was started the moment totality commenced, that moment being determined by Father O'Connor, who watched the projected image of the sun on a transparent screen arranged behind the eyepiece of the 3-inch Cooke telescope. This telescope and screen were supported on the tube of the 20-foot coronagraph and were fed with light from the 16-inch cœlostât. At the moment Father O'Connor saw that totality had commenced he called out "Go," and simultaneously pulled the cord which released the clockwork. The hand then started to make a single revolution round the dial during the estimated time of totality.

3. *The Day of the Eclipse and After.*

During our three weeks' stay at Hernösand, every day had been cloudy except August 9, and the day of the eclipse. Most days were quite clear in the early part of the morning, and then clouds would form, and cover the sun at the time at which eclipse would take place. There were clear intervals in the afternoon, and the clouds would disappear at night. All this time the wind was in the N.W. or N.N.W. quarter, and we experienced a certain

number of showers of rain, though there was no day of continuous rain. The barometric height was very constant, about 29.5 inches, and all these types of weather conditions accompanied the same direction of the wind and the same height of barometer. But on August 9 a beautifully clear sky had accompanied a S.E. wind. On the evening of August 20 the wind again changed to that quarter, with a slight rise in the barometer. A beautiful night heralded the absolutely perfect weather conditions for the day of the eclipse, although clouds formed in the afternoon, about an hour after the eclipse was over. In general the atmosphere at Hernösand was very translucent.

Several drills had been held each morning, commencing on August 18, the observers being drilled separately at each instrument and then all together. Seven students of the Technical School under the direction of Herr Askling assisted us, in addition to Herr Wiberg and Herr Helenius, whose duties have already been mentioned. Three of these students, with Herr Askling, made a composite drawing of the corona, on specially prepared cards, on which concentric circles had been drawn round a dark disc representing the moon, at successive radial distances apart of $\frac{1}{8}$ a lunar diameter for the first diameter and $\frac{1}{4}$ for the second. During the drills they made sketches from a drawing of the corona of 1901, each taking one quadrant only.

The duration of totality had been calculated from the formula, page 2, *Nautical Almanac Circular* No. 20, based on the path of the moon's shadow as published by Dr. Crommelin in the *Journal of the British Astronomical Association* for January 1914. This path was plotted on the Swedish General Staff Maps for Hernösand, and gave the distance of our station at the Technical School from the central line of total eclipse as 3.9 miles. The duration of totality under these circumstances was reckoned to be 129.5 seconds. It was actually about 4 seconds less.

A goodly number of spectators assembled in the field about one hour before totality, and watched the progress of the eclipse through darkened glasses. To prevent any inadvertent intrusion we roped off a large enclosure round the instruments. The spectators were extremely quiet, and no trouble was experienced from their presence. At 10 minutes before totality, as observed on the projected image of the partially eclipsed sun on the ground-glass screen by the method of cusps, Father O'Connor blew three blasts on a whistle. At the signal the observers and their assistants stood to their stations, and the coelostat clocks were wound up. At 5 minutes before totality, at the signal of two blasts on the whistle, the lamps were lit and the slides drawn. At 10 seconds nominally, but in reality at 12 seconds before totality, one blast was blown, the signal for exposures on the "flash" spectrum. At the signal "Go," the string was pulled which released the mechanism of the eclipse clock, and the exposures with the coronagraphs were started.

The naked-eye view of the corona in a perfectly transparent

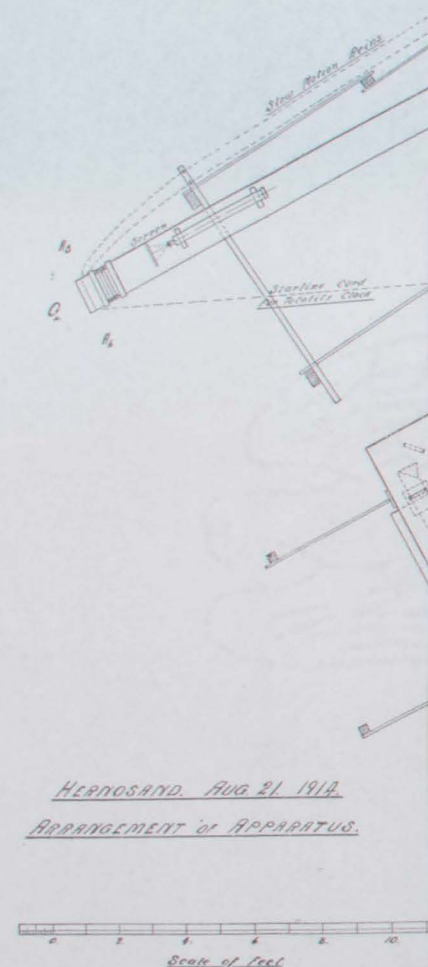
and dark sky was superb. Such views as we could take in the intervals of exposures showed a long fish-tail streamer on the western side of the sun, a brilliant streamer N.E., a shorter and less brilliant streamer S.E., and between them a long equatorial ray, but much fainter than either. No one seems to have seen the prominence in the S.E. quadrant which is such a marked feature on the photographic plates. Nor were the polar rays very marked visually. The general impression from visual observations was that the west side of the corona was of the minimum type, while the east side was of an intermediate type when the streamers begin to open out polewards. During totality the planet Mercury shone brilliantly to the N.W. of the sun, and the planet Venus low down on the S.E. The eclipse was a very bright one. About 20 minutes before totality a decidedly cold wind blew from the S.E. The total drop in temperature during the eclipse was $7^{\circ}4$ F.

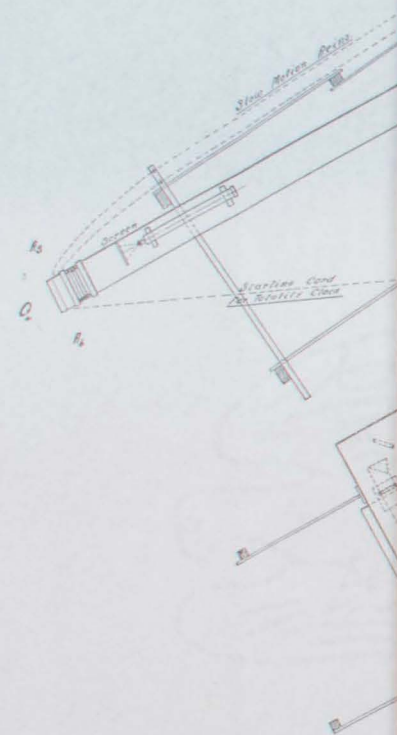
The plates were all developed and the instruments packed on August 21 and 22. We took the first boat possible from Hernösand to Stockholm, which, however, did not leave until August 25; and, passing safely through two Swedish mine-fields between Sundsvall and Stockholm, under the escort of armed vessels, we arrived safely at the Swedish capital on the afternoon of August 27. There his Excellency the British Minister, Sir Esmé Howard, very kindly took charge of our instruments on account of the war, and subsequently transmitted them to the British Vice-Consul at Bergen, who secured their safe transit across the North Sea to Hull. We left Stockholm on August 28 by rail for Bergen, whence we started next day on board a Norwegian steamer for Newcastle. Warned twice by British cruisers, which were patrolling the North Sea, we were enabled to avoid a German mine-field some distance from the mouth of the Tyne, by making for the north of Scotland and coming down the coast. Finally we entered the Tyne on the early morning of August 31, escorted by torpedo boats.

4. Summary of Results.

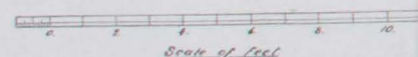
Five large-scale photographs of the corona were secured which show much fine detail. Also four photographs were taken with the Abney coronagraph, and one with the Ross lens, by Mr. Whitlow, which show the extension of the coronal streamers further than was observed with the naked eye by the Swedish students who made the composite drawing on the graduated chart. The drawing is in excellent accord with the main features as photographed; but whereas the greatest extent of the corona on the drawing is $1\frac{1}{2}$ lunar diameter, the 10-seconds photograph taken with the Abney coronagraph shows the extension in the S.E. streamer to have been fully 2 diameters. Both photograph and drawing agree in showing a double curvature in this streamer. It first bends upward, and then downward, until it terminates almost in a point.

The eclipse is interesting as having occurred at a period when





HERNOSAND AUG 21 1914.
ARRANGEMENT OF APPARATUS.



G.J.G.

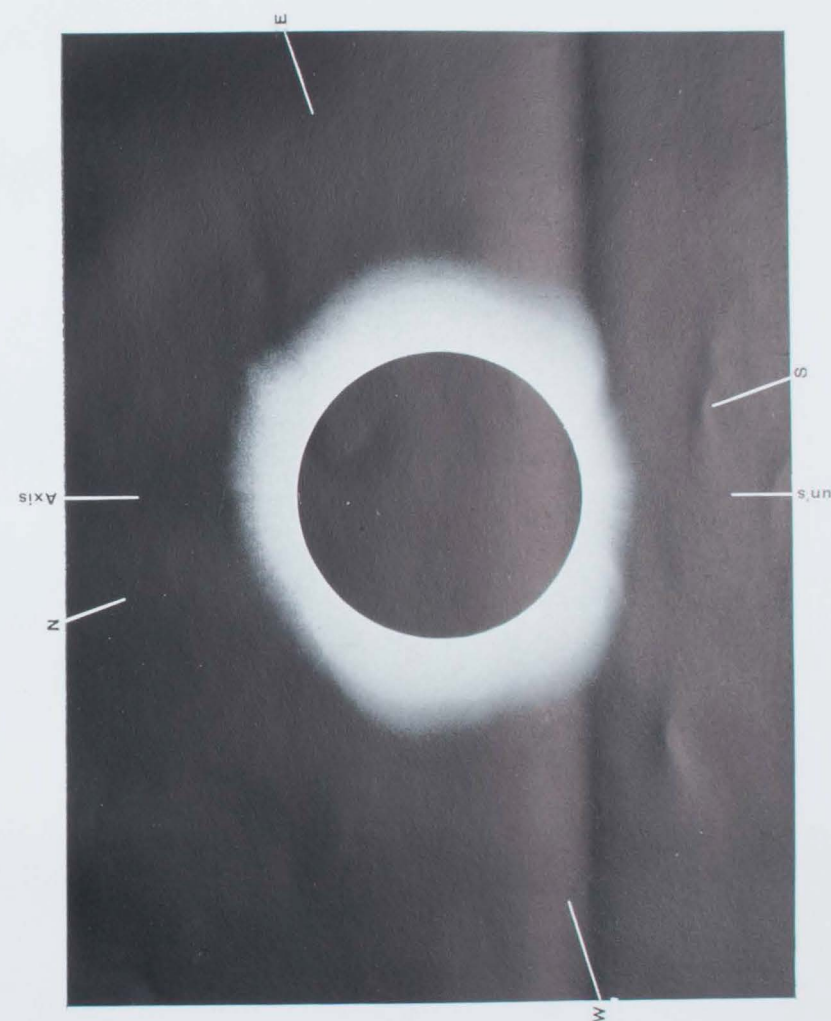
the solar-spot activity was increasing; very few, if any, former coronas having been photographed at a similar phase of the sun-spot cycle. The preceding minimum of spot-activity had also been very protracted. The general form of the corona corresponds neither to a "maximum" nor a "minimum" corona. The long fish-tail streamer on the west side, the roots of which extend from position-angle 230° to 295° , combined with the polar rays, which in the N. cover an arc of 75° , between position-angles 330° and 45° , and on the S. an arc of 65° , between position-angles 160° and 225° , are features characteristic of a "minimum" type of corona. But on the E. side the spreading streamers indicate an intermediate type. The N.E. streamer is remarkable, consisting of a sheaf or bundle of bright filaments, closely packed together as seen in perspective, and traceable for about $26'$ of arc from the sun's contour. It is evidently the projection of a great streamer emanating from the solar surface, possibly from the neighbourhood of the large spot that was on the sun's disc. The filamentous structure of the other streamers is also noteworthy. These filaments are superposed upon a bright central ring representing the lower corona. Both the larger and the small-scale photographs agree in showing this decidedly brighter inner coronal ring, sharply defined, and about $1'$ to $2'$ in height. The slide of the plate-holder for the last larger-scale photograph was only just closed before the emergence of the sun's bright limb, and shows a considerable arc of the chromosphere. Prominences were photographed at the following position-angles: -0° , 11° , 100° , 143° – 153° , 235° , 257° – 275° , 287° , 353° . They are all small except the fine arched prominence with a bright keystone, between 143° – 153° , which rises about $85''$ from the limit. Continuous with the prominence of height $50''$ at position-angle 353° is a remarkable bright filament in the corona of a different character from the polar rays. In the longest-exposed negative of the larger series it can be traced as far as $7'$ from the limb. It is slender, and curves over towards the equator.

With the Zeiss lens Mr. Whitelow secured two plates, at 30 seconds, and 1 minute, after totality was over. These show the whole of the dark moon projected on the luminous background of the corona.

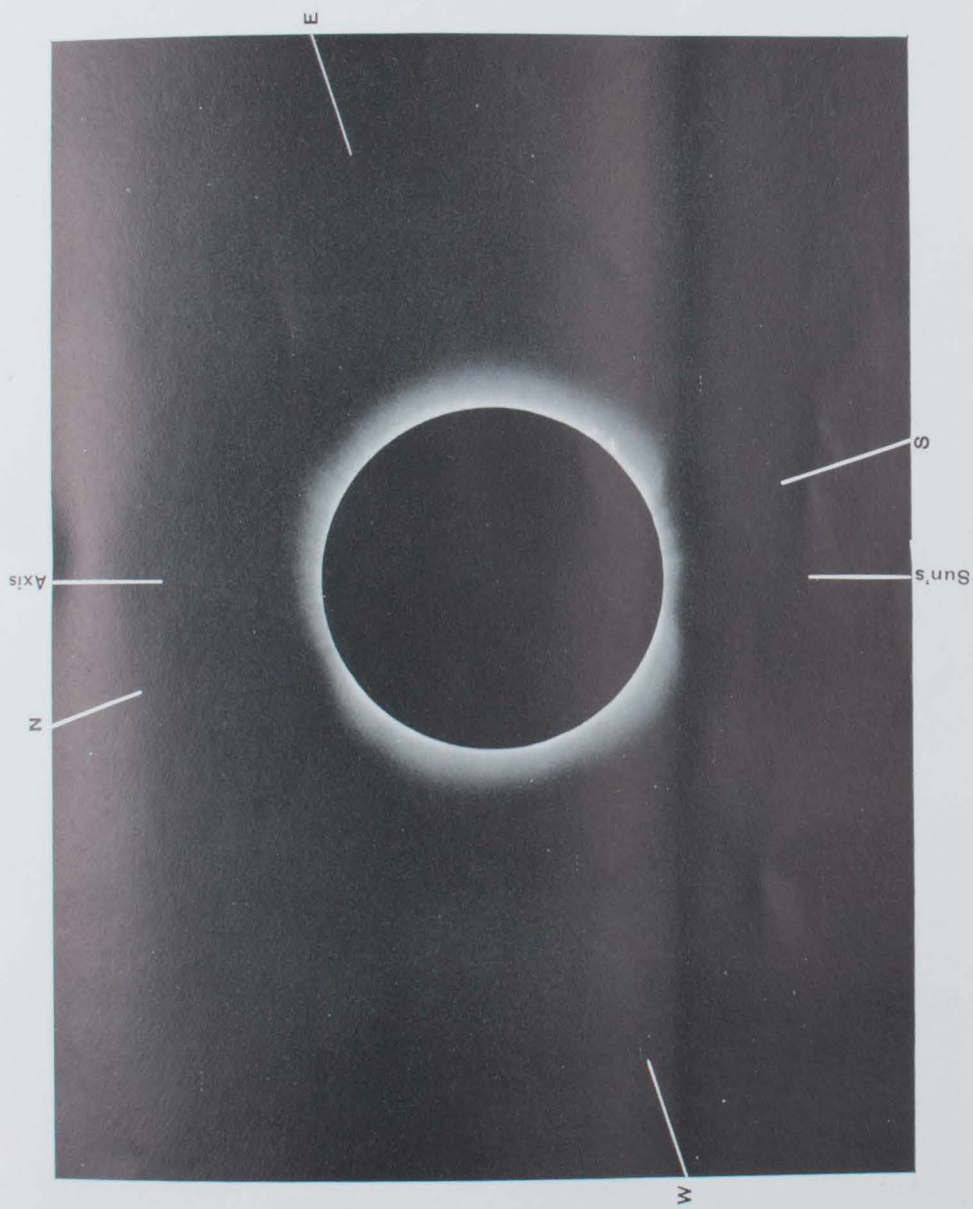
The spectrum of the corona, though extremely faint, is very interesting. It presumably consists of a series of bands or flutings, those in the red being the more prominent.

The provisional wave-lengths of these red bands are:—

- | | | |
|----|----------------------|----------------|
| 1. | 6643.9
6630.5 | } three lines. |
| 2. | 6530.9
6502.8 | |
| 3. | 6384.3
6363.0 | } seven lines. |

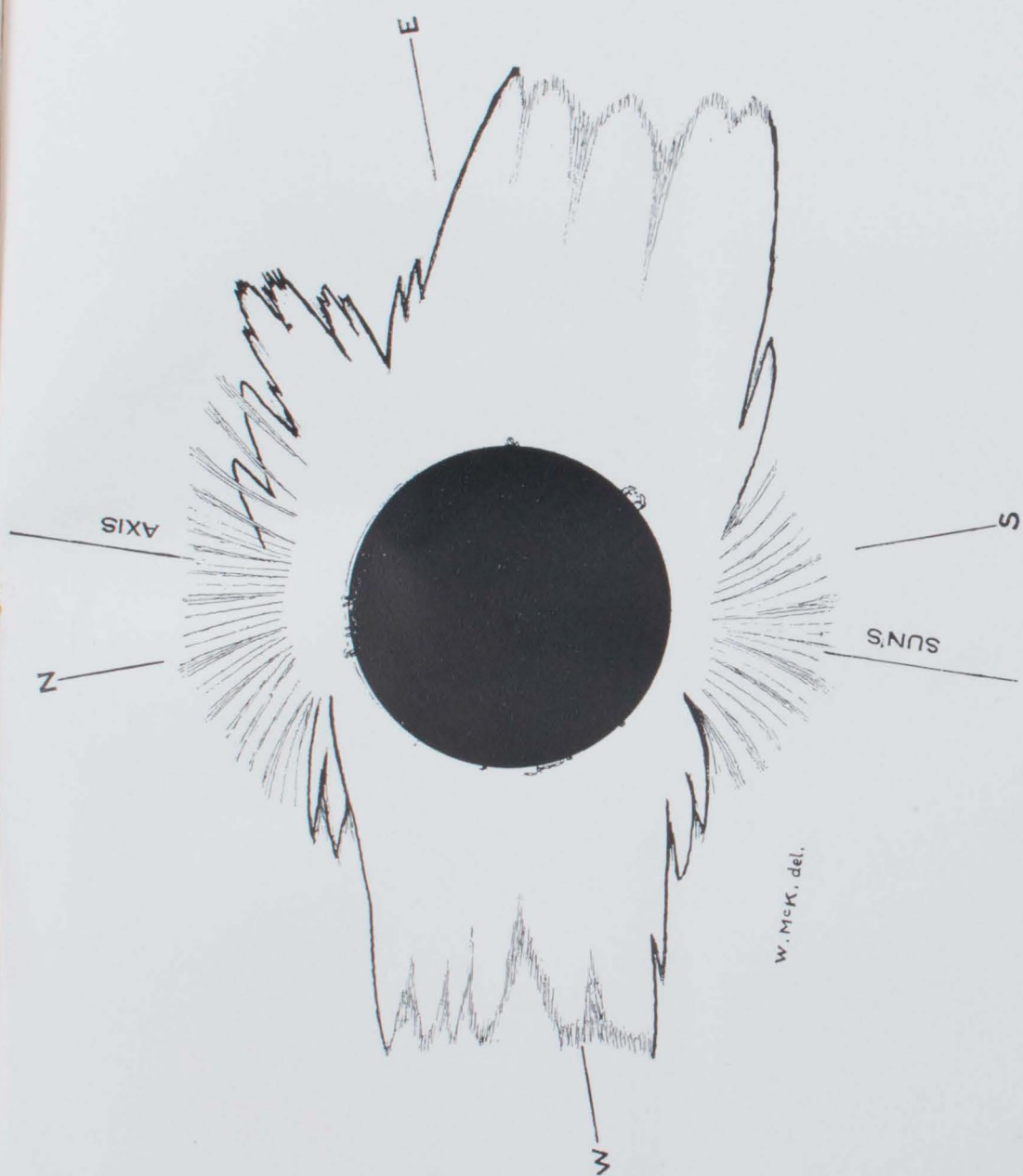


Exposure 25 seconds. 20-foot Coronagraph. Reduced 10.



Exposure 7 seconds. 20-foot Coronagraph. Reduced $\frac{1}{10}$.

Had an alarm
but didn't
I should have
checked it on
the morning
must have been
a day long



Outline Diagram of the Main Features of the Solar Corona. 1914 August 21

Had an almost
been handy
I should have
it stopped it on
the thermometer
must have been
a day long

Jan. 1915. *Total Solar Eclipse of 1914 August 21.* 117

The lines, though sharp, are difficult to measure on account of their faintness. The most prominent line in this region is $\lambda 6374.3$, occurring in the third band. Other bands are:—

- | | | | | | |
|----|----------|--------------|----|----------|---------------|
| 4. | 5118.1 | } two lines. | 5. | 5315.3 | } four lines. |
| | 5114.3 | | | 5302.7 | |

This last band covers the region of the well-known green coronal radiation. It is present, but extremely faint. There are also probably lines about the following wave-lengths:—5662, 5588, 5544, 5512, 5476, 5227, and 4997, though all these numbers are subject to revision. Seeing that the slit length was $\frac{7}{8}$ -inch, and the arc spectrum occupied $\frac{1}{10}$ -inch, even if the slit had been placed quite tangentially to the moon's limb about $\frac{1}{10}$ -inch would have been covered by the corona on each side of the iron arc. The fact that the coronal bands are separated from the iron arc spectrum indicates that the slit was just inside the image of the moon, and that the outlying portions on each side covered the region of the lower parts of the streamers, but not the lower corona or upper chromosphere. The image of the moon was slightly out of centre on the slit, and just above the central horizontal line.

Stonyhurst College Observatory :
1914 December 28.

*Had an occasion
been handy
I should have
observed it
The moon
must have been
a very large*

334
56

IX.

STONYHURST OBSERVATORY

ANNUAL REPORT

The Eclipse Expedition to Hernösand, Sweden,
1914, August 21.

The expedition was one of those organised by the Joint Permanent Eclipse Committee of the Royal and the Royal Astronomical Societies. It was the seventh total solar eclipse expedition conducted from the Stonyhurst Observatory, four under the leadership of Father Perry, namely those at Cadiz, in 1870, Carriacou, W. Indies 1886, Moscow 1887, and Salut Islands, French Guiana 1889, where his devotion to duty cost him his life; and three under that of Father Cortie, at Vinaroz, Spain, 1905, Vavau, Tonga Islands, 1911, and Hernösand, Sweden, 1914. With the exception of the expedition of 1905, all these were official Government expeditions. It had been originally settled that Professor Fowler and Father Cortie, with Major Hills, and Father O'Connor as volunteer observers, and Mr. Curtis as assistant to Professor Fowler, should form a party to observe the eclipse at Kiev, in Russia. But the refusal of the Russian Government, through the British Foreign Office, to allow the Jesuit Fathers to proceed to Kiev, necessitated the division of the original expedition, and it was arranged that we should form a separate expedition to Hernösand, a station which had not been originally selected owing to its inferior chances of good weather conditions. The permission which was ultimately granted for our entrance into Russia, through the intervention of Dr. Backlund, the Imperial astronomer at Pulkova, was fortunately not communicated to us. Had we accompanied Professor Fowler,

x by Father Holmeyer

with him we should have had to abandon our expedition at Riga, on account of the impossibility of proceeding to Kiev, owing to the incidence of the war and the mobilization of troops, and had we reached Kiev, we should have shared the ill-fortune of Professor Campbell and the party from the Lick Observatory, on account of clouds.

Owing to the kind offices of Professor B. Hasselberg, of the Academy of Sciences at Stockholm, the chief of the Swedish Commission for the observation of the eclipse, and the exceeding courtesy of Herr Rektor Tham, we secured an excellent site at Hernösand in a field at the back of the Technical School. The school buildings, containing physical laboratories, mechanics' and carpenter's shops, dark room, and a complete electrical plant was placed unreservedly at our disposal. Our instruments were also expedited through the Customs House after merely formal inspection.

A considerable amount of time had been expended by the staff of the observatory in the remote preparations for the eclipse, and two cœlostats and a long focus and short focus camera had been set up and adjusted in the observatory grounds. The party ultimately consisted of Father Cortie, Father O'Connor, Mr. G. J. Gibbs, of Preston, and Mr. E. T. Whitelow, of Birkdale, a great benefactor of the observatory. We left Hull on July 28th, arrived at Gothenburg on July 30th, and at Stockholm the same evening. There we were welcomed by Father Wulf and Father Rodés, who were proceeding to Hernösand on an expedition from St. Ignatius' College, Valkenburg. We journeyed together from Stockholm by boat, leaving on the morning of August 2nd, and arriving at Hernösand on the afternoon of the

following day. We at once commenced with the erection of the instruments, the determination of the meridians and azimuths being made by theodolite by Father O'Connor. We were fortunate in having with us so skilled an engineer as Mr. Gibbs, who undertook the whole charge of setting up the instruments. The co-ordinates of the station chosen are latitude $62^{\circ} 38' 8.8''$ N., and longitude $17^{\circ} 57' 32.25''$ E. of Greenwich, as determined by an officer of the Swedish survey staff at the request of Professor Hasselberg.

Our instrumental equipment included a 16-inch cœlostat, belonging to the Royal Astronomical Society, and an 8-inch "Grubb" cœlostat, kindly lent by the Royal Irish Academy. These two instruments gave much trouble in adjustment for smooth running, especially so the former, but all the difficulties were successfully overcome by Mr. Gibbs. The details of the erection of the instruments are fully described in the preliminary report of the Eclipse Expedition communicated to the Royal Astronomical Society (Monthly Notices R.A.S., Vol. LXXV., No. 3., January, 1915.) The 16-inch cœlostat supplied light to three coronagraphs, and a horizontal telescope for projecting an enlarged image of the sun on to a circularly graduated screen of ground glass. To obtain large scale pictures of the corona, $2\frac{1}{2}$ inch to the solar diameter, we employed a 4-inch photographic lens, also kindly lent by the Royal Irish Academy, having a focal length of 20 feet. This was mounted in a strongly built wooden camera in sections, designed by Mr. Gibbs. The camera bellows carried plate-holders 10×8 inches. Six exposures were made on the corona of 2, 4, 10, 25, 7, 3 seconds duration, and five of these were most successful. For photographing the

made by
Beetham
PRESTON

x by Father Whitelow

XII.

extension of the filmy streamers of the corona we employed two cameras, one with a 4-inch Dallmeyer lens, focal length 34 inches, the "Abney" camera used so frequently in former eclipse expeditions, and a Ross lens 3.5 inches aperture and 12 inches focal length, belonging to Mr. Whitelow. These two cameras were mounted one on top of the other, and in front of the 20-foot camera. Four exposures were made of 10, 50, 15, and 5 seconds with the "Abney" camera, and one long exposure of 95 seconds with the Ross lens. These exposures were made on plates especially bathed to render them impervious to solarization, so as to obtain the inner as well as the outer corona. In addition to these cameras, Mr. Whitelow had mounted on a wedge-head cut to the latitude of Hernösand, a Zeiss lens of 14 inches focus, with which he successfully photographed the moon projected on the corona, 30 seconds, and one minute after totality. The function of the 3 inch Cooke telescope, mounted on top of the long camera, was to enable Father O'Connor to give signals, 10 minutes, 5 minutes, and 10 seconds before totality, by observation on the graduated glass screen of the angles subtended by the cusps of the moon at the centre of the sun's projected image.

The 8-inch cœlostast was employed to supply light to a 5-inch Alvan Clarke lens, focal length seven feet, which threw an image of the sun on the slit plate of the spectrograph. This spectrograph was designed in conjunction with Professor Fowler, and was constructed under his supervision at the Imperial College of Science, South Kensington. It was probably the most powerful slit spectrograph so far used in eclipse observations, and gave an exceedingly bright spectrum, covering

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about 4 inches between λ 6700 and λ 4800. It was of the Littrow type. The slit belongs to the Royal Astronomical Society, the diagonal prism to the Imperial College of Science, the O.G. to the Greenwich Observatory, the mirror to the Joint Permanent Committee, and the plate-holders to the Cambridge Observatory. The constants of the instrument were:—

Length of slit, $\frac{7}{8}$ -inch.

Width of slit, .0017-inch.

Aperture of O.G., 6 inches.

Focal length of O.G., 98 inches.

Edge of prism, 7 inches.

Refracting angle of prism, 40° .

Deviation of prism at $H\beta$, 28.5° .

Diameter of plane mirror, 6.5-inches.

Purity of the spectrum, 6400.

A novel feature in eclipse expeditions was the placing of a comparison iron-arc spectrum on the plate exposed for the spectrum of the corona during the eclipse. Through the kindness of Herr Helenius, the town electrician, long leads were conveyed from the electric mains of the Technical School, and connected through a variable resistance, with an arc having solid iron pointed poles. The pressure was 110 volts and the current 12 amperes. By means of a single lens and a diagonal the image of the arc was formed on the slit. The diagonal could be pushed forwards and backwards by means of a slotted groove. The lens was adjusted so that the solid angle of the beam of light from the arc formed on the slit was equal to that also subtended by the O.G. from the slit. This adjustment is necessary in order to fill the O.G. with light from the arc. A zinc

shield with a horizontal slot, $\frac{1}{16}$ inch wide, was employed to cover the slit plate during the exposure on the corona. The slot covered the position of the dark image of the moon. The slit had been placed almost tangential to the limb of the sun on the E. side. The exposure had been in progress about 40 seconds on the corona, when the slotted shield was placed in position, the diagonal pushed forward, and the arc was struck. An exposure of four seconds was given to the arc, the diagonal was pushed back, the slotted shield removed, and the exposure was continued on the coronal spectrum until the end of totality. Wratten and Wainwright's Orthochromatic B plates were used, so that the red end of the coronal spectrum might be photographed. The operations connected with the photographing of the arc spectrum took about 20 seconds.

Drills commenced on Monday, August 17th, and we were assisted by seven students of the Technical School, under the direction of Herr Askling, the master of mechanical science. Four of these students were trained to make a composite drawing of the corona, each taking one quadrant, on graduated discs. They practised on a drawing of the corona of 1901.

Had the eclipse occurred on any other day during our stay at Hernösand, except one, August 9th, we should have been baulked by clouds. A persistent N.W. wind was accompanied by a considerable amount of cloud. Otherwise the atmosphere was of extraordinary transparency. On the evening of August 20th the wind shifted to the S.E., and brought with it a beautiful clear sky, though clouds appeared about one hour after the eclipse was over. A considerable number of

spectators assembled in the field, and watched the progress of the partial phase through dark glasses. To prevent any inadvertent intrusion we roped off an enclosure for the instruments. At 10 minutes before totality, as indicated by the cusps on the ground glass screen, Father O'Connor blew three blasts on a whistle. The observers and their assistants stood to their stations, the clocks were wound up, and lamps were lit. At this time the illumination of the distant mountains was weird but beautiful. The temperature was decidedly colder, with a cold rush of wind from the S.E. The total drop of temperature during the eclipse was 7.4° F. At five minutes before totality, at the signal of two blasts on the whistle, the slides were drawn, and silence was called. At ten seconds nominally, but really at twelve seconds before totality, a single blast was the warning for exposures on the "flash" spectrum. At the signal "Go," when totality was reached, Father O'Connor pulled a cord, releasing the mechanism of the eclipse clock, the hand of which commenced to make a circuit of a two-foot dial in the computed duration of totality—129 seconds. It really was 125 seconds. The whole scene was most impressive, the silence being only broken by the clicking of the camera slides. The sight of the corona in a perfectly pure sky was indeed magnificent. On the W. of the eclipsed sun was a long fish-tail streamer, while on the E. there were bright winged streamers, a very bright one N.E., a larger, though less bright one, S.E., and a faint bayonet-like streamer of great length almost on the equator. To the N.W. blazed the planet Mercury, while Venus was shining brightly on the E. horizon.

As we were uncertain when a boat might come from the north to take us homewards, we commenced the dis-

x by Father Lohmeyer

mantling and packing of the apparatus, and the development of the plates immediately after the eclipse was over. We were quite ready for departure by the morning of August 23rd, though a boat did not come to take us to Stockholm until August 25th. On account of the war not only was our return journey hastened, but the route had to be changed. We had already traversed two Swedish mine fields under the escort of armed vessels between Sundsvall and Stockholm, where we arrived on August 26th. The British Minister, Sir Esmé Howard, very kindly took charge of our instruments, and subsequently transmitted them to the Vice-Consul, at Bergen, whence they were safely shipped to Hull. On the morning of August 28th we left Stockholm for Christiania and thence to Bergen, where we arrived on the afternoon of August 29th, and took a Norwegian steamer across the North Sea for Newcastle. We were stopped on the early morning of August 30th by a British cruiser and warned of the existence of a German mine field some fifty miles from the mouth of the Tyne. A second repeated the warning the same afternoon. Accordingly we changed our course for Peterhead, and came down the coast inside the mine field. Finally we were escorted into Newcastle, after this adventurous passage, by three torpedo boats, and arrived safely on the morning of August 31st.

The general form of the corona of 1914 was rather of the "minimum" than of any other type. The open spaces at the poles full of beautiful rays extending over an arc of 75° about the N. pole, and of 65° about the S. pole, and the long fish-tail on the W. side, the roots of which covered an arc of 65° are characteristic of this type. But on the E. side it is rather of the "intermediate" type, the spreading of the streamers being a character-

istic feature. It is interesting from the fact that it is a corona associated with a rising sun-spot curve after a protracted minimum. The N.E. streamer is noteworthy as lying over the background of continuous corona by projection and consisting of a sheaf or bundle of very bright rays, which can be traced $26'$ from the sun's limb. The filamentous nature of the other streamers is also marked. These filaments are superposed upon a bright continuous ring, representing the lower corona. This bright ring, between $1'$ and $2'$ of arc in height all round the sun is seen on both the large scale and the smaller scale photographs. A considerable extent of the chromosphere on the W. limb is shown on the last exposed of the larger scale photographs, as the slide was only just closed before the end of totality. The southern boundary of the S.E. streamer extends further from the sun than other feature of the corona. It has a double curvature, and on one of the smaller scale photographs can be traced as far as two diameters from the sun. Although the composite drawing made by the Swedish students is a faithful representation of what was seen by the unaided eye, the extent to which the corona was traced is not so great as has been photographed. Eight prominences in all appear on the plates, a fine one between position angles 143° — 153° , rising in the form of an arch with a bright detached keystone, to a height of $85''$. At position angle 353° is a bright prominence, $80''$ in height, and near this is a remarkably bright filament, which can be traced as far as $7'$ from the sun, of a different character from the polar rays. It curves over towards the equator. Immediately below this, on the W. limb of the sun, are two bright streamers, which are superposed on the background of what may be termed the continuous mass of streamers.

x by Father Holmeyer

Continuing the curvature of these two streamers and the bright filament as projected, on to the sun's disk, they meet near the large sun-spot at position heliographic longitude $67^{\circ} 12'$, latitude $18^{\circ} 18'$ on the day of the eclipse. Plotting five points on each of these bright rays, and taking the centre of the spot itself as a sixth point, it appears by an application of Pascal's theorem, that each set of five points with the spot lie upon a conic section. It is highly probable, therefore, that these bright rays are the projections on a plane of streamers of particles emanating from the spot, for three projected conics meet near the spot. Similarly the bright rays which were selected from the sheaf on the N.E. are projections of conic sections meeting near the spot, so that this feature may also be reasonably attributed to the action of the large sun-spot.

The spectrum of the corona photographed on each side of the spectrum of the iron-arc, though extremely weak, is yet measurable. It appears to be unique. In the first place, although the corona was a bright one, the characteristic coronal radiation at w.l. 5303 is only just discernable on the plate. This result agrees with that obtained by other observers. Secondly the intenser radiations are in the red end of the spectrum, and other observers have called attention to a bright radiation at w.l. 6374. This line is well marked on the negative, but it is not an isolated radiation. It occurs as a strong member of a band, or fluting, there being also two other well marked flutings in the red. The wave-lengths of their terminal lines are as follows:—

- | | | | |
|---------------------|----------------|---------------------|--------------|
| 1. 6643.9
6630.5 | } Three Lines. | 2. 6530.9
6502.8 | } Six Lines. |
| 3. 6384.3
6363.0 | } Seven Lines. | | |

The line 6374.3 is probably the most prominent of all the lines. Two other bands occur at:

- | | | | |
|---------------------|--------------|---------------------|---------------|
| 4. 5118.1
5114.3 | } Two Lines. | 5. 5315.3
5302.7 | } Four Lines. |
|---------------------|--------------|---------------------|---------------|

this last band covering the well-known green coronal radiation. All the lines in these bands are sharp, though very faint. There are also probably lines about the following wave-lengths: 5662, 5588, 5544, 5512, 5476, 5227, and 4997, though all these numbers are subject to revision. The general character of the coronal spectrum as photographed is undoubtedly that of a series of bands, or flutings. From a study of the position of the slit relatively to the corona, it appears that the spectrum is not that of the upper chromosphere, nor of the lower corona, but of the roots of the streamers on the E. side of the sun.

Astronomical.—All the fine nights up to July have been employed in experimental work with the transit instrument in preparation for the rectification of our Longitude by the radio-telegraphic time signals from the Paris Observatory, *via* the Eiffel Tower.

The instrument is a very old one, and has a very extraordinary fault. When the middle wire in the focal plane is set to zero of collimation by the South collimator, it is found to be completely wrong by the North collimator. I can account for this only on the supposition of a considerable pivot inequality, together with an indenture on one of the faces of one of the V supports, so that in one position of the axle one of the pivots rests in a lateral hollow, while in the reversed position the hollow is avoided. The result of this is an azimuthal error, appearing as a collimation error. But a large number of

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THE SUN-SPOT AND THE SOLAR CORONA OF
1914 AUGUST 21.

BY

THE REV. A. L. CORTIE, S.J.

The Eclipse Expedition to Hernösand, Sweden,
1914, August 21.

The expedition was one of those organised by the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Societies. It was the seventh total solar eclipse expedition conducted from the Stonyhurst Observatory, four under the leadership of Father Perry, namely those at Cadiz, in 1870, Carriacou, in 1886, Moscow 1887, and Salut Island, French Guiana 1889, where his devotion to duty cost him his life; and three under that of Father Cortie, namely at Vavau, Tonga Islands, 1911, at Vavau, Spain, 1905, Vavau, Tonga Islands, 1911, and at Hernösand, Sweden, 1914. With the exception of the expedition of 1905, all these were official Government expeditions. It had been originally settled that Professor Fowler and Father Cortie, with Major Hills, and Father O'Connor as volunteer observers, and Mr. Curran as assistant to Professor Fowler, should form a party to observe the eclipse at Kiev, in Russia. But the refusal of the Russian Government, through the British Foreign Office, to allow the Jesuit Fathers to proceed to Kiev, necessitated the division of the original expedition, and it was arranged that we should form a separate expedition to Hernösand, a station which had been originally selected owing to its inferior character under good weather conditions. The permission was ultimately granted for our entrance into Russia through the intervention of Dr. Backlund, the Imperial Astronomer at Pulkova, was fortunately not communicated to us. Had we accompanied Professor Fowler

The Sun-spot and the Solar Corona of 1914 August 21.
By the Rev. A. L. Cortie, S.J.

1. In former papers (*Monthly Notices, R.A.S.*, lxxiii, pp. 431-436, pp. 539-543) evidence has been furnished to show that regions of long-continued sun-spot activity were associated, in four cases, with bundles of divergent streamers in the solar corona. The following table gives a summary of the results so far attained, to which are added those connected with the present investigation.

Disturbed Area of Sun-spots.			
Corona.	Duration.	Mean Longitude.	Mean Latitude.
1893 Apr. 16	1893 Jan. 16-	Nov. 16	49°3' to 14°9' - 7°5' to -13°1'
1898 Jan. 22	1898 Jan. 19-	July 29	132°7' ,, 117°8' - 8°8' ,, -13°7'
1905 Aug. 30	1905 May 11-	July 7	72°0' ,, 52°3' -12°4' ,, -18°5'
1908 Jan. 3	1907 May 5-1908 Jan. 8	258°7' ,, 240°3'	+ 4°9' ,, + 9°1'
1914 Aug. 21	1914 Mar. 30-	Nov. 14	71°4' ,, 56°3' +27°7' ,, +17°2'

In the four cases so far discussed the regions of solar activity happened to be situated near to the Sun's limb on the dates of total eclipse. It is not claimed that the treatment was exhaustive, as there may well have been other streamers connected with regions of spot-activity which were not placed in these more favourable positions for investigation. In particular, in the case of the eclipse of 1893 April 16, Professor Schaeberle has discussed (*Contributions from the Lick Observatory*, No. 4) several other regions of activity, situated on the Sun's disc, which were presumably connected with streamers in the Sun's corona.

2. *The Sun-spot.*—The sun-spot which crossed the Sun's disc August 13-26 was the largest spot which had appeared in the new cycle of spot-activity. Its position on August 21 was longitude 67° 18', north latitude 18° 18'. We must go back to 1910 October to find any spot approaching it in size. When it appeared on the limb on August 13, it was a regular spot of Type IV., the preliminary stages of its life-history having been passed on the invisible hemisphere of the Sun. It attained a disc-area of 6·5 units ($\frac{1}{10000}$ of the visible hemisphere), and was the largest spot of the year. Through the kindness of Professor Hale, Professor Frost, and Professor Newall, I have been supplied with spectroheliograms of the spot and the accompanying flocculi in hydrogen and calcium radiations, from the Mount Wilson, Yerkes, and Kodaikānal Observatories. And besides the Stonyhurst series of drawings, through the kind offices of the Astronomer Royal I have at my disposal a fine series of photographs of the spot and the surrounding faculae obtained at Greenwich. The area of faculae and flocculi surrounding the spot is of great extent. The hydrogen flocculi cover a region from longitude 69°9' to 54°7', and

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from latitude +27°1' to +16°3'. In this area of hydrogen flocculi there is, at longitude 59°3' and latitude +21°9', on the Mount Wilson spectroheliogram of August 21, and less markedly in that of August 22, a dark patch which evidently marks the position of the following spot of the group, when it passed through the two-spot stage, or Type II. of its life-history on the invisible hemisphere of the Sun. It will be interesting to ascertain whether this portion of the mass of flocculi exhibited an opposite polarity to that of the spot itself in the magnetic field.

The bright calcium flocculi, as shown on the spectroheliograms from Kodaikānal and Yerkes, are of much greater extent than the hydrogen flocculi. The limits of longitude are approximately 70°0' to 52°0', and of latitude from +28°5' to +15°4'. The dark patch in the hydrogen flocculi, already alluded to, is well shown both in the Yerkes and Kodaikānal spectroheliograms, in calcium light, of August 22.

The sun-spot of 1914 August 21 was not an isolated disturbance, but one of a series of disturbances in the same locality on the Sun. Not only was it the largest spot of the new cycle and of the year, but it occurred in that region of the Sun which was first disturbed at the advent of the new cycle, and was most disturbed during the year. Confining ourselves to the limits of longitude and latitude of the flocculi accompanying the spot of August 21, we find that the same region was disturbed from March 30 to November 15, intermittently, by five spot-groups, four of which were among the most important disturbances of the year. The date March 30 also, and the group that then appeared on the E limb, marks the beginning of the recrudescence of spot-activity, for the first three months of 1914 were almost as barren of sun-spots as the year of absolute minimum 1913. The following table gives the mean positions of these spot-groups from the Stonyhurst drawings:—

No.	Date.	Mean Heliographic.	
		Longitude.	Latitude.
	1914.		
1	Mar. 30-Apr. 11	71°4'	27°7'
2	Apr. 27-May 2	56°3'	26°1'
3	Aug. 13-Aug. 26	66°5'	19°0'
4	Sept. 10-Sept. 22	65°3'	17°2'
5	Nov. 7-Nov. 15	69°3'	23°3'

The groups 1, 3, 4, 5 were the more important groups.

3. If any connection existed between the streamers of the corona of 1914 August 21 and a disturbed spot-region, all the evidence of the life-histories of the spots pointed to the particular region occupied by the large spot of the same date. It is also worthy of note that the total solar eclipse of 1914 is one of the very few that have been observed when the spot-activity was beginning to increase. The mean daily area of spots for 1914 from the Stonyhurst drawings was 0·82. That for 1913 was only 0·04, and

The Eclipse Expedition to Hernösand, Sweden,
1914, August 21.

The expedition was one of those organised by the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Societies. It was the seventh total solar eclipse expedition conducted from the Stonyhurst Observatory, four under the leadership of Father Perry, namely those at Cadiz, in 1870, Carriacou, W. Indies 1886, Moscow 1887, and Salut Island, French Guiana 1889, where his devotion to duty cost him his life; and three under that of Father Cortie, at Vinaroz, Spain, 1905, Vavau, Tonga Islands, 1911, and Hernösand, Sweden, 1914. With the exception of the expedition of 1905, all these were official Government expeditions. It had been originally settled that Professor Fowler and Father Cortie, with Major Hills, and Father O'Connor as volunteer observers, and Mr. Cur as assistant to Professor Fowler, should form a party to observe the eclipse at Kiev, in Russia. But the refusal of the Russian Government, through the British Foreign Office, to allow the Jesuit Fathers to proceed to Kiev, necessitated the division of the original expedition, and it was arranged that we should form a separate expedition to Hernösand, a station which had not been originally selected owing to its inferior chances of good weather conditions. The permission which was ultimately granted for our entrance into Russia through the intervention of Dr. Backlund, the Imperial astronomer at Pulkova, was fortunately not communicated to us. Had we accompanied Professor Fowler

so that the increase, which took place mainly in nine months, was slightly more than twentyfold.

4. *The Corona.*—The form of the corona of 1914 was that of the minimum type in its main features, especially as seen by the naked eye. But it was differentiated from a purely minimum type by some bright streamers which were superposed upon the equatorial wings. It has already been described in the Preliminary Report of the Total Solar Eclipse (*Monthly Notices, R.A.S.*, lxxv. p. 116). The features we wish particularly to call attention to in the present investigation are the following:—In the N.E. quadrant there was a remarkably bright sheaf of rays, with two brighter ribs at P.A. $48^{\circ}0'$ and $52^{\circ}3'$ which extended as far as $26'$ from the limb. In the N.W. quadrant was a curved streamer, with two prominent tips or horns at P.A. $332^{\circ}9'$ and $335^{\circ}7'$. Above this streamer at P.A. $357^{\circ}4'$ was a very bright single curved ray, with the curvature towards the equator, which reached to about $7'$ from the Sun's limb. These features mainly contributed to differentiate the corona from that of a minimum type, and gave it the appearance of an inchoate intermediate type. As already remarked, in the coronas of 1893, 1898, 1905, 1908, the regions of selected spot-activity were close to the Sun's limb on the days of eclipse. Hence it was only necessary to show that the "radiant" area, or "apex" of the converging streamers, was situated in such a region of spot-activity, to establish a probable connection between the phenomena. The weight of the evidence for a real, and not merely a fortuitous, connection is increased by its occurring in four cases, and not merely in one case.

In the present instance the heliographic longitude of the spot being $67^{\circ}18'$, it was situated some 68° from the Sun's limb. A method of solution of the problem as to whether the streamers detailed above were connected with the spot was suggested by Mr. F. Henroteau, a Belgian refugee, now resident at Stonyhurst, and formerly of the Royal Observatory, Uccle. He has also made all the necessary measurements and constructions connected with the work. According to Pascal's theorem, if the intersections of opposite pairs of sides of a hexagon are collinear, the six points lie on a conic section. The method adopted was, therefore, to plot on squared paper five points, measured on a ray which it was suspected was connected with the spot, and to take the centre of the spot as a sixth point. With these six points a hexagon was constructed, and the test of collinearity of the intersection of the directions of its opposite pairs of sides, showed whether the five points on the ray, and the sun-spot were situated on a conic. Six rays were so treated, those detailed above and one also in the S.W. quadrant. All except the last mentioned stood the test, and as five projected conic sections meet in the region of the spot, though not in the actual spot itself, it is considered that the evidence is sufficient to establish a connection between these streamers and the spot. The measures were made on squared paper superposed on enlarged photographs of the eclipsed

Sun, on a scale of six inches to the Moon's diameter. The relative positions of the five points measured on a ray and the sun-spot were set down on a still larger scale on squared mm. paper, before constructing the hexagons. A curve of errors was also drawn for each case to ascertain how far the point O, representing the spot, could be shifted without altering the collinearity of the three points of intersection of the opposite pairs of sides of the hexagon.

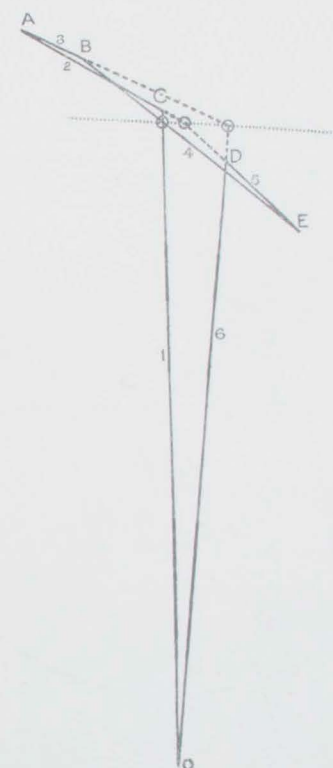


FIG. 1.—A, B, C, D, E are five points on a bright ray at position-angle $357^{\circ}4'$. O is the centre of the spot. The small circles, which are collinear, are the intersections of the opposite sides of the hexagon.

In all the cases except one this point could be shifted, but the curve of errors showed whether it could be shifted beyond the region of disturbance, such as that of the flocculi, for instance, connected with the spot.

In the case of the bright single ray at P.A. $357^{\circ}4'$ the solution is rigid, as the collinearity of the points of intersection is disturbed by altering the position O of the spot. This case is illustrated in fig. 1 above. In the case of the two tips of the streamer in the N.W. quadrant, the solution is not so rigid, as the position of

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the centre of the spot, the point O, can be altered within limits without disturbing the collinearity of the points of intersection of opposite sides of the hexagon. This is due to the fact that the angles of the hexagon are very acute or very obtuse. But the limits through which O can be shifted lie within the region of the flocculi, so that it is true to say that the streamer emanates from the region of the spot, though not necessarily from the spot itself.

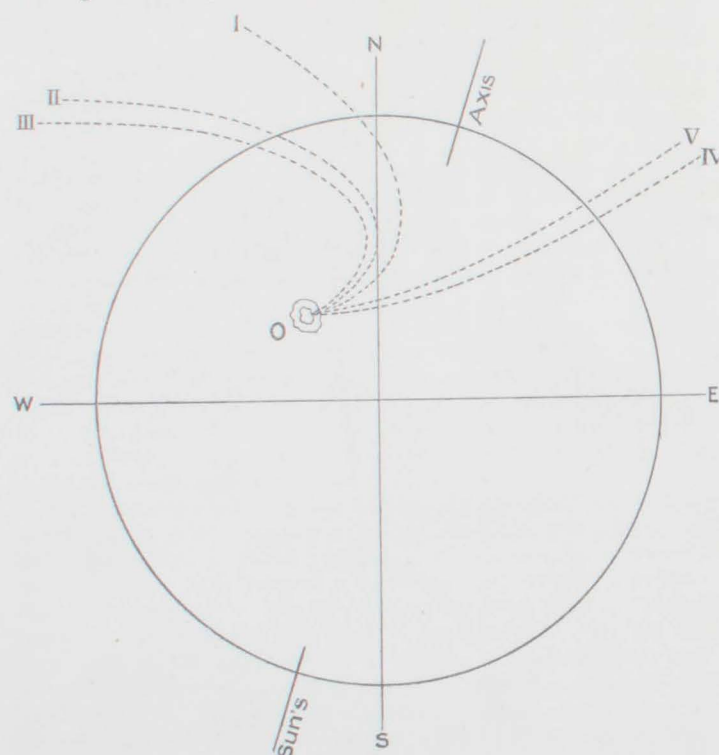


FIG. 2.—Curves I., II., III. on the West; Curves IV, V on the East; O is the spot.

The very bright streamer in the N.E. quadrant points almost directly at the spot. It is only necessary to give the directions of the bright ribs a slight curvature to lead them directly through the spot. But this renders the solution still less rigid than in the preceding cases. It is possible to shift the position of the centre of the spot considerably without altering the collinearity of the three points of intersection of opposite sides of the hexagon. But even in this case the directions of the rays pass through the region of disturbances connected with the spot.

We may for convenience (fig. 2) number the curves in the

order of decreasing value of P.A. Applying the geometrical process of reciprocation, and effecting a graphical solution, curve I. is a very elongated ellipse, curves II. and III. are hyperbolæ, and curves IV. and V., being nearly straight lines, are the projections in all probability of conics seen almost edgewise. Since these five curves intersect one another in the region of the spot, it is highly probable that the disturbed region of the Sun's surface, which included the sun-spot of 1914 August 21, was the seat of the emanation of widely divergent streamers, represented in projection by the five conics discussed above.

This result, combined with those established for the eclipses of 1893, 1898, 1905, and 1908, lends additional weight to the opinion that the mode of propagation of matter from a centre of disturbance on the Sun, which may be supposed to be operative in the production of terrestrial magnetic storms, is in the form of divergent streamers, and not in that of a single discharge, on the analogy of a stream of cathode rays.

5. The following table gives a summary of a comparison of the spotted state of the Sun, and the terrestrial magnetic phenomena for the years 1912-14, from the Stonyhurst records:—

Year.	Mean Daily.		Number of Magnetic Disturbances.	
	Spot-Area.	Declination Range.	Moderate.	Greater.
1912	0.22	8.1	18	1
1913	0.04	9.7	23	1
1914	0.82	10.2	25	3

Two of the three greater magnetic storms of 1914, which occurred on April 5-6, accompanied the first transit of the Sun's disc of the area which, as described above, was intermittently disturbed from March 30 to November 15, and contained the large spot of August 21. They marked, too, the beginning of activity of a new solar cycle. Moderate magnetic disturbances were also probably connected with the same region on April 1, June 25, 26, 27, and November 11. The third greater magnetic storm of 1914, that of September 27, accompanied the transit of an active spot-group across the Sun's disc, September 24-October 2. This spot was situated upon almost exactly the same parallel of latitude as the spot-region discussed above, and removed from it just about 180° in longitude, that is, diametrically opposite to the former spot-region. As will be gathered from the table, the general revival of magnetic activity preceded that of sun-spot activity. It commenced in the year of absolute sun-spot minimum.

Stonyhurst College Observatory,
1915 April 6.

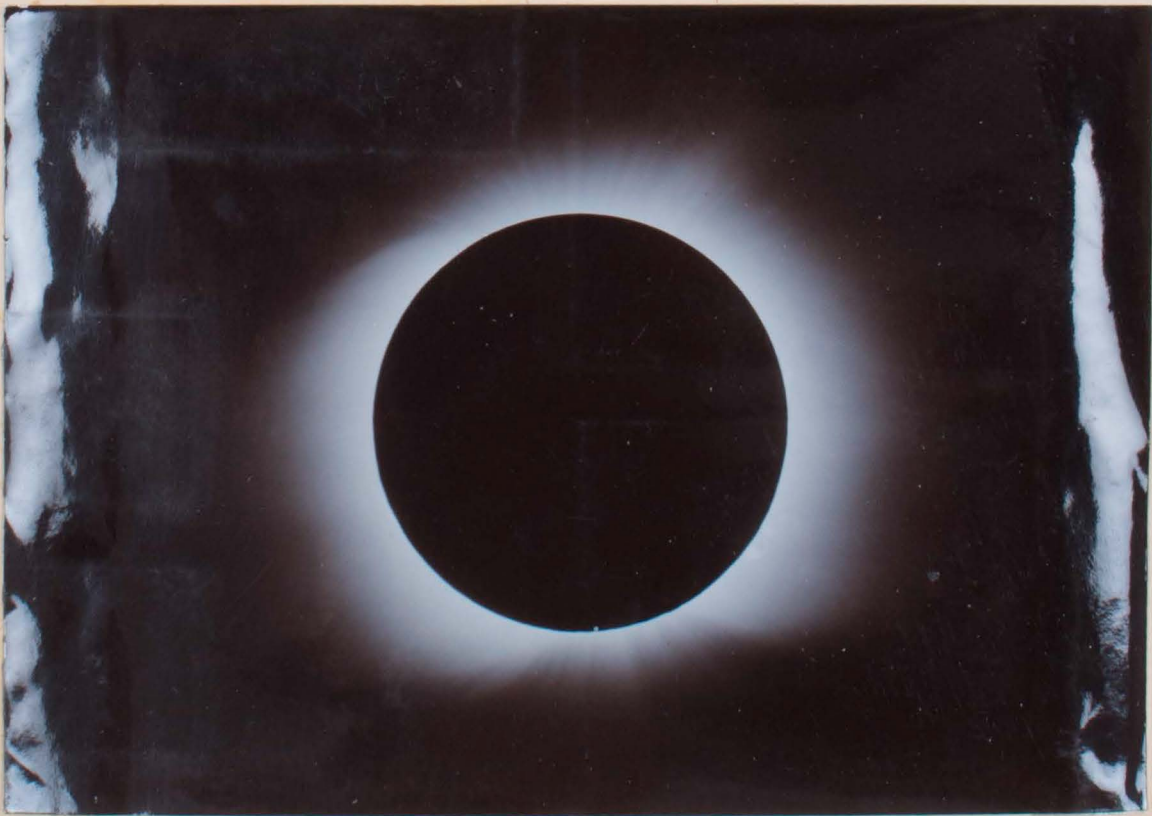
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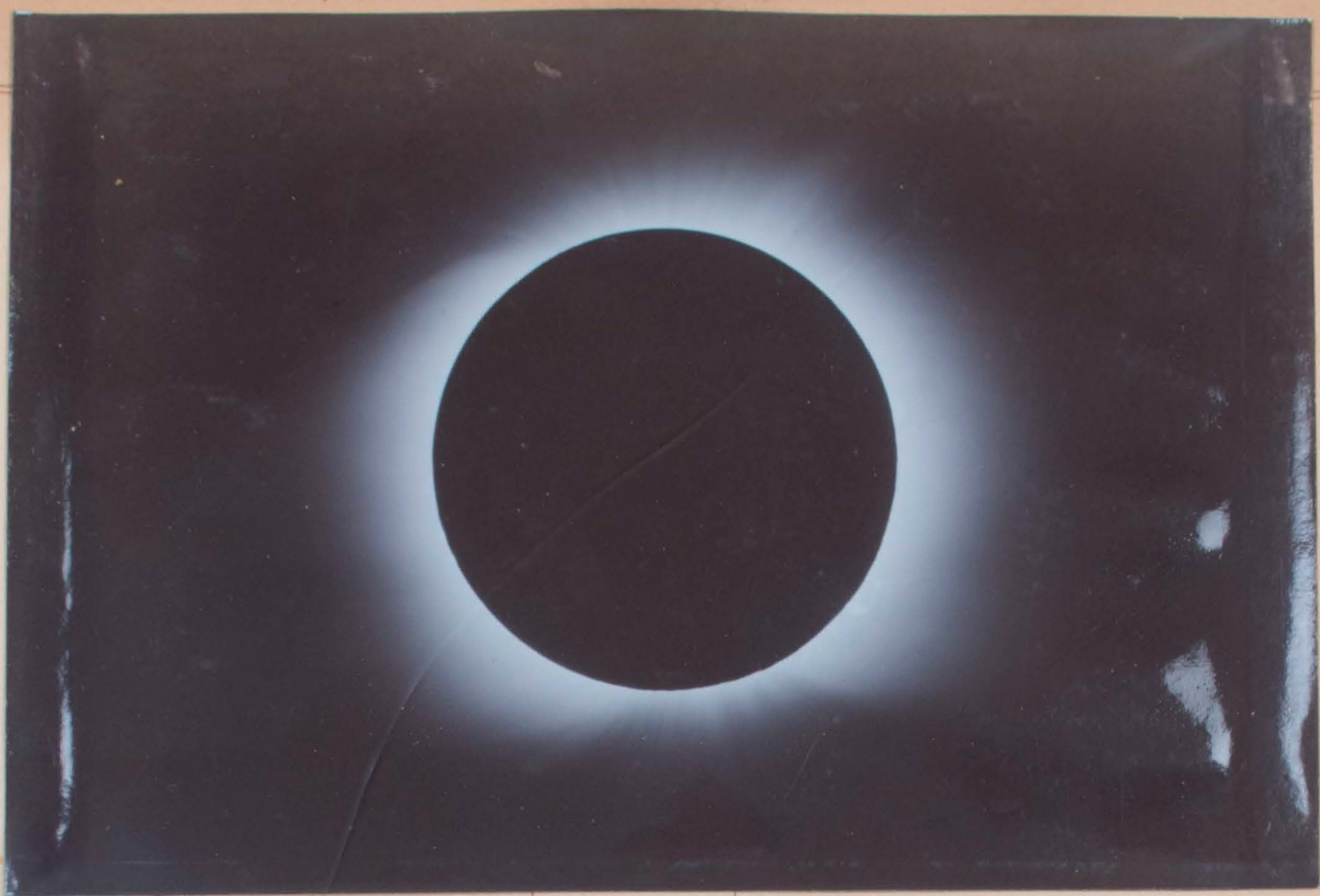
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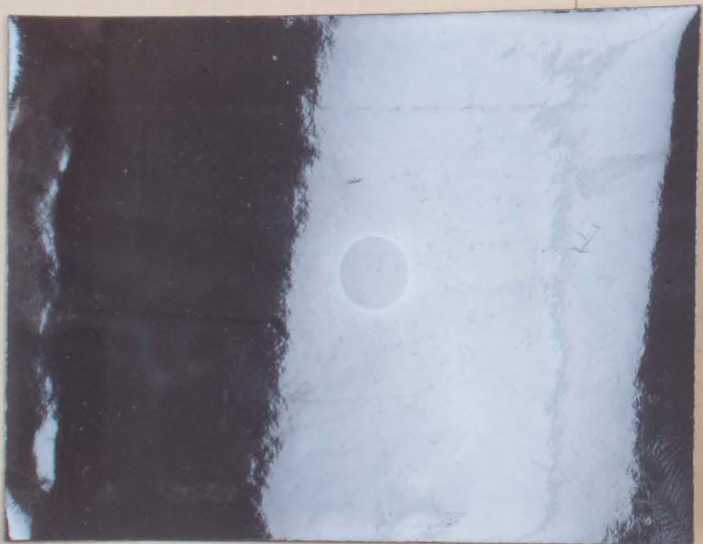
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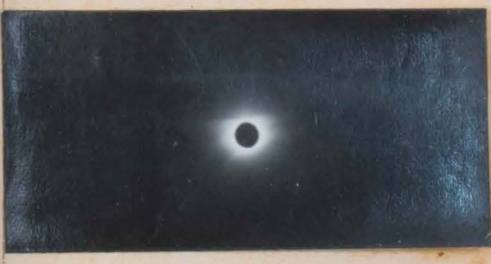
DIRECT PRINTS from Negatives - 20 ft. Camera



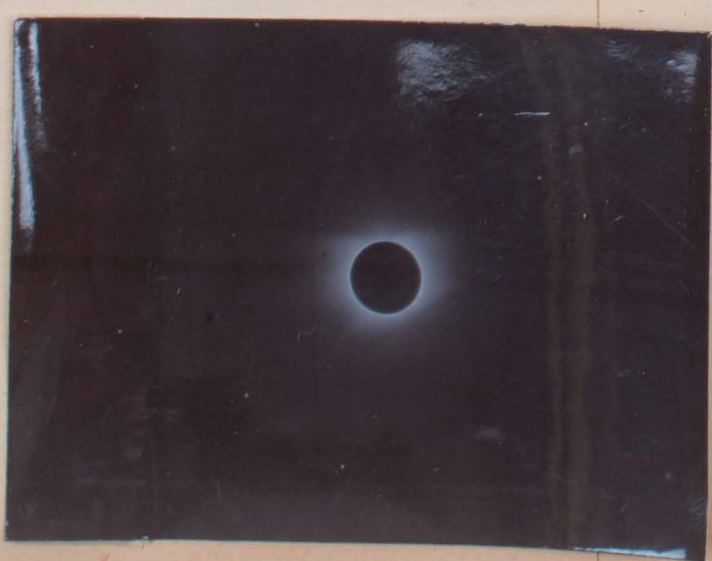
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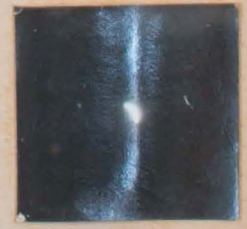


PRINTS from
Mr Whitelaw's
negatives



15 sec

Ditto - exposures
made immediately
after completion
of totality.
The corona is
still partially
visible

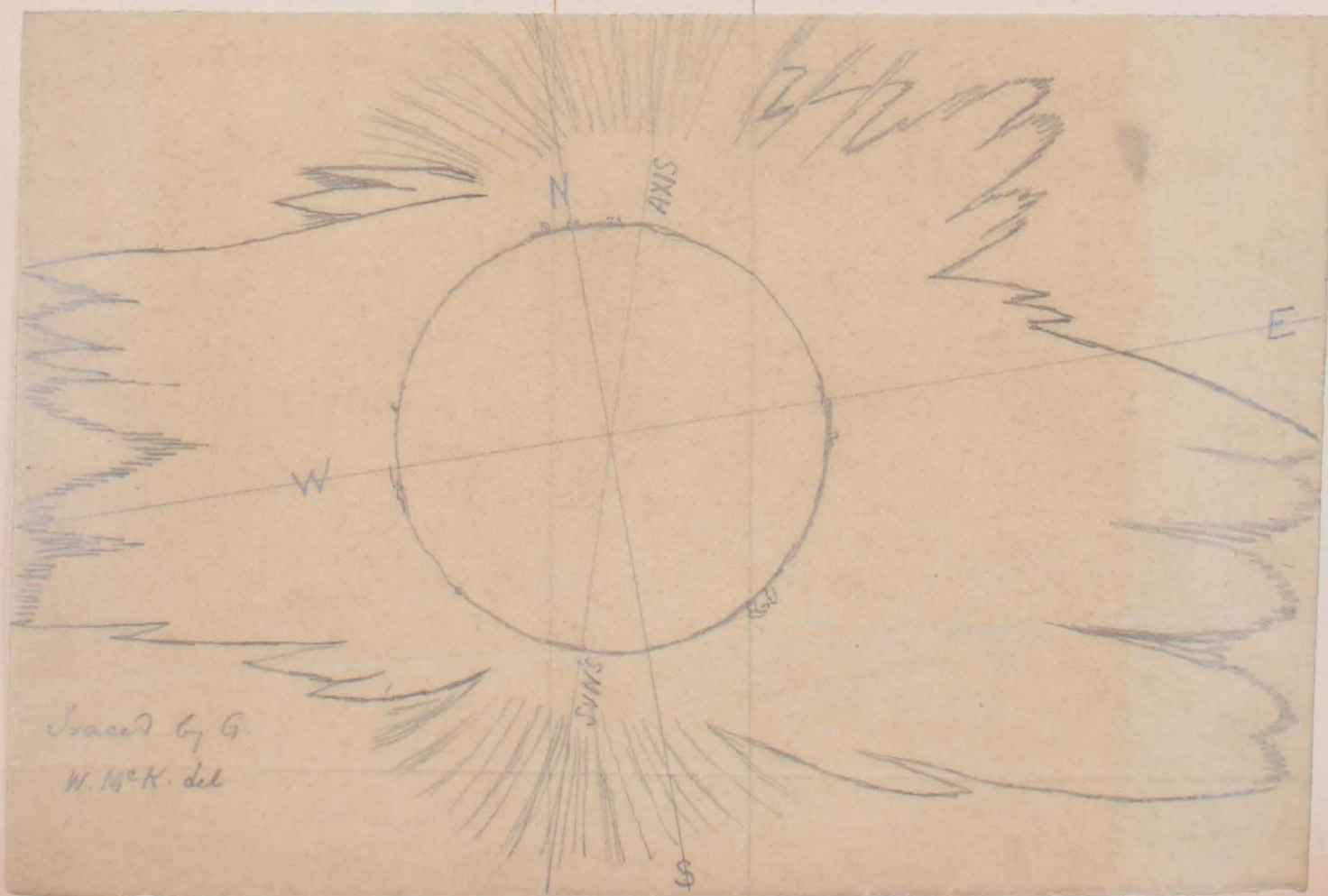


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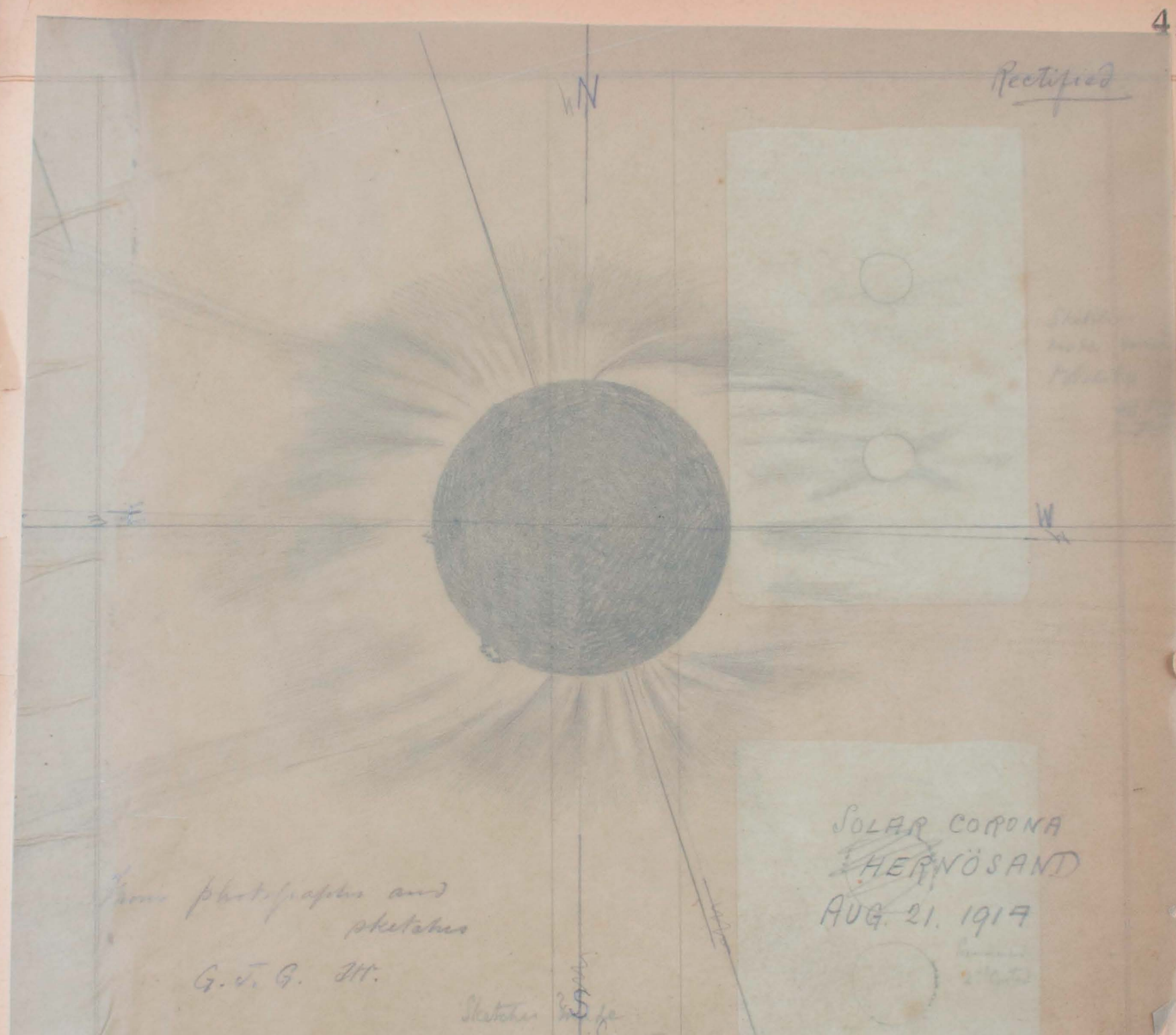
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Reduced photograph of a drawing exhibited at the Royal Institution London



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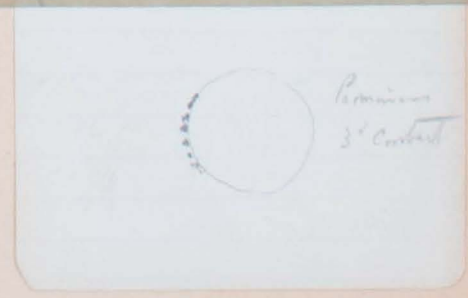


From photographs and sketches

G. J. G. III.

SOLAR CORONA
HERNÖSAND
AUG. 21. 1919

Sketches made
immediately after
totality
G. J. G.



The BRITISH GOVERNMENT ECLIPSE EXPEDITION TO HERNÖSAND, SWEDEN.

By the REV. A. L. CORTIE, S.J., F.R.A.S., Chief
of the Expedition.

Owing to the refusal of the Russian Government to relax the law which excludes Jesuits from Russia, it was impossible for Father Cortie and Father O'Connor to proceed, as had been arranged, to Kiev, as part of the official expedition of the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. The expedition had to be divided, and Father Cortie was commissioned to lead a party to Hernösand, in Sweden, at which place the prospective weather conditions were not so favourable as at the Russian stations. Besides Father O'Connor, he was accompanied by Mr. G. J. Gibbs, of Preston, and Mr. E. T. Whitelow, of Birkdale, so that the expedition was wholly composed of astronomers from Lancashire.

The expedition left Hull by the s.s. *Calypso*, on the evening of July 28th, and after a rough passage arrived at Gothenburg on the morning of the 30th. Travelling by the train leaving Gothenburg at mid-day, Stockholm was reached on the night of the same day, and so we were enabled to celebrate the feast of St. Ignatius with the mission of German Jesuits established in that city. There, too, we met Father Wulf and Father Rodés, from the College of St. Ignatius, at Valkenburg, in Holland, who were also proceeding to Hernösand on an expedition from that College. The German Fathers at Stockholm extended the most courteous hospitality not only to their brother Jesuits, but also to the lay members of the British Expedition, and on the afternoon of the same day Father Lohmeyer conducted us on a delightful trip on the fiords in the environs of Stockholm. After official calls on the Bishop, the British Minister, the director of the observatory, and Professor B. Hasselberg, who had made all preliminary arrangements for our reception at Hernösand, we left Stockholm on

the morning of August 2nd, and reached our destination on the afternoon of August 3rd. Through the courtesy of the Swedish astronomers all difficulties with regard to the Customs examination of our instruments had been smoothed over, so we were able the very next day to commence the erection of our instrumental outfit.

The objects aimed at by the expedition were to obtain direct photographs of the sun's corona during totality, and also to photograph its spectrum in the red, yellow, and green regions of the spectrum. For the direct photography of the corona we had three cameras, of varying focal lengths, as instruments of long focal length would give large images showing the details principally in the lower portions of the corona, and those of shorter focal length would, by furnishing smaller and brighter images, be calculated to show the extension of the filmy network of streamers that constitute the solar crown of glory. Our largest camera had a lens of four inches aperture, belonging to the Royal Irish Academy, and a tube 20 feet long. Next in order was a camera with a lens of four inches and focal length 30 inches, and lastly one belonging to Mr. Whitelow, with lens of $3\frac{1}{2}$ inches aperture and focal length only 12 inches. These were mounted horizontally *en echelon*, and were supplied with light by a 16 inch mirror, driven by clockwork. On the top of the tube of the long camera was placed a telescope to project an image of the sun on to a plate of ground glass, so as to fit a graduated circle. This enabled Father O'Connor to tell us when the eclipse was ten minutes, five minutes, and ten seconds from totality, as he had calculated beforehand the crescent of the sun that would be left unobscured at these precise times. Two of the accompanying illustrations show the large mirror and the battery of cameras. Mr. Whitelow (5) is sitting by the two cameras of shorter focal length, and he has besides another camera on a tripod stand pointed at the sun, with which to make observations before and after totality. Father O'Connor (1) is seen at the end of the long camera, which he operated, and on top of it is seen the projection telescope. When instruments are thus used horizontally to receive light from a rotating mirror, they must point exactly

to the position of sunrise for the day of observation. This adjustment, and in fact most of the mathematical work of the expedition, was in the hands of Father O'Connor. A very fine spectrograph had been especially put together with parts of instruments belonging to the Joint Permanent Committee, the Royal Irish Academy, The Royal Astronomical Society, the Imperial College of Science, the observatories of Greenwich, Cambridge, and Stonyhurst, for photographing the spectrum of the corona. It was devised by Father Cortie, in conjunction with Professor Fowler, of South Kensington. Though a beautiful instrument, it was probably somewhat too powerful for the photography of the faint coronal spectrum. We need not enter minutely into technical details, but the essential optical parts of the spectroscope were a large prism of seven inches edge and angle 40° , a mirror $6\frac{1}{2}$ inches in diameter, and a lens six inches in diameter, and 98 inches focal length. In our illustrations subjoined Father Cortie (3) is seen at the camera end of the instrument, and in another (4) Mr. Gibbs is shown with what we irreverently called his "timber yard." For, in addition to the spectrum of the corona, we arranged to throw the arc spectrum of iron on the spectroscope slit, for the sake of obtaining well-known fiducial points for measurement, during the actual eclipse. The electric leads were laid down by the town electrician, who also supplied a set of resistance coils. The iron arc, lens, and diagonal prism, were set up in the "timber yard." Mr. Gibbs was the engineer to the expedition, and in a very few days he had the instruments mounted solidly, utilising the packing cases loaded with stones as foundations. We were assisted in the eclipse operations by seven students of the Technical School, by Herr Askling, the master of mechanical science, by the town electrician, Herr Helenius, and by the mechanic of the institute. Drills commenced on Monday, August 17th, and were continued every day. Through the courtesy of Herr Rektor Tham, the Technical School, with well-equipped laboratories, dark room, and mechanics and carpenters' shops, had been placed almost entirely at the disposal of the two expeditions. Father Wulf placed his instruments in a large lecture room facing due south;

the British expedition had the site of their instruments in a field adjoining the school. We owed these arrangements to the good offices of Professor B. Hasselberg, of Stockholm, the chief of the Swedish Eclipse Commission.

The town of Hernösand is situated mostly on a small island, the port lying on the strait which separates it from the mainland. Part of the town, including the residential suburbs, charmingly placed among pine woods on undulating hills, is on the mainland. Two bridges spanning the strait connect the two portions of the town. The port is a great centre of the timber trade, and large piles of timber are stacked in the yards surrounding the open sound to the north, by which vessels enter the port. A link with home and Lancashire was the presence of a steamer loading with wood pulp for the docks at Preston. In the distance beyond the north sound are ranges of mountains clad with the prevalent pine trees. The atmosphere is of transparent purity, but the surrounding hills are conducive to the formation of clouds. During the days preceding the eclipse, although the weather was generally beautifully fine, there was, with the exception of only one day, a very considerable amount of cloud, and that generally about eclipse time. On the evening of August 20th the wind, which had blown almost consistently from the north-west, changed its direction to south-east, and a beautiful starlight night gave promise of a succeeding fine day. In the event, the morning of the eclipse was perfectly cloudless. A goodly number of spectators turned up, in their best clothes to the field we occupied at the back of the Technical School, about 11 a.m., and watched the partial phases of the eclipse through dark glasses. Unlike the crowd which surrounded our site in Spain, in August, 1905, they were quite undemonstrative, but highly polite and much pleased. To prevent any possible inadvertent intrusion we roped off the instruments in a large enclosure. Three students of the Technical School assisted Father O'Connor at the 20-foot coronagraph, one other took plates from me at the spectrograph, and four others devoted themselves to making a composite drawing during totality of the corona. The town electrician,

Herr Helenius, stood by the switch for the iron-arc, the school mechanic by the eight inch celostat, and Herr Askling had to cover and uncover the slit of the spectrograph at the proper moments. Mr. Gibbs placed the image of the corona on the slit, and also the image of the iron-arc at the proper time during totality. Father Cortie made the exposures with the spectrograph.

As totality advanced it became perceptibly colder, a drop of temperature of about 7°F . taking place, with a cold wind which suddenly arose in the S.E. At ten minutes before totality Father O'Connor blew three blasts on a whistle, and we stood to our stations, the clocks were wound up, and Herr Askling called "silence" in Swedish. Two blasts was the signal for the five minutes interval before totality, by which time a murky darkness had spread over the whole landscape, the effects on the distant mountains being very beautiful. One blast at ten seconds before totality was the signal for commencing operations with the spectrograph. "Go," cried Father O'Connor, and as he pulled a string releasing the mechanism, the big finger of the eclipse clock (4) constructed by Mr. Gibbs commenced to move over the dial. When I had put in the second plate-holder for the spectrum of the corona, which was to be a long exposure, I looked up. No other word but magnificent can adequately describe the sight of the totally eclipsed sun in a cloudless sky. On the western limb was a long fish-tail streamer, extending about two solar diameters, on the Eastern limb one long streamer, N.E. another shorter streamer, S.E. and yet a third, longer but less luminous than the other two, extending straight out like a bayonet, equatorially. To the N.W. above the sun glowed the planet Mercury, while Venus was brilliantly shining low down on the eastern horizon. In the middle of my long exposure the iron-arc was switched on, a diagonal prism was rapidly placed in position and a suitable aperture over the slit of the spectrograph by Mr. Gibbs, and a four seconds exposure made. Off went the arc and diagonal, the exposure on the corona was continued until just before the end of totality, which lasted 2 mins. 5 secs. I shut up the slide, out came the brilliant star-like edge of the sun. The eclipse

had been quite a bright one, much brighter than those I had observed in Spain, in 1905, and in the Tonga Islands, in 1911. The same afternoon, which, by the way, was cloudy, we packed nearly all the instruments, as we were anxious to get back to England, on account of the war, and I commenced the development of the plates. The packing was completed next day, and Mr. Gibbs and myself finished the development of the plates. We have five excellent large scale photographs of the corona, four of smaller scale to show the extensions, and one of still smaller scale, exposed by Mr. Whitelow, for about 90 seconds, which shows an extension of the corona of over two solar diameters. The large scale photographs show much detail, very fine polar rays, and fine prominences. On the plate the longest exposed of this series is an object close to the moon's limb, which looks very much like a comet. In addition the whole outline of the moon is distinctly projected on the sun's corona on photographs taken by Mr. Whitelow, 30 seconds and one minute after totality. The spectrum of the corona shows several lines, and the spectra of the cups will require detailed study.

By Sunday morning, August 23rd, we were ready to take the first boat for Stockholm, which should come from the north. We could not get away until Tuesday, and at once experienced a dense fog at sea. We were safely piloted through two Swedish mine fields by armoured vessels, and arrived at Stockholm on the Wednesday afternoon with our precious instruments and plates. The British Minister most kindly took charge of the instruments to forward them to England on a favourable opportunity, and we were able, after making necessary calls on the Swedish astronomers, who had done so much for us, in securing us a site and freedom from customs duties on the instruments, to leave Stockholm for Bergen by train on Friday morning, August 23rd. We left Bergen by a Norwegian steamer, bound for Newcastle, on Saturday afternoon. Early on Sunday morning we were stopped by a British cruiser and warned of the existence of floating mines, laid down by the Germans, somewhere off the mouth of the Tyne, well out to sea. Accordingly the lifeboats having been got ready,

we changed our course for the north of Scotland, and came down the coast. A second cruiser overhauled us in the course of the afternoon to make sure that we knew of the danger ahead. "My word," remarked an American on board, "but the North Sea is patrolled thorough by your cruisers." Finally, early on Monday morning, we were escorted to the mouth of the Tyne by three torpedo boats. An exciting and adventurous passage.

Although the Swedes at Hernösand were most kind and helpful to the expedition during our whole stay, and we cannot be too thankful in particular to Herr Rektor Tham, who practically handed over his Technical School to us for our use, yet we could not help noticing that the tone of the papers grew more and more pro-German and anti-British. This is largely due to the Swedish distrust of Russia, as Finland was once a portion of Sweden, a distrust fomented by the lying reports about the progress of the war furnished to the Swedish press by the notorious Woolf's Agency. The refusal of the Russian Government to admit us was a blessing in disguise. The other wing of our intended expedition to Kiev, under Professor Fowler, got as far as Riga, but, being unable to proceed, the expedition was abandoned. At Kiev itself, where a party of American astronomers, under Professor Campbell, of the Lick Observatory, was stationed, the eclipsed sun was obscured by clouds. The Greenwich astronomers at Minsk observed the eclipse successfully, but in a clouded sky. At Feodosia, in the Crimea, where the Cambridge Observatory party, under Professor Newall, erected their instruments, clouds again rendered observations impossible. May we not attribute our extraordinary good luck to St. Bridget, of Sweden, to whom the four Fathers made a novena in preparation for the eclipse.

INDIFFERENCE.

He's neither glad nor sorry—like a dog at his father's wake.—JOYCE. *English as we speak it in Ireland.*

"TIPPERARY" AT STONYHURST.

The following is the local version of "Tipperary," alluded to on page 983, as having been sung at the concert of October 7th:—

(1.)

Englishmen and Irishmen a-fighting go to-day,
Scotsmen too, and Welshmen too, and everyone is gay;
Every school has sent them, but we'll find among the first

English, Irish, Scots and Welsh are there from Stony-hurst.

Chorus:

It's a long way that leads to Berlin,

It's a rough way, we know;

It's a long way that leads to Berlin,

But the Allies mean to go!

So good-bye, Dick and Billy,

Farewell, Loo and Claire;

It's a long, long way that leads to Berlin,

But we'll get right there!

(2.)

Sergeant Hill's been teaching men to use their bayonets;
Major Pearse is officer to twice five hundred pets;
Spencer, Jackie Petre, too, will teach the Germans why
Englishmen refuse to run, but aren't afraid to fly.

(3.)

India and Australia are both a fairish way,
But India sends us Constable, Australia sends McGahey;
Back from New York Archer-Shee has come to bear the
brunt;
Sammy Lynch, our great full-back, is moving to the
front.

(4.)

Griffin's down at Devonport; at Sandhurst not a few,
Gethin, Cuffey, Kennedy, and Geoff O'Donoghue;
Geoffrey darlin', here's to you, and many a lucky shot;
And the same to Gerald Leigh Malines McElligott!

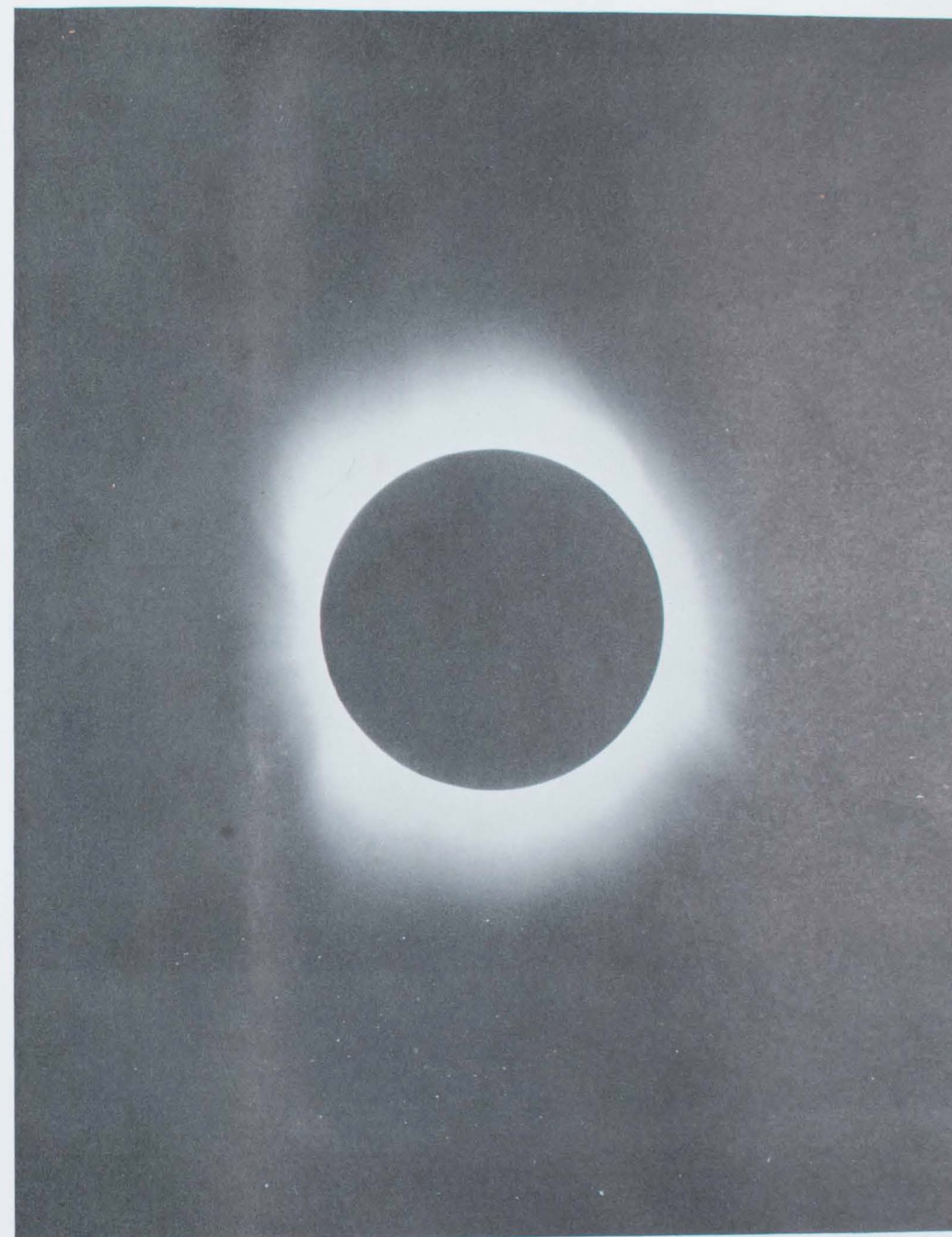
(5.)

Thornton up to Greenock with the Scottish Rifle goes,
Trappes is down at Plymouth till he's told to face the
foes;
Makepeace with the Terriers is out for making war,
So is Gwyn, and so is Flinn, and many, many more!

(6.)

Many, many more, and sure we've not forgotten you,
Riley, Thwaites, Filose and French, and Hoper-Dixon,
too!

Geoff and Edmund Callaghan, we're thinking of you all—
And of you, dear Maurice, you, who were the first to fall.



THE SOLAR CORONA.
A Photograph by the Stonyhurst Party, British Government Solar Eclipse Expedition,
Hernösand, Sweden, August, 1914.

*This meeting I attended
with my Comm. W. L. Martin*

ROYAL INSTITUTION OF GREAT BRITAIN.

WEEKLY EVENING MEETING,

Friday, February 26, 1915.

J. H. BALFOUR BROWNE, ESQ., K.C. D.L. J.P. LL.D.,
Vice-President, in the Chair.

The Rev. A. L. CORTIE, S.J. F.R.A.S.

Total Solar Eclipse of 1914.

THE path of the shadow of the moon during the total solar eclipse of August 21, 1914, entered Europe by the Scandinavian peninsula, crossing from Mosjøen, on the west coast of Norway, to Hernösand on the east coast of Sweden. Thence it passed over the Åland Islands in the Baltic Sea, and penetrated Russia near the city of Riga. Pursuing its course in that Empire it traversed the cities of Minsk, Kiev, and Theodosia in the Crimea, and, crossing the Black Sea, reached Asia Minor near the city of Trebizond. The expedition from the Stonyhurst College Observatory, dispatched under the auspices of the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, was stationed at Hernösand. An expedition for observing a total solar eclipse has a three-fold character, for it is an adventure, an experience, and an experiment. The uncertainty of the weather conditions that will be experienced on the eventful day, which may render the work of months of preparation abortive, always make an expedition an adventure. From past experience prognostications founded on average meteorological results for any given station are generally useless. With regard to the present eclipse, one distinguished Russian astronomer declared that he would wait until all other observers had selected the stations which would presumably enjoy fine weather conditions, and then would take a sporting chance at whatever station was left. Of the seven expeditions that have been dispatched from Stonyhurst to observe total eclipses, two only have enjoyed good weather conditions. Father Perry observed the eclipse of 1870, at Cadiz, in thin clouds; at Carriacou in the West Indies, in 1886, between drenching showers of rain; while that of 1887, when he went to Moscow, was altogether blotted out by thick clouds. In 1889 he went to the Salut Islands, French Guiana, but though the weather was fine, his devotion to duty cost him his life. The story of how he was supported from a sick bed to his instruments by British sailors, and then was almost carried back to H.M.S. "Comus" to die, is a pathetic page in the history of eclipse expeditions. Under my own direction the eclipse of 1905 at Vinaroz, in Spain, was observed through thin clouds; that

of 1911 at Vavan, in the Tonga Islands, through thick clouds. But at Hernösand we observed in a perfect translucent blue sky, though had the eclipse taken place on any other day, during our three weeks' stay, except on August 9, and the day of the eclipse, August 21, we should have been baulked by clouds. But though exceptionally favoured by weather conditions, we experienced our share of other adventures.

It had been proposed that Father O'Connor and myself should join Professor Fowler's party intended for Kiev. But the reiterated refusal of the Russian Government through the British Foreign Office to allow the Jesuit Fathers to enter Russia necessitated the division of the original expedition. It was arranged that we should form a separate expedition to Hernösand, a station which had been excluded from the original programme of British official expeditions, on account of its inferior chances of good weather conditions. The permission which was ultimately granted for our entrance into Russia, through the intervention of Dr. Backlund, the Imperial Astronomer at Pulkova, was fortunately not communicated to us. Had we accompanied Professor Fowler, with him we should have had the mortification of abandoning our expedition at Riga, on account of the impossibility of proceeding to Kiev, owing to the incidence of the War and the consequent mobilization of troops. Even had we succeeded in penetrating to Kiev we should have shared the ill-fortune of Professor Campbell and the party from the Lick Observatory, and been prevented from observing by clouds.

Our return journey from Hernösand during the war was also excitingly adventurous. Between Hernösand and Stockholm we traversed two Swedish mine-fields, under the escort of armed vessels. Arriving at Stockholm on August 26, we had to change our intended homeward route via Gothenburg and Hull, and started via Christiania, and thence by the truly magnificent mountain railway to Bergen. Thence on August 29 we took a Norwegian steamer to cross the North Sea to Newcastle. Had it not been for timely warnings given us in the course of the succeeding day by British cruisers, we should in all probability have run into a mine-field laid by the Germans some little distance from the mouth of the Tyne. Accordingly we changed our course for Peterhead, and came down the coast inside the mine-field. Finally, we were escorted into Newcastle on the early morning of August 31 by three torpedo-boats. The British Minister at Stockholm, Sir Esmé Howard, very kindly took charge of our instruments, and subsequently transmitted them to the Vice-Consul at Bergen, whence they were safely shipped to Hull.

One experience of those who go on eclipse expeditions is invariable, and that is of the kindness and helpfulness of all with whom observers are brought into contact. Professor B. Hasselburg, of the Academy of Sciences at Stockholm, did everything in his power to secure the success of the British expedition. He recommended

a suitable site for our instruments at Hernösand, and obtained the expediting of our cases by the Custom-house officials after a merely formal inspection. At Hernösand the Rector of the Technical School, Herr Tham, placed his school, containing physical and chemical laboratories, mechanics, and carpenters' shops, and a dark-room, entirely at our disposal, and that of an expedition from St. Ignatius' College, Valkenburg, Holland, consisting of Father Wulf and Father Rodés. The Technical School had an efficient electrical installation, and Herr Helenius, the town electrician, laid down leads gratuitously, so that we were enabled to employ the current at our instruments. We finally chose to erect these in a field at the back of the Technical School, at an altitude of about 300 feet above sea-level. The co-ordinates of the station were: latitude $62^{\circ} 38' 8.8''$ N., and longitude $17^{\circ} 57' 32.25''$ E. of Greenwich. The computed duration of totality was 129 seconds. It really was 125 seconds. The station was 3.9 miles from the central line of totality.

Our experiences in the erecting and adjusting of the instruments are described in some detail in the Preliminary Report of the expedition, communicated to the Royal Astronomical Society by the Joint Permanent Committee.* It will be only necessary, therefore, to summarize some of the more important details. The members of the expedition, in addition to myself, were Father O'Connor, of the Stonyhurst College Observatory; Mr. G. J. Gibbs, of Preston; and Mr. E. T. Whitelow, of Birkdale, Southport. Our instrumental equipment included a 16-inch cœlostat belonging to the Royal Astronomical Society, and an 8-inch "Grubb" cœlostat, kindly lent by the Royal Irish Academy. The 16-inch cœlostat supplied light to three coronagraphs and a horizontal telescope for projecting an enlarged image of the sun on to a circularly graduated screen of ground glass. The long focus coronagraph had an O.G. of 4 inches aperture, and focal length 20 feet. This also was kindly lent by the Royal Irish Academy. The image of the sun for best focus was $2\frac{1}{2}$ inches in diameter. For obtaining images of the filmy extensions of the coronal streamers we employed two cameras, one with a 4-inch O.G., focal length 34 inches, the other with O.G. 3.5 inches and focal length 12 inches. Our programme of exposures included six exposures with the long-focus lens of 2, 4, 10, 25, 7, 3 seconds respectively. All these, except the first, were successfully made by Father O'Connor. With the 34-inch coronagraph four exposures of 10, 50, 15, 5 seconds were secured, and with the 12-inch camera one long exposure of 95 seconds. These two instruments were under the charge of Mr. Whitelow. The plates employed were bathed by Mr. Crowther, of Carlisle, in a solution to render them impervious to solarization. In addition to these two cameras Mr. Whitelow had mounted on a wedge-head, cut to the latitude of Hernösand, a Zeiss lens

* Monthly Notices, R.A.S. lxxv. No. 3, January, 1915.

The coronagraphs were supplied by Father O'Connor and the instruments of Father Wulf and Father Rodés were supplied by the Royal Irish Academy.

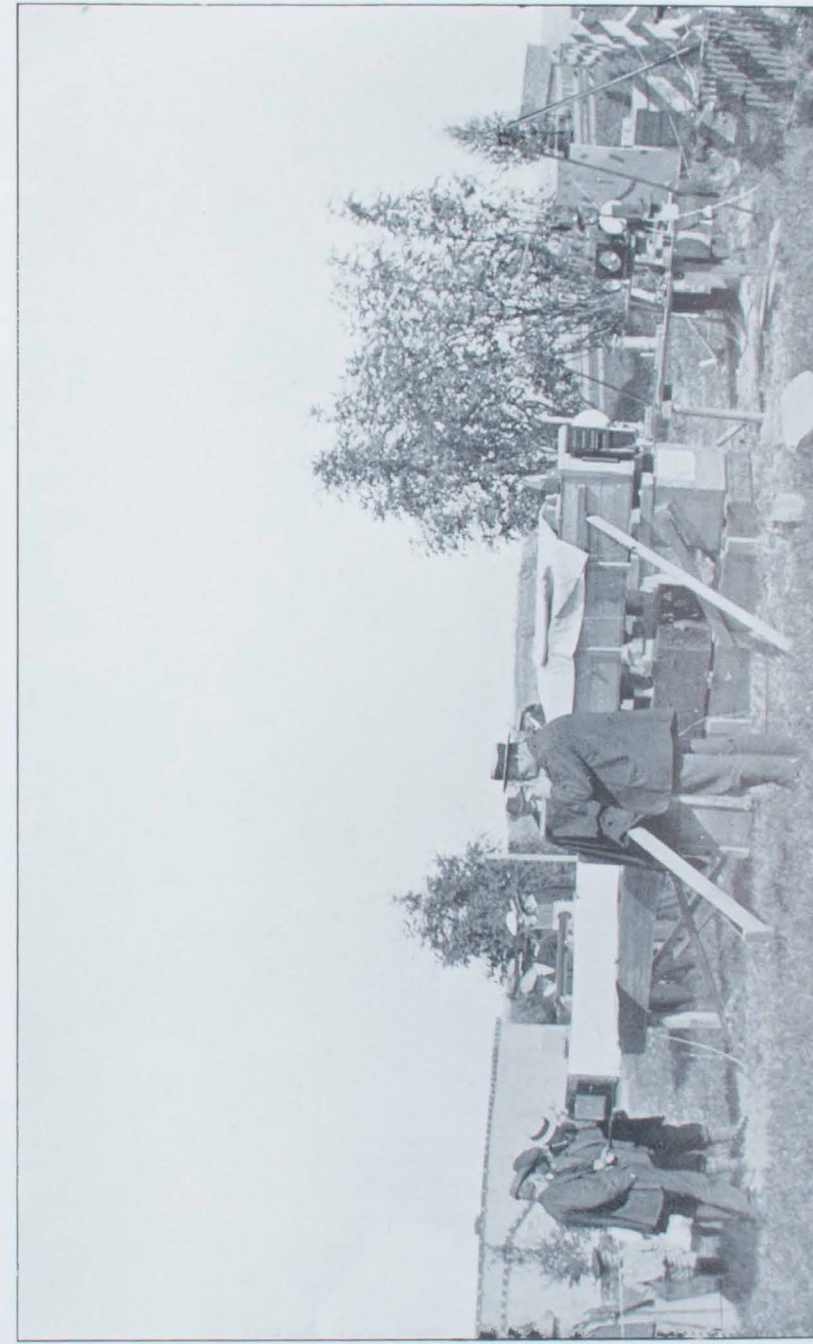
of 14-inch focus, with which he successfully photographed on "Hydro" plates the moon projected on the corona, 30 seconds, and 1 minute after totality. The function of the 3-inch Cooke telescope mounted on top of the long camera was to enable Father O'Connor to give signals 10 minutes, 5 minutes, and 10 seconds before totality, by observation on the graduated glass screen of the angles subtended by the cusps of the advancing moon at the centre of the sun's projected image. An ingenious eclipse-clock constructed by Mr. Gibbs, a large hand completing the circuit of a two-foot dial once in 129 seconds, was also set up. It was illuminated by an electric lamp.

The 8-inch cœlostast was employed to supply light to a 5-inch Alvan Clarke lens, focal length 7 feet, which projected an image of the sun on to the slit plate of the spectrograph. This spectrograph was designed in conjunction with Professor Fowler, and was constructed under his supervision at the Imperial College of Science, South Kensington. It was probably the most powerful slit spectrograph so far used in eclipse expeditions, and gave a very brilliant spectrum covering 4 inches lineally between λ 6700 and λ 4800. It was of the Littrow type, and the constants of the instrument were as follow:—

Length of slit	$\frac{1}{2}$ inch.
Width of slit	0.0017 inch.
Aperture of O.G.	6 inches.
Focal length of O.G.	98 inches.
Edge of prism	7 inches.
Refracting angle of prism	40°.
Deviation of prism at $H\beta$	28.5°.
Diameter of plane mirror	6.5 inches.
Purity of the spectrum	6400.

This instrument was worked by Father Cortie and Mr. Gibbs.

A novel feature in eclipse operations was the photographing of a comparison spectrum given by an iron-arc on the same plate as the spectrum of the corona. A current of 12 amperes at a pressure of 110 volts was employed. The image of the arc was formed on the slit by means of a single lens, 4.9 inches aperture, and a diagonal prism. The diagonal was mounted in front of the lens so that it could be pushed forwards and backwards in a slotted groove. To fill the O.G. with light from the arc, the lens was adjusted so that the solid angle of the beam of light from the arc was equal to that subtended by the O.G. from the slit. A zinc shield with a horizontal slot $\frac{1}{10}$ inch wide was employed to cover the slit plate, during the exposure of the corona, when it was desired to expose for the spectrum of the arc. The slot lay across the dark image of the moon. The coronal image was placed on the slit plate so that the slit was almost tangential to the sun's limb on the E. side. The exposure on the spectrum of the corona had been in progress about 40 seconds, when the slotted shield was placed in position, the diagonal was pushed forward, and the arc struck. After an exposure of 4 seconds on the



THE ECLIPSE INSTRUMENTS. The morning of the eclipse, August 21, 1914.

*View of
Eclipse
Clock*

clock

*Alvan
Clarke*

*View of
the
instruments*

arc the diagonal was pushed back, the slotted shield removed, and the exposure was continued on the corona, none of the optical parts for the formation of the image having been disturbed in the meanwhile. All the operations necessary for photographing the arc spectrum took about 20 seconds.

Drills commenced on August 17, and we were assisted by seven students of the Technical School, under the direction of Herr Askling, the master of mechanical science. Four of these students were trained to make a composite drawing of the corona, on graduated disks, each confining his attention to one quadrant. They practised on a drawing of the corona of 1901. The result was a very good picture of the chief details of the corona as visible to the naked eye. The photographs, however, taken with the coronagraphs of shorter focal length, show a greater extension than was visible to the eye.

On the evening of August 20 the wind shifted to the S.E., and brought with it a perfectly clear sky, though clouds appeared about an hour after the eclipse was over. A considerable number of spectators assembled in the field, many of whom watched the progress of the partial phase through dark glasses. About 20 minutes before totality came the well-known eclipse wind, quite a chilly breeze from the S.E. The total drop of temperature was 7.4° F. At 10 minutes before totality, as indicated by the cusps on the ground-glass screen, Father O'Connor blew three blasts on a whistle. The observers and their assistants stood to their stations, the clocks were wound up, and the lamps were lit. At this time the illumination of the distant mountains to the north was weirdly beautiful. At 5 minutes before totality, at the signal of two blasts on the whistle, the slides were drawn, and silence was called. At 10 seconds nominally, but in reality at 12 seconds before totality, a single blast was the warning for exposures on the "flash" spectrum. At the signal "Go!" when totality was reached, Father O'Connor pulled a cord, which released the mechanism of the eclipse clock. The experience of the sight of a magnificent corona in a perfectly pure sky was most impressive and enthralling. On the west of the eclipsed sun was a long fish-tail streamer, while on the east were three bright winged streamers, a very bright one N.E., a longer though less bright one S.E., and a fainter bayonet-like streamer placed almost equatorially. In the N.W. blazed the planet Mercury, while Venus was shining brightly in the E. sky.

The general form of the corona of 1914 was rather of the "minimum" than of any other type. The open spaces at the poles, full of beautiful rays, and the long fish-tail streamer on the W. side, are indicative of this type. But on the E. side it approximates to the "intermediate" type, the spreading of the streamers being a characteristic feature. It is interesting from the fact that, occurring at a time when the sun-spot curve was rising after a protracted minimum,

*on the afternoon of the day the eclipse
calculated clock stopped at 10:00 - a corrected picture
within the ordinary clock had stopped on 10:00*

it suggests the genesis of the "maximum" type, as the superposition of bright streamers on the two long wings in the equatorial regions, which probably are a sub-permanent feature of all coronae. The N.E. streamer is projected over the background of the continuous corona, and consists of a sheaf or bundle of very bright rays, which can be traced as far as 26' from the sun's limb. The filamentous nature of the other streamers is also marked. The lower corona is represented by a bright continuous ring all round the sun, between 1' and 2' of arc in depth. This is seen on both the large scale and small scale photographs. A considerable arc of the chromosphere is shown on the W. limb, on the last-exposed of the larger scale photographs, as the slide was only just closed before the end of totality. The southern boundary of the S.E. streamer extends farther from the sun than any other feature, fully two diameters. It has a marked double curvature. On the W. side of the corona at position angle 356', in close proximity to a small bright prominence, is a remarkably distinct filament, which can be traced as far as 7' from the sun. It curves over towards the equator. Immediately below the filament are the bright edges of two shorter streamers, which are superposed upon the main mass of the coronal wing. These three bright rays are as characteristic of the N.W. limb as the bright sheaf of rays of the N.E. limb. We shall discuss their probable import in a subsequent part of this discourse.

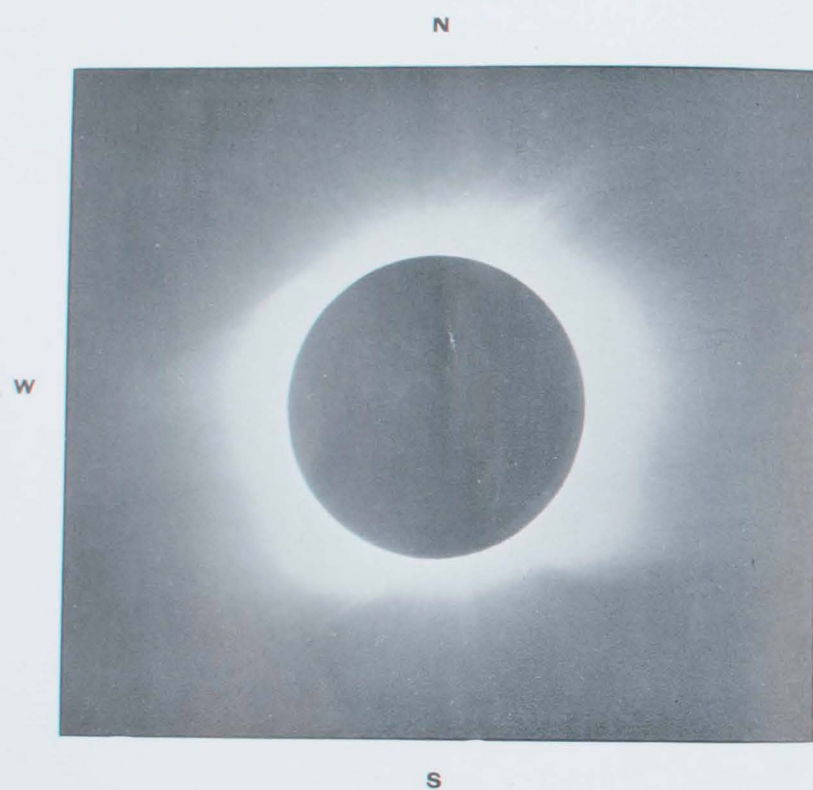
The spectrum of the corona next claims our attention. Although extremely weak on the plate it is quite measurable. The corona was a bright one, yet the well-known green radiation of the coronal light about wave-length 5303 is inconspicuous, though just discernible on the plate. This result agrees with that obtained by other observers. Secondly, the intenser radiations are in the red end of the spectrum. Other observers of the eclipse have called attention to a well-defined bright radiation about wave-length 6374. This line is one of the strongest on our negative, but it is not an isolated radiation. It occurs as a member of one of a series of three bands or flutings at this end of the spectrum. The wave-lengths of these terminal lines are as follows:—

- | | |
|---|---|
| 1. $\left. \begin{array}{l} 6643\cdot9 \\ 6630\cdot5 \end{array} \right\}$ Three lines. | 2. $\left. \begin{array}{l} 6530\cdot9 \\ 6502\cdot8 \end{array} \right\}$ Six lines. |
| 3. $\left. \begin{array}{l} 6384\cdot3 \\ 6363\cdot0 \end{array} \right\}$ Seven lines. | |

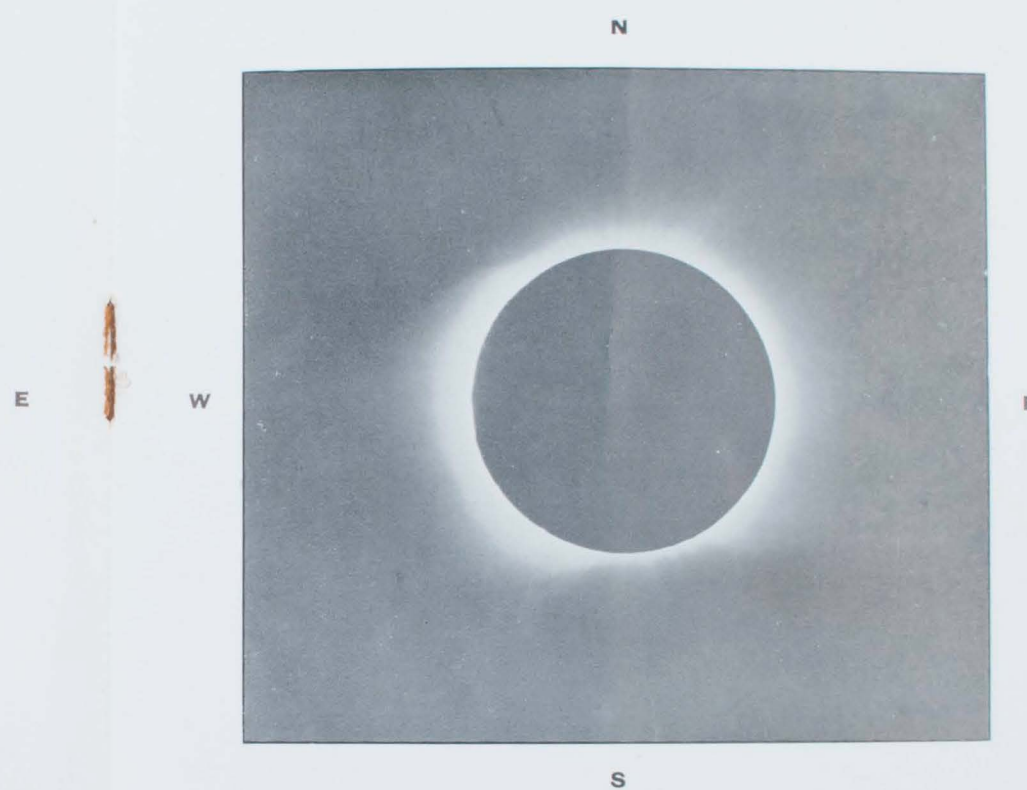
Two other bands occur at wave-lengths—

- | | |
|---|--|
| 4. $\left. \begin{array}{l} 5118\cdot1 \\ 5114\cdot3 \end{array} \right\}$ Two lines. | 5. $\left. \begin{array}{l} 5315\cdot3 \\ 5302\cdot7 \end{array} \right\}$ Four lines. |
|---|--|

All the lines in these bands are sharp, though the images are very faint. There are also other lines visible which have not as yet had definite wave-lengths assigned to them. The general character of the



THE SUN'S CORONA, August 21, 1914.
Exposure 25 seconds, 20-foot coronagraph. Reduced $\frac{7}{10}$.



THE SUN'S CORONA, August 21, 1914.
Exposure 3 seconds, 20-foot coronagraph. Reduced $\frac{7}{10}$.

coronal spectrum on the photograph is undoubtedly that of a series of bands or flutings. From a study of the position of the slit relatively to the corona, it appears that the spectrum is not that of the upper chromosphere, nor that of the lower corona, but of the roots of the streamers on the E. side of the sun. The spectrum is unique, and suggests, as many another physical experiment, a fresh problem for further investigation.

We have dwelt upon our own results and operations, as these are naturally more familiar to us than those of the other British expeditions. Unfortunately two of the other three expeditions were entirely spoilt by adverse circumstances. It was a hard fate which compelled Professor Fowler to be stranded at Riga, and to be unable to proceed to his destination on account of the war. It was perhaps a harder fate which, frustrating all the careful preparations and adjustments of instruments at a chosen site at Theodosia in the Crimea, befell Professor Newall. For he had the mortification of being robbed of a view of the eclipsed sun by purely local clouds. Two miles from his station the Italian expedition under Professor Riccò enjoyed a cloudless sky. We sympathize with these astronomers in their naturally keen disappointment. At the same time we can rejoice in the success of the Greenwich observers, Mr. Jones and Mr. Davidson, at Minsk. With the Thompson coronagraph they obtained seven large scale photographs of the corona full of fine detail. More interesting still was the employment of two photographic cameras, with green colour screens, to obtain information as to the presence and distribution of coronium. In front of the object-glass of each of these a prism was placed. Its function was to disperse the continuous light passing through the monochromatic filters. Had coronium been present it would have shown itself as a bright ring or portions of a ring round the eclipsed sun. The resulting photographs show that it was entirely absent. This observation, which corroborates and strengthens the value of those made by other observers in this eclipse, is of great importance. The corona was bright, and yet there was no green coronium radiation as we should have naturally expected. As we have already noted, the faintest possible trace of this radiation appears in a band or fluting on our own photograph of the coronal spectrum.

The Greenwich observers have also been successful in another direction. With the Hills quartz spectroscope, specially improved for this occasion in various adjuncts, the spectrum of the "flash" has been photographed down to wave-length 3118 in the ultra-violet. This is considerably farther than had been photographed before, as far as accurate measures of the wave-lengths of the lines are concerned. At least 120 lines of a shorter wave-length than those which were photographed by Mitchell in 1905 have been measured.

The extended spectrum of the flash in the ultra-violet secured by the Greenwich observers, and the novel and unique spectrum of the corona in the red photographed by the Stonyhurst observers, are

outstanding features of the spectroscopic records obtained at this eclipse. In addition, both parties of observers employed a comparison spectrum for the first time in eclipse observations, the Greenwich observers using the spark spectrum, and the Stonyhurst observers the arc spectrum of iron.

The co-ordination of the various phenomena observed on the sun's surface, or in the surrounding envelopes, is of primary importance in the advance of knowledge of solar physics. Sun-spots are undoubtedly the chief foci of activity in the manifestations of energy displayed by faculae, flocculi, and eruptive prominences. The relation, therefore, which may exist between sun-spots, or areas of sun-spot activity, and the streamers of the sun's corona is a subject worthy of investigation.

The concordance between the general aspect of the sun's corona and the curve of sun-spot activity has been well established. At times of maximum sun-spot activity the corona extends all round the sun in irregular masses. At minimum there are two long wings disposed equatorially, generally in the form of a wind-vane, with open spaces at the poles filled with delicate filmy rays. At periods intermediate between maximum and minimum there are a number of bright streamers, which are superposed upon the equatorial wings, which have now extended both northwards and southwards. It has not unfrequently been asserted,* since sun-spots are confined within zones some 30° north and south of the equator, while prominences, which are more active at sun-spot maxima, are found in all latitudes, and even at the poles, that the solar corona reflects rather the variations of the curve of prominence activity than those of the sun-spot curve. Hence the conclusion has been drawn that the streamers of the corona emanate from regions of prominence activity. But there seems to be very little, if any, direct evidence of this from eclipse photographs. Whatever direct evidence we possess of the connexion between prominences and the solar corona points to the formation of a system of beautiful interlacing arches in the lower portions of the corona, immediately over the prominences. This is shown in a striking manner, for instance, in the photographs obtained by Professor Schaeberle in the eclipse of 1893, and in my own photographs of that of 1905.

If the streamers are supposed to emanate from regions of sun-spot activity, it is not difficult to explain the general aspect of the corona. As a preliminary, it must be borne in mind that we are viewing the streamers, which really exist in space in three dimensions, projected around a seemingly flat disk in two dimensions. The sun-spot zones have a limiting latitude of about 30° north and south of the solar equator, and at times of minimum have a mean latitude which is much lower. This explains the two main wings which are

* e.g. Proceedings of the R.I., xx, p. 352.

disposed equatorially at such periods. At times of "intermediate" activity, when the sun-spot curve is rising towards a maximum, or falling towards a minimum, we should expect the wings to extend to higher latitudes and lower latitudes. This, too, is verified; the long equatorial wings of the minimum period assuming the form of four petals of a single dahlia. Sometimes sheaves of bright streamers are in addition projected across this winged background. Such were the coronae of 1886, 1896, and 1898. A curve of limiting latitudes of the greater sun-spot disturbances reflects in its variations very closely the positions of the main wings of the corona.

At periods of maximum solar activity large and active spot centres are found in all latitudes, within the limits 20° N. and S. The streamers proceeding from such regions of activity would be projected in all possible directions around the sun, when viewed in two dimensions, from the earth, and would be sufficient to give the appearance of such coronae as those of 1882, 1893, and 1905. The areas of sun-spot activity at such periods are also the areas of bright faculae, of extensive overlying flocculi, and of the more violent outbursts of metallic and active prominences. It seems to be probable that these disturbances, focused on sun-spots, are more responsible for the irregular form of the corona at maximum than the prominences alone. In this view of the matter the wings are covered over by the projected images of streamers radiating in all directions.

In a research communicated to the Royal Astronomical Society* in the year 1913, evidence was adduced in the cases of four eclipses, namely, those of 1893, 1898, 1905, and 1908, of the existence in the sun's corona of bundles of rays, diverging apparently from narrow belts of areas of long-continued sun-spot disturbance. Moreover, the areas of disturbance had been connected with series of magnetic storms on earth, thus suggesting that the mode of propagation of the sun's influence which is operative in magnetic storms is represented by the stream lines of the solar corona. In these cases the areas of sun-spot disturbance had been near the limb of the sun.

The eclipse of 1914 took place when the sun-spot curve was rising, the mean daily area of spots in 1914 being about twenty times what it had been in 1913, which was the year of absolute minimum. The largest spot of the year was on the disk, being of considerable size, in north heliographic latitude $18^\circ 18'$ and longitude $67^\circ 18'$. But it was situated about 68° from the west limb. It has already been noted that superposed on the coronal wings N.W. were two bright streamers, and above them a very bright filament at position angle 356° , and over the E. wing a sheaf of bright rays constituting the N.E. streamer. Is it possible that these striking features of the solar corona, which are mainly responsible for differentiating it from the minimum type, were connected with the area of disturbance of

* Monthly Notices, R.A.S., vol. lxxiii. Nos. 6, 7.

which the spot was the centre? We have a single large spot on the sun surrounded by a larger area of faculae, and doubtless a still larger area of flocculi, and an incubative stage of the transition from a "minimum" to the "intermediate" type.



FIG. 1.—A, B, C, D, E, are five points on a bright ray at position angle 356° . O is the centre of the spot. The small circles which are collinear are the intersections of the opposite sides of the hexagon.

Mons. F. Henroteau, a Belgian astronomer from the Royal Observatory at Uccle, Brussels, a refugee at Stonyhurst, suggested the application of Pascal's theorem in pure geometry, to ascertain

whether there was any connexion between the streamers named and the spot. His constructions were made from measures taken on an enlarged positive of the corona, six inches to the moon's diameter. In fig. 1, A, B, C, D, E, are five points accurately measured on the single bright ray at position angle 356° , and O is the centre of the large spot. The lines O C, C A, A B, B E, E D, D O form a hexagon. The intersections of the directions of the opposite pairs of sides O C, B E; C A, E D; A B, D O are in a straight line. Hence a conic

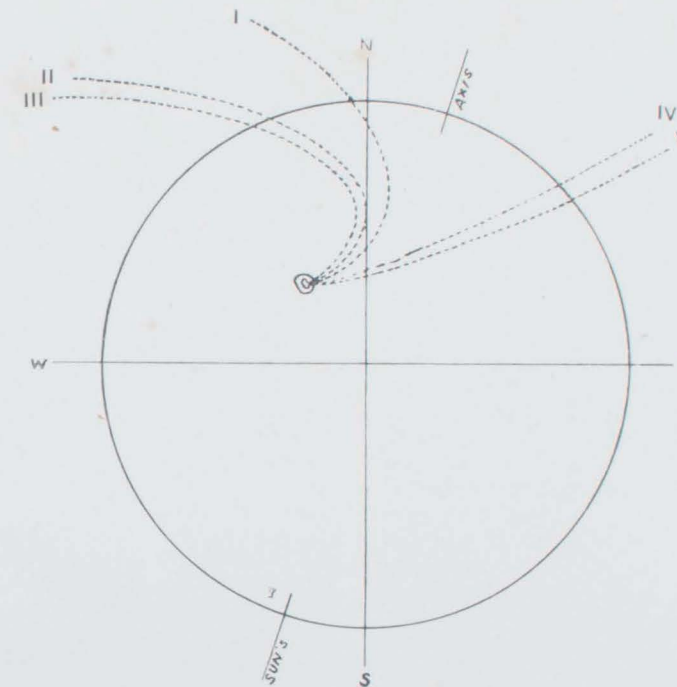


FIG. 2.—Curves I, II, III, on the West. Curves IV, V, on the East. O is the spot.

passes through the five points measured on the ray and the sun-spot. Applying the geometrical process of reciprocation and making a graphical solution, it is found that the projected conic is a very elongated ellipse. Treating by the same method the bright edges of the N.W. streamers, it is found that the projected conics certainly come from the area immediately surrounding the spot, and probably from the spot itself. The geometrical solution in these cases is not so rigid,

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Total Solar Eclipse of 1914

[Feb. 26, 1915.]

first, because the edges of the streamers are not so well-defined as in the first case, and secondly, because some of the angles of the hexagons are very acute, so that the point O, representing the spot, could be shifted, within limits, without altering sensibly the collinearity of the points of intersection of the opposite sides of the hexagon. The two projected conics are hyperbolæ.

We now turn to the luminous sheaf of rays in the N.E. quadrant, of which two bright ribs were selected for measurement. In these cases the solution is again not so rigid, even as in the last two cases, and the position of O could be considerably varied, without sensibly affecting the collinearity of the points of intersection of the opposite sides of the hexagon. The reason is that these rays point almost directly, with a very slight curvature, at the spot, which at first sight seems paradoxical. All we can affirm is, that the six points in each case lie on conics which probably pass through the region of the spot. The projections being nearly straight lines would indicate that the conics of projection from the region of the spot are seen nearly edgewise.

In the N.W. quadrant, therefore, curve I (fig. 2) is an elongated ellipse, which certainly passes through the immediate region of the spot. Curves II and III are hyperbolæ which most probably pass through the immediate region of the spot. They almost certainly pass through such a region as could be represented by the accompanying facule and flocculi. All we can affirm about curves IV and V is the probability that they pass through the region of disturbance. The total result of this investigation is that the area of disturbance marked by the sun-spot as a centre was the seat of emanation of streams of matter, represented certainly by the projected conic of curve I, very probably by those of curves II and III, and probably by those of curves IV and V. From this result, and those established in former investigations for the eclipses of 1893, 1898, 1905, and 1908, it would follow that the mode of propagation of matter from a centre of disturbance on the sun, which may be supposed to be operative in the production of terrestrial magnetic storms, is in the form of a set of diverging rays, and not in that of a single cathode-like discharge.

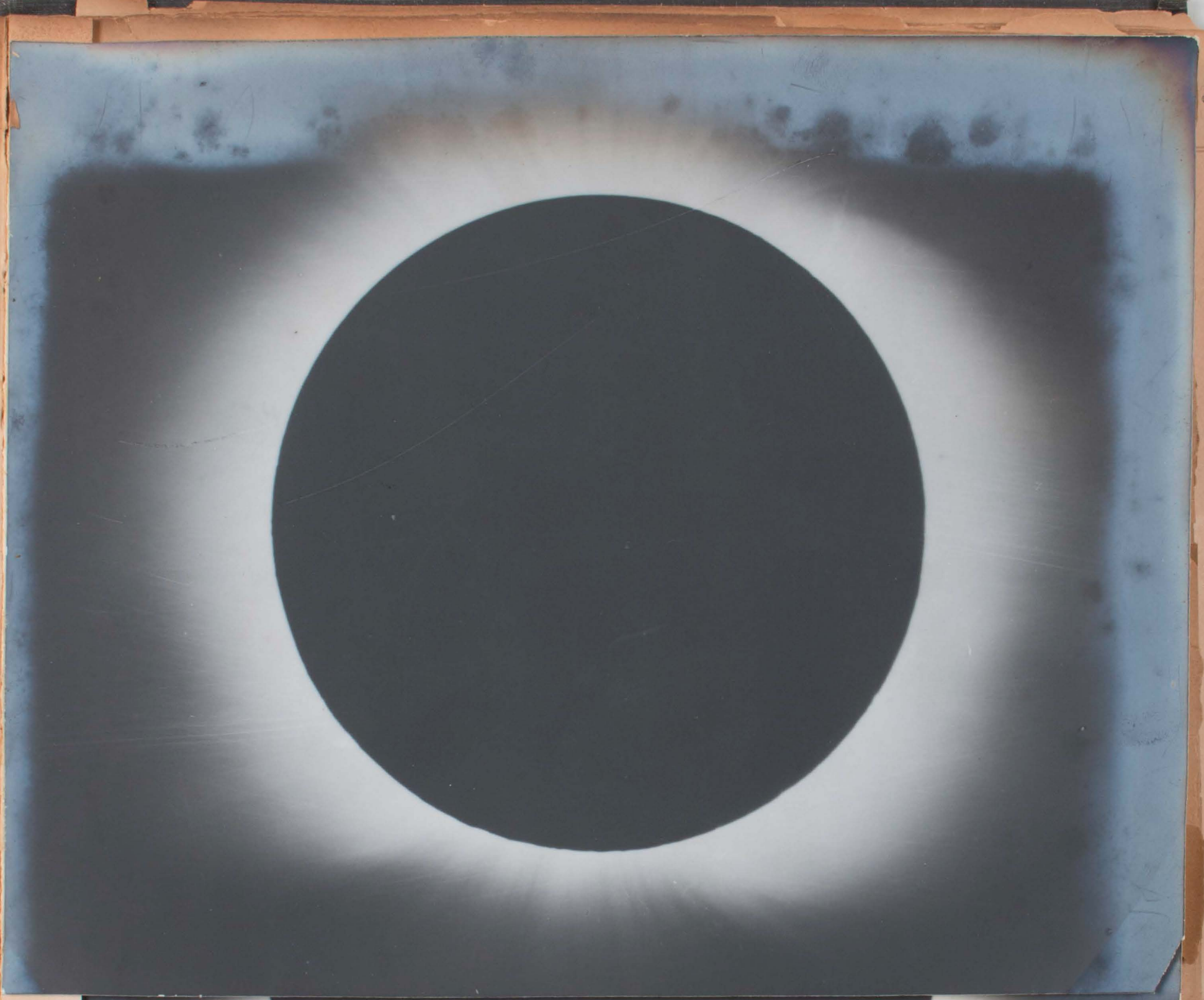
[A. L. C.]

Obs
the

5

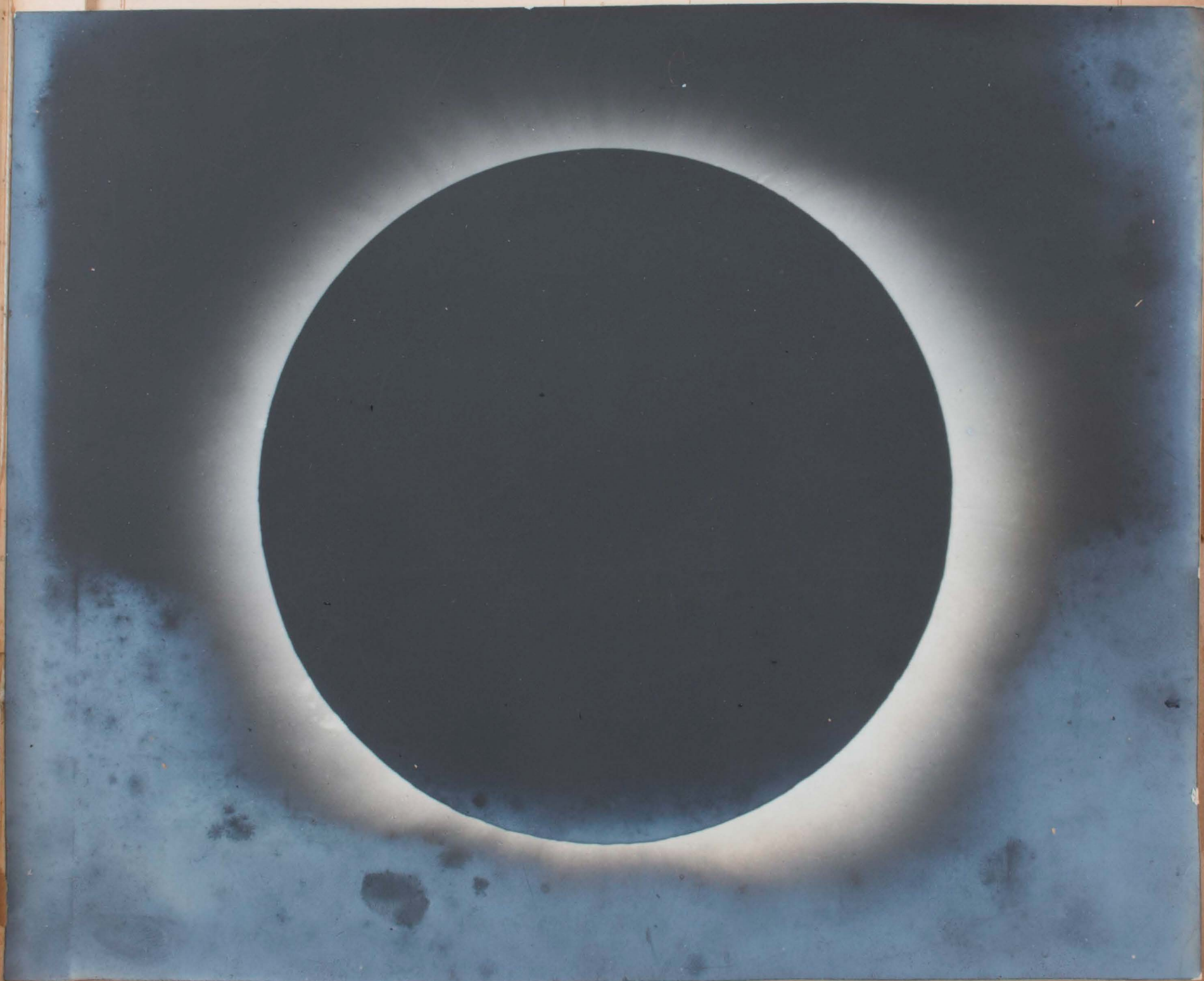


DIRECT PRINT and Two enlargements - photograph of the Eclipsed Sun



DIRECT PRINT and Two enlargements - photograph of the Eclipsed Sun

45 5



DIRECT PRINT and Two enlargements - photograph of the Eclipsed Sun

St. Blackburn
Station
July 28th 1914
Fr. O'Connor
Fr. Cuthbert
G/A



Fr. Cuthbert during
his afternoon
excursion from
St. Blackburn to
Sally, the Helen





Father & Brother
 & Lohmeyer
 on that same excursion



← The same





*Father Cortie, making trial exposures of plates
in the Spectrophotometer - myself attending to the
image of the sun on the slit.*





*Father O'Connor examining the image of the Sun
on the screen of the 20 ft. Camera.*





E.T. Whitlow
with three cameras
for photographs of crabs.
Beyond is the 16" Celestat
which fed two of the cameras
and the 20ft camera
which just appears on
the left hand margin



Frederic How
4/8 1/2 1/2 1/2 1/2
Mr O'Connor
Mr Whitlow
Mr Van der Bilt



Myself attending to the
 ▷ (on the wood block stand)
 The two Celestrats and "Eclipse"
 clock appear in the background
 9/18.



A Rainbow - over the instruments
 the instruments are under cover



Here Pickers Ham

16" Celestrat

Dancing Clock
 Parking Car

Spectrograph
 To Carter 9/18.
 20 ft. camera



S.S. CALYPSO approaching Gothenburg
July 30 / 1914



As above



View from Window (my bed room)
Hotel Kung Karl, Stockholm



Stockholm from the roof
of the Observatory



Ditto



Ditto



HERNÖSAND
View from the window of my room



The same



The same



ENGLISH
SHIPS
LAID UP
to prevent
capture by
Germans
the Baltic

The same



The same
One of the small "omnibus" steamers
which ply on the rivers.



Sunset over the mainland taken
from a high point on the island
of HERNÖSAND.



The instruments partly erected



Lunch
E.T.W. Fr.C. Fr. O.C.



All ready for the eclipse



Good Bye. ↑
Kerr Astleing ← Rector Thron



Early morning on route Christiania - Bergen

NOVEMBER 29, 1919.

ECLIPSE OF THE

55

65

In the early evening of the twenty eighth of July
our party of four joined from the Humber on board
the "Calypso" bound for Göteborg in Sweden.
A beautiful evening and smooth water seemed to
promise a pleasant passage across the North Sea
whilst the peaceful aspect of the great port of
Hull gave no hint of the terrible disaster which
was about to involve the nation. Before the night
was far advanced a storm broke over the ~~first~~ ship
and for some twenty hours or more the lively and
pitching & rolling of the vessel were responsible for many vacant
places at the table at meal times. The Daylight of the
second morning at sea disclosed a more comfortable state
of affairs and the sight of land in the distance was
evidence that the voyage was nearly ended. Presently
the vessel rounded the (the most northerly
point of Denmark) the long lying land was a long way
off but we could discern a tall lighthouse and some
of the larger buildings: toward the north the rock
bound coast line of Norway could be seen. The storm
which had delayed us had now died completely away
and a delightful sail ^{during the last} ~~for~~ a few hours brought us ^{into} the
the estuary of the Göta Elf up which we sailed
to the quay ^{on} which we were to land; perhaps the most

NOVEMBER 29, 1919.

ECLIPSE OF THE

55

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24
148

Most striking feature of interest was the large number of motor boats in use, boats of all sizes from the smallest in which the crew of one man was at the same time steersman and engineer to vessels large enough to carry hundreds of tons of cargo and to take the open sea. Our attention was very soon fully occupied with the business of claiming freight and claiming our luggage. The customs officials, as soon as they learned what was the object of our journey, very courteously and promptly ~~passed~~ gave us free passage which was indeed very necessary because, owing to the late arrival of the steamer, there was some danger of our missing the train. Stockholm train and express trains in Sweden are few and far between. We crammed ourselves and our belongings into two "taxis" and the drivers were urged to make their best speed to the railway station. The roads over which we passed were ~~very~~ had very uneven surfaces and our drivers appeared to recognize only one speed limit and that was the utmost ^{speed} they could attain, the cars bounced about and rolled like ships in a rough sea so that we were fully occupied in keeping ourselves and our possessions in some sort of order. Presently we found ourselves ~~safely~~ comfortably settled in the train for Stockholm with a journey of nine hours before us.

2

NOVEMBER 29, 1919.

ECLIPSE OF THE

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The trains in Sweden are well appointed and very comfortable. The second class compartments are good enough for anybody, roomy with spacious seats well upholstered and ~~at~~ ^{there} the luggage racks show what can be done in that direction. They are broad and strong, neither do they display that absurd legend with which luggage racks are decorated in this country: if the racks are not strong enough to carry any hand baggage which is likely to be put on them why not make them strong enough?

The train journey from Gothenburg to Stockholm gave us a good foretaste of Swedish scenery: rivers in rock-bound beds, lakes of pure water and great extent, small patches of arable land, houses built of wood and supported on rough stone foundation walls and ~~and~~ ^{and} ~~forest of~~ ^{forests of} pine and birch. The wooden houses, usually painted in bright white or in bright colors give delightful touches to the landscape and appear to be very comfortable the methods of construction would fall a long way short of the requirements of our ~~expectations~~ ^{expectations} to bye laws in this country but it is very doubtful whether they are any the worse for that. Being constructed of wood they are of course liable to ~~the~~ ^{serious} fires entailing danger and swift destruction: they ~~are~~ ^{are} usually arranged, even in the towns, so as to have

3

7

have quite considerable ^{open} spaces around them which spaces are occupied ~~with~~ by trees with the result that ~~towns~~ ~~like~~ the smaller towns look more like woods with houses scatter amongst them.

The railways are usually "single line" with passing places at the stations and so far as our limited experience ~~for~~ went we found that the express stopped at nearly all stations.

Stockholm

Our introduction to Stockholm was very impressive, darkness had set in when we arrived and the train suddenly emerged from a tunnel and ~~we~~ disclosing to us wide expanses of water surrounded by splendidly lighted ~~quays~~ ^{quays} and crossed by magnificent bridges the brilliancy & beauty astonished us as the reflections of the innumerable lamps danced on the waves. Whether by day or by night Stockholm is one of the most beautiful cities in the world its principal buildings, the King's Palace, the Parliament House, the Museums ^{all} face ~~across~~ ~~toward~~ the busy waters, waters busy with craft of all sorts and sizes plying from point to point or from port to port, almost all being painted white and therefore adding brilliant touches to views already most impressive. The traffic ~~to~~ in Sweden appears to be chiefly water borne and the still

7

NOVEMBER 29, 1919.

ECLIPSE OF THE

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While

with which the vessels are manoeuvred can only be
the ~~at~~ outcome of ~~using~~ the experience of ~~many~~ generations.

Apprenticeship followed
and just for a strip
this account



STOCKHOLM I AFTONBELYSNING
STOCKHOLM IN ABENDBELEUCHTUNG — STOCKHOLM AT NIGHT

In the early evening of the twenty eighth of July
our party of four joined from the steamer on board
the "Calypso" bound for + Gothenburg in Sweden.
A beautiful evening and smooth water seemed to
promise a pleasant passage across the North Sea
whilst the peaceful aspect of the great port of
Hull gave no hint of the terrible disaster which
was about to visit the coast.

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PARCELS: WHALLEY.
TELEGRAMS: STONYHURST.
TELEPHONE: 23 WHALLEY.
STATIONS: WHALLEY & CLITHEROE.

Observatory
STONYHURST COLLEGE,
BLACKBURN.

29 Dec 14

5950

Dear Mr. Gibbs

I have succeeded in
making a celluloid stirrup
for the magnet. It is very
small and weighs only
3.1 grams; and the whole
weight, with magnet, is
33.3 grams. Can you make
a torsion plummet of this
weight? My suspension



Thread is very good,
I think. It is of two
unspun silk threads coated
with celluloid solution. It is, then,

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of vacant
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stable state
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and some
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The storm
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into
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sailed
much

NOVEMBER 29, 1919.

ECLIPSE OF THE

55

65

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was about to befall it.

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second wave

of affairs

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a single thread and damp-
proof. The torsion effect is
small; 90° twist causing an
error of only ~~1/1000~~ 1/1000 in

With all best wishes &
Kinest Blessings

Yours sincerely
Widgrens

STONYHURST COLLEGE,
BLACKBURN.

Oct 16. 1914.

Dear Mr. Litch.

I hope this by now you are
well on the way to convalescence.

Mr. Lowly has very kindly sent
me a set of slides made by the
members of the Preston Scientific
Society. I am now like the old
woman who lived in a shoe.
I am very much obliged to you
for your kindness, and I will

STONYHURST COLLEGE,
BLACKBURN.

Sep. 2. 1914.

Dear Mr. Litch.

I presume that like
myself you are feeling the
rebound after our strenuous
journey from Stockton and
are somewhat fatigued. I
cannot express to you how
grateful I feel for all you

have also developed your films
and I could have a look at
them. Please to borrow for
me in very kind regards.

Yours very sincerely

A. L. Corbridge.

did to ensure the success of
our expedition. I do not know
what I should have done
without you.

I should like to see you
about the electrical installation
when you have a little time
as I wish the work to be
completed before the end of
the vacation if possible.

When could I come over
to Preston? You will probably

return those slides of which I
have duplicates or which I
shall not incorporate into my
lecture. But there is one slide
I particularly want, which is not
among those sent, and that is
of the canvas that covered us,
could you add to my obligations
by letting me have a slide of
that canvas by Thursday next?

Yesterday I took the precious
negatives to Whitelands and he
will make reductions for slide
purposes and enlargements also

from the plates. His drawing was
very interesting.

To-day Newbourn's men have
come and I trust that we shall
now get the electric installation
finished without undue delay.

Prof Newall is very disappointed
at getting a cloud over the
sun at Kewdenia. He thinks his
own photographs excellent.

Yours very sincerely

A. L. Bortie

PARCELS, WHALLEY.
TELEGRAMS, STONYHURST.
TELEPHONE, 25 WHALLEY.
STATIONS, WHALLEY & CLITHEROE.

STONYHURST COLLEGE,
BLACKBURN.

Sep^r 2. 1914.

5640

Dear Mr. Gibbs.

I presume that like
myself you are feeling the
rebound after our strenuous
journey from Stockholm and
are somewhat fatigued. I
cannot express to you how
grateful I feel for all you

PARCELS: WHALLEY.
TELEGRAMS: STONYHURST.
TELEPHONE: 23 WHALLEY.
STATIONS: WHALLEY & CLITHEROE.

STONYHURST COLLEGE,
BLACKBURN.

Oct 30. 1914.

Dear Mr. Gibbs.

The Stonyhurst Magazine
was issued last night and
I hasten to send you a copy.
There is much in it besides
the account of our eclipse
expedition which at least to
me is intensely interesting
especially in the news of the
war as the ads mentioned

PARCELS: WHALLEY.
TELEGRAMS: STONYHURST.
TELEPHONE: 23 WHALLEY.
STATIONS: WHALLEY & CLITHEROE.

STONYHURST COLLEGE,
BLACKBURN.

Nov 17. 1914.

Dear Mr. Gibbs.

Thank you for your goodness
in sending me the slow-motion
roll, and for the trouble you
took over it. I am delighted to
hear that you are about once
more. You must take care of
yourself and not overdo things
at first.

The dinner, R.A.S. club, was
extremely pleasant. But we had

Nothing about the eclipse at the meeting. We shall have probably a joint discussion meeting of the R.S. and R.A.S. on the eclipse, and though Greenwich is not bound by the rule of the Committee, they will defer publication of their results until the joint meeting.

Transparencies of our large scale photographs were on view in the library R.A.S. and were very much admired.

Whaley tells me that our photographs are the best of all. White has certainly worked hard at the transparencies.

To-day I received the news of being invited to lecture at the Royal Institution on the eclipse.

Take care of yourself.

Kindest regards to Mrs. Little.

I cannot tell you how much

I appreciated the kindly feeling which prompted

The presentation of the illuminated address by
the Royal Society

are known to me and many
are my old pupils. I feel
quite proud of the splendid
list, incomplete as it is, of
more than 200 names of
Officers from the College who
are serving in the army and
navy. With kindest regards
to Mrs. Gills and yourself
I am

Yours very sincerely

A. L. Corliss. S.

P.S. I have corrected two mistakes
in p. 969 and p. 993. The
reporter of current events has
omitted to state that most of the
slides I showed at my lecture
were from your negatives. I
particularly mentioned this in
the lecture.

PACKETS: WHALLEY
TELEGRAMS: STONYHURST
STATIONS: WHALLEY & CLITHEROE
TELEPHONE: 23 WHALLEY

STONYHURST COLLEGE,
BLACKBURN.

Nov 17. 1914.

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at first.

The dinner, R.A.S. club, was
extremely pleasant. But we had

TRINITY COLLEGE,
CAMBRIDGE.

Nov 7. 1914

My dear Sir

I hope you will be able to dine
with the Rev. Astronomical Society
Club on Friday next, the 13th, as
their guest. The dinner is at 7.15
at the Criterion, Piccadilly Circus,
and as the dinner takes place
immediately after the ^{meeting} dinner we do
not dress for it.

We are asking all the eclipse observers
as guests of the Club on Friday, and I
hope you will be able to come.

I remain

Yours faithfully

G. J. Little Esq.

W. L. Glaisher

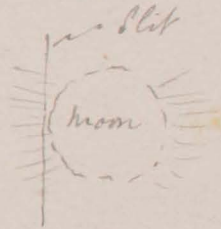
15. XII. 1914

Letter to Mr. Cotte

In reply to your letter of yesterday
I enclose a sketch of the position
of the sun's image as seen on
the slit plate but would not
care to lay much stress on
the accuracy of the position
I have shown for the following
reason:-

The front surface of the
slit plate was of white and
brightly polished metal.
Consequently the image of the
moon's limb could not be
traced on that surface the
setting had therefore to be
done by estimation.

I feel pretty certain that
the moon's limb must
have been practically
tangential to the slit.
It may even have fallen
somewhat short.



G. J. G.

STONYHURST COLLEGE,
BLACKBURN.

Dec 14. 1914

Dear Mr. Lidd.

I am very much

interested in what position

the slit was placed on the

wings of the moon when we

took our photograph of the

corona spectrum. It was on the

2 a advancing side and just

PARCELS: WHALLEY
TELEGRAMS: STONYHURST
STATIONS: WHALLEY & CUTTHEROE
TELEPHONE: 28 WHALLEY

STONYHURST COLLEGE,
BLACKBURN.

Nov 26. 1914

Dear Mr. Lidd.

I have conveyed your message

to Hackett Liddgroves and he

was very pleased. My lecture

at the Royal Institution is

to be on Friday February 26.

I shall be delighted to see

you here next week. I shall

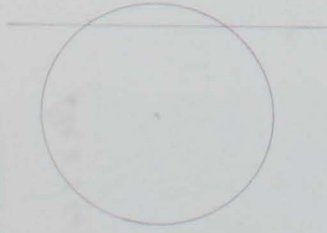
be away this week and

and I go to Manchester

on Wednesday December 2 to
preside at the meeting of the
Astronomical Society. I return
on the Thursday morning.
Could you meet me for the
11-20 at Blackburn arriving
Whalley 11-42 and have
lunch here, and spend the
afternoon when we could go
into the matters astronomical
and electrical that require
your attention.

Yours very sincerely
A. L. Cortis. S.

within the disc but where?



Is this anywhere in the approximate position. The slit was $7/8$ inch in width, and the slot was $1/16$ inch wide.

Would you draw its position here or less to scale with a diameter of the sun $2 1/8$

inch wide. My object is to ascertain if possible from the direct current photographs on what position of the sun the slit was lying.

2. I should be very much obliged for the loan of the answer negative. I must make a better slide than the one I have.

Yours very sincerely

A. L. Corbridge, Esq.

STONYHURST COLLEGE,
BLACKBURN.

Nov 26. 1914.

Dear Mr. Gibbs.

I have conveyed your message to Professor Sidgwick and he was very pleased. My lecture at the Royal Institution is to be on Friday February 26. We shall be delighted to see you here next week. I shall be away this week end and I go to Manchester

POPULAR SCIENCE
BEAS. LECTURES.

THE SUN AND STARS.
A SUBLIME THEME.

The large audience that assembled in the Corn Exchange on the 11th inst., were taken on a long trip into "the depths of the vast universe," by the Rev. A. L. Cortie, F.R.S., an eminent authority on this subject, who lives at Blackburn, and is on terms of friendship with Mr. George Gibbs, one of the distinguished alumni of the Bedford Modern School. Mr. Arnold C. Powell, M.A., Headmaster of that School, was Chairman, supported by Mr. A. Allpress, President of the Council of the Bedford General Library and Literary and Scientific Institute.

Mr. Powell, introducing Father Cortie, said it was due to the lecturer that they who were living in a tiny town in a tiny country should attune their minds to the great vastness of which he was going to speak, and be prepared for the reception of almost inconceivable truths. A railway train travelling at 60 miles an hour would take about 180 years to accomplish the journey from the Earth to the Sun. Light travelled 186,000 miles in one second. If the sun went out, we should not notice it until eight minutes afterwards. But that was nothing compared with the distance of other stars. If an inhabitant on Canopus could see this world, he would see it as it was at the outset of the Wars of the Roses. It would take about 466 years for light to reach that world.

The Rev. A. L. Cortie then began his lecture, which was illustrated by magnificent photographs of the Sun, planets, stars and constellations, planets and nebulae, taken by the finest optical instruments in the world. The lecturer assumed that he had an intelligent audience possessing something more than an elementary knowledge of the subject, and therefore the information he imparted was all

the more acceptable. Beginning with small things, he pointed out that our system of sun and planets was relatively a very small part of the greater system of stars of which our sun was only a unit. Were the sun and stars always in the form in which we now see them, or were they formed out of one primeval mass by the working of physical and chemical laws? That was the problem he proposed to discuss.

Some notion was then given of the distances of planets from the sun, and their relative sizes. The sun was 1,300,000 times the size of the earth, which could be put inside one sunspot. All the planets turn on their axes in the same direction, and if that were a matter of chance, as when a ball was thrown from the hand, the odds would be 256 to one against all of them turning one way, but if the asteroids were included, the chances would be millions to one against it. The planets also revolved round the sun in the same direction. The sun also turned on its own axis in the same direction. These concords show that the sun and planets belong to a family. A diagram drawn by Mr. G. Gibbs showed that the planets move in ellipses which are alike in being very nearly circles, whereas the comets travel in very long orbits. In passing Father Cortie said an American had predicted that a terrible catastrophe was going to take place when the sun and planets got into a straight line and exerted a united pull of gravitation: he did not believe it, especially as a conjunction happened some two months ago without anything unusual taking place (laughter). With regard to the reticulations on the surface of Mars, he was also sceptical, and attributed them to a well known tendency of the eye to convert points into a straight line. As to the supposed inhabitants of Mars, he pointed out that the planet was several millions of miles further from the Sun than the Earth, and the mean temperature there was about 70 degrees of frost. Of course God could create inhabitants suited to any climate, but supposing by inhabitants was meant beings constituted as we are, then the Martians would not enjoy living in that temperature, nor in an atmosphere which was as tenuous as that of the highest mountains here, and where water was very scarce. Some astronomers held that there was no evidence of water on Mars.

An amusing account was given of the proposal to communicate with the intelligent Martians by building up the 47th Prop. of Euclid on a large scale. It was suggested that if the Martians were able to infer from that figure the existence of intelligence in the designers of it, they were much more intelligent than some boys he had met with. Bode's law of the relative distances of the planets from the Sun was described, and this again indicated the planets belong to one family. From this the lecturer passed to a computation of the stars in our system and exhibited photographs taken by long exposures with the largest telescopes on the tops of high mountains in the clearest atmosphere. With an ordinary Kodak Mr. Gibbs captured 6,500 stars in an area where only 120 were visible to the naked eye. But powerful instruments revealed stars in clouds, assuming their greatest density in the Milky Way, which was evidently the backbone of "our system," in which it was estimated that the number of stars was not less than 1,000 millions, and not more than 2,000 millions—say 1,600 millions, which was about the population of the Earth. With regard to the distances of the stars, one of the nearest to the Earth emitted four years ago the light we now see, but there are stars whose light takes 30,000 years to reach the Earth. Then there are other systems outside our system, but there is unity of plan among them all. Next Father Cortie described and pictured in Nebulae in their progressive degrees of development from tenuous vapour to the formation of a nucleus of star clusters. From this he passed to the spiral nebulae, which are outside our system, and it was said that 750,000 of them might be photographed. Stars could be seen condensing out of the vapour in the arms of these tremendous celestial whirlpools, and there is evidence that they are in motion. He also touched on the chemical composition of the heavenly bodies as revealed by the telescope, again showing unity of plan. Finally, views were shown of the surface of the Moon as an example of the dead worlds which abound in the universe.

In conclusion the lecturer reviewed the argument. He had given them a concordance of unity of direction of spin, and revolution round the sun, in the same plane at relative distances, and in ellipses which were almost circles. Hence they claimed that the planets form one family circle. There was a unity of plan, as if they were evolved from one original nebula. It was computed that the number of bodies in our system was not less than 10,000 millions, and it was shown that the stars were systematically arranged as regards the Milky Way. All this argued unity of origin. He had shown them nebulae in systematic order, from mere luminous clouds through progressive stages of cohesion, and stages of spiral nebulae, and finally the star clusters. Then they had also the identity of material, the existence of dead worlds, and the whole crowd in motion. Applying the physical principle of the conservation of energy, viz., that the quantity of energy was constant, combined with the principle of the degradation of energy, which asserted that they must have a potential set up, and that at the end of it came a dead level of heat and motion—what followed physically? Speaking as a scientist, and not as a priest, he could only say, with Lord Kelvin, that it inevitably led to the conclusion that there was a First Intelligent Cause. Thus on physical grounds alone they inferred a First Intelligent Cause, which could only be Almighty God.

The thanks of the audience to Father Cortie were voiced by Mr. Powell, who said the wonders he had heard described had left him well-nigh speechless.

BEDS. TIMES 19.XII.1919
Local Topics.

The fine lecture given by Father Cortie on the "Formation of the Sun and Stars," recalls the fact that Bedford is honourably connected with the Science of Astronomy. The lecturer mentioned his friendship with Mr. George Gibbs, O.B.M., the inventor of the heliometer, and a mathematical pupil of Mr. Edward Langley. His star, we believe, is still in the ascendant in the astronomical sky. In the early Victorian period there was Admiral W. H. Smyth, who lived in the Crescent at a house which was the residence of the late Mr. John Smith, but in Admiral Smyth's time was known as the Bedford Observatory. Substantial volumes written by Admiral Smyth are in the Bedford Library; he was also an authority on Bedford tokens and other subjects. His sons, Charles Piazzi Smyth and Sir Warrington Smyth, F.R.S., both alumni of Bedford School, were even better known in the scientific world, the former as an astronomer, and the latter as a geologist. Another man of many accomplishments was Thomas Gwyn Elger, whose text book on the Moon contains practically all that is known of our satellite.

An old Bedfordian who did good work in stella science and held appointments at Government observatories was O. A. Le Beau, whose articles in this paper some of our readers may recall. He is, we believe, still at the Cape Observatory. Professor Piazzi Smyth, who left Bedford School in 1835, also became assistant in the Royal Observatory at the Cape of Good Hope, but in 1845 was appointed Astronomer Royal at the Edinburgh Observatory, and held that position until his resignation in 1865. Another old boy of Bedford School, who is distinguished in Astronomy, is W. G. Thackeray, who left school in 1872, and holds office at the Royal Observatory, Greenwich. But the crowning distinction of all is surely the latest, viz., the fact that S. R. Pike has just gained the Henry Skynner Scholarship of £100 a year for five years, at Balliol College, Oxford, for his knowledge of Astronomy and Mathematics. This Scholarship was also open to all the undergraduates of a certain number of terms standing in the University, and S. R. Pike has won it while still a member of Bedford School. Excellent astronomical text books and charts have been published by Mrs. H. P. Hawkins, and among them may be mentioned the invaluable "A.B.C. Guide to Astronomy," and a work entitled "The Stars from Year to Year," with Charts for every month, and one of the South Polar Stars (Simkin, Marshall).

Bedford Daily Evening
"FORMATION OF THE SUN AND STARS."
18/XII/1919
Fine Lecture at Bedford.

The third of the series of popular lectures arranged by the Council of the Bedford Library took place at the Corn Exchange on Thursday evening, the hall being, as usual, packed. The lecturer was the Rev. A. L. Cortie, F.R.H.S., and his subject was "The Formation of the Sun and Stars." The space of Father Cortie's discourse, barely an hour and a half, was all too short for his enthralled audience, who found infinitely more interest in his lucid and powerful exposition of the wonders of the starry realms than they could have found themselves by industriously poring over the best text books on astronomy. The lecture derived added fascination by the series of splendid slides of photographs of constellations and nebulae which had been taken by means of the largest and strongest telescopes in the world.

Mr. A. C. Powell, Headmaster of the Bedford Modern School, was in the chair, and in the course of his introductory remarks said that living as they did in a tiny little town, in a tiny little country, in a tiny little solar system, he thought the audience should endeavour to attune their minds to a realisation of the great distances of which the lecturer would speak. Supposing a railway train were to start and go on without stopping at 60 miles an hour, it would take 180 years to get to the sun. Take a faster thing—light—which travelled in a second a distance equal to seven times round the world. If the sun were suddenly to go out it would be eight months before we noticed it. Light, travelling from this world to Canopus would take 466 years to get there.

Father Cortie said he proposed first to treat of the relatively small system of the sun and planets circling round it, of which the earth was one; next to touch on that system of stars, of which the sun was only a unit; and then to put before them the problem as to whether the sun, planets and stars were always in their present form, or whether there was reason to believe that at one time the sun and stars formed parts of one primeval mass, and by the working out of physical and chemical laws were gradually evolved and formed.

The centre of our own system was the sun, which was 92,800,000 miles away from us. It was 1,300,000 times the size of the earth, but was not very dense, being made up of gas under pressure; the earth was bound to the sun by ties of gravitation, and the sun was the source of all heat, light and other activities which we enjoyed. The planets in the solar system, in order of their proximity to the sun, were Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

At this point the lights were lowered and some remarkable astronomical diagrams and photographs were shown on the screen. Describing diagrams of the planets, drawn to scale, the lecturer pointed out the wonderful concord of direction and revolution existing among the solar system, showing that they were all members of a family. After illustrations of the moon-like phases of Mercury and Venus, and the polar caps of Mars, Father Cortie discussed the possibilities of human existence upon Mars, and said he did not agree that the ridges observed on its surface were canals made by Martian engineers to relieve their very dry system. These corrugations were, he thought, due to a sort of optical illusion, the effect of seeing a thing on the "verge of a vision." When he was asked "Is Mars inhabited?" he first replied "You must first define the term." Do you mean "Is Mars inhabited by intelligent beings constituted like ourselves?" Owing to its immense distance from the sun, Mars' mean temperature was equal to about 70 degrees of frost. The atmosphere was very tenuous, akin to that experienced on the summit of the highest mountain in the world, and the probability was that the water vapours necessary for human existence was not to be found there. Jupiter was 1,300 times the size of the earth, its year was equal to twelve of ours, and it was 440,000,000 miles from the sun. It had four moons, clearly visible, which were discovered by Galileo, and five other moons which could only be seen through great telescopes. Saturn was the loveliest of the planets. Its rings were not solid, but nebulous. Neptune, the farthest of the planets, was discovered by mathematical calculations consequent upon observation of perturbations on Uranus.

The second part of Father Cortie's lecture was devoted to consideration of the bodies in vast star fields outside our own system. Very beautiful were some of the pictures shown of the Milky Way, the Constellation of Orion, the Pleiads, and wonderfully impressive was the lecturer's vivid description of the stars destined for separate existence, hanging inchoate in the arms of the whirlpool of the nebulae.

FATHER CORTIE DEAD

DIRECTOR OF STONYHURST COLLEGE OBSERVATORY.

The death occurred on Saturday evening of Father Aloysius Cortie, director of the Stonyhurst College Observatory, aged 66.

Father Cortie was born in London on April 22nd, 1859, and after studying at Stonyhurst and St. Beuno's, North Wales, entered the Society of Jesus in 1878, being ordained priest in 1892. He studied astronomy under the late Father Perry, S.J., F.R.S., and in 1881 was attached to the Stonyhurst Observatory. He was made Fellow of the Royal Astronomical Society in 1891, and for many years served on the council of that body. From 1900 to 1910 he was a director of the Solar Section British Astronomical Society, and in 1911 was president of the Manchester Astronomical Society.

Father Cortie had directed several Government astronomical expeditions and recently visited America to observe the total eclipse of the sun which occurred in that country in February. In 1905 he directed an expedition to observe the total solar eclipse at Vinarog, Spain, and directed other expeditions to the Tonga Islands, South Pacific in 1911, and to Hernosand, Sweden in 1914.



A distinguished scholar in solar and stellar physics and in terrestrial magnetism, he taught physics and mathematics at Stonyhurst College for 27 years, and was a director of music at the College for 19 years and a Gilchrist lecturer.

Father Cortie was given an honorary degree of doctor of Padua University in 1922. He had lectured on astronomical subjects in most of the chief towns in England, and was a member of the Salford Diocesan Commission on Church Music. A keen student of astronomy Father Cortie had written numerous papers on astrophysics and terrestrial magnetism.

He was well known in Preston on account of his association with the Preston Scientific Society, with which body he had been connected for a long period of years.

See also "The Tablet" May 23rd 1925

AN ASTRONOMER OF NOTE.

FATHER CORTIE, S.J.

Manchester City News 23. V. 1925

By the death of Father A. L. Cortie, on Saturday last, at the age of sixty-six years, an astronomer of world-wide reputation has departed. He was director of the Stonyhurst College Observatory, a Fellow of the Royal Astronomical Society, and president of the Manchester Astronomical Society, and one of its oldest and most valued members. Two or three weeks ago Father Cortie was elected president of the Manchester Literary and Philosophical Society. He received his education at Stonyhurst and St. Bruno's College, North Wales; forty-one years ago became a member of the Stonyhurst College Observatory staff, and some years since succeeded the late Father Sidgreaves as director. He made the sun and its wonderful phenomena a special study, and on three occasions was a leading figure in solar eclipse expeditions—Spain in 1905, the Tonga Islands in 1911, and at Hernosand, Sweden, in 1914.

Father Cortie was an honorary doctor of Padua University, a very high distinction. Galileo, the great mathematician and astronomer, was Professor at that University from 1592 to 1610. Father Cortie was a capable musician, and formerly he had charge of the choir at Stonyhurst. Personally he was a man of great charm, homely and unaffected in manner, easy of approach, and ever willing to help when his advice and counsel were sought. By all who had the privilege of his acquaintance he was regarded with affection and admiration.

AN APPRECIATION FROM A SCIENTIFIC FRIEND.

With the death of Father Cortie, S.J., the Manchester Astronomical Society has lost its president, who for some fourteen years in succession has filled this office with unremitting devotion and ability, born of personal devotion and enthusiasm for the most refined science.

Father Cortie, with his great store of physical, chemical, and astronomical knowledge, made at all times an ideal chairman, never at a loss to answer sudden and difficult questions arising in connection with scientific argument, discussions, and lectures. Not only did he do this ably, but as often as not in a very interesting and entertaining, not to say humorous, manner, as he was fond of a good scientific pun or joke, even if against the science itself, which he held so dear. Ever ready with well considered and shrewd advice, he efficiently helped to negotiate awkward corners and difficulties in the lives of the many societies, which were glad and persistent to have him amongst their councillors.

Often when the lecturers through unexpected circumstances could not keep their appointments he would readily step into the breach at short notice, invariably filling the threatened gap with an interesting discourse on the varied subjects he was so competent to deal with. Being, moreover, a practical observer, and having at his disposal at Stonyhurst Observatory an elaborate outfit and combination of astronomical and astrophysical instruments, he was always able to give his lectures the excellent background of personal observation.

I often wondered, with his manifold activities, how he could find time to do it all, along with the routine work daily called for in connection with his directorship at the Stonyhurst College Observatory and the official teaching hours at the same college. Yet he was a prodigious writer also, a ready correspondent on scientific matters, a frequent contributor to the lecture room of the Royal Astronomical and other societies, to the numerous provincial literary societies, and to scientific publications beyond number.

Father Cortie was essentially a "sunspot" man, a term I heard him more than once apply to himself, but that does by no means imply that he confined himself to the study of the sun alone, although this was paramount. Being myself interested in the same direction as an amateur, we corresponded frequently on the subject, just as with his predecessor, the late Father Sidgreaves, who died a little under six years ago, and who also filled the presidential chair of the Manchester Astronomical Society with great ability for many years.

We shall miss Father Cortie badly, and it will be difficult to replace him, all the more so as he possessed the rare quality of never failing urbanity, coupled with the excellent ability of imparting his knowledge to his listeners, and thereby instilling enthusiasm and interest. It will be our duty to keep his memory well before our minds, if only as a small token of gratitude for the interesting and valuable education he imparted to us always so willingly and disinterestedly.

The funeral took place at Stonyhurst College on Wednesday, the celebrant of the Requiem Mass being the Rev. Father Weld, S.J., rector of the college. In addition to a large number of clergy who had been long associated with Father Cortie the congregation included Sir Frank Dyson (the Astronomer Royal), Mgr. L. J. O'Kelly, who represented the clergy of the Salford diocese; Father T. L. Parker, secretary of the diocese; Mr. C. L. Barnes, who represented the Manchester Literary and Philosophical Society; Mr. A. A. Buss, F.R.A.S., and Mr. W. Porthouse, F.R.A.S., who represented the Manchester Astronomical Society; and Mr. G. J. Gibb, F.R.A.S., of the Preston Scientific Society.

UNIVERSE, MAY 22, 1913

Obituary.

FR. CORTIE, S.J.

DISTINGUISHED CAREER OF GREAT
JESUIT ASTRONOMER.

By the death of the Rev. Aloysius Lawrence Cortie, S.J., at Stonyhurst, on May 16, the world of science has lost a distinguished astronomer and the Society of Jesus a zealous priest.

From very early times it would appear that among the greatly various contributions made by the society to the advancement of civilisation and science, those of its astronomers are among the chief. Fr. Cortie worthily followed the great tradition established in past centuries by the Jesuit astronomers of China and by their no less eminent brethren in the West.

"When the Jesuit Order," says *The Times*, "was suppressed throughout the world in 1773, the great French astronomer, Lalande, said, in an outburst of indignation:—

Caryvalho and Choisenl have irretrievably destroyed the finest work of man, unrivalled by any human institution—the human race has lost that wonderful and invaluable assembly of 20,000 men, disinterestedly and unceasingly occupied with functions most important and most useful to man.

"The devoted lives of such men as Fr. Cortie (and they are many) show us that the loss, however great, was fortunately not 'irretrievable.'"

Born on April 22, 1859, Fr. Cortie went to Stonyhurst in 1872, and in 1878 joined the Society at Roehampton, where he pur-

sued his classical studies until 1881, when he returned to St. Mary's Hall, Stonyhurst. On the completion of the course in philosophy there he taught mathematics and natural science in the school from 1885 to 1888. In 1889 he went to St. Beuno's for theology, and was ordained priest in 1892.

He became the first Prefect of Studies at the newly-founded college at Stamford Hill in 1894, and again taught mathematics at Stonyhurst from 1895 to 1904. He took the four vows in 1896.

LEADS GOVERNMENT EXPEDITIONS.

The first public recognition of his scientific work came in 1891, when he became a member of the Royal Astronomical Society. His attention was specially directed to the relation between terrestrial magnetism and solar spots, and he was intensely interested in the observation of solar eclipses.

He directed the expedition which went to Vinaroz, Spain, to observe the total eclipse in 1905. In 1911 he headed the Government expedition to the Tonga Islands for the same purpose, and in 1914 a similar one to observe the eclipse at Hernösand, in Sweden. At the Stonyhurst Observatory, where he succeeded Fr. Sidgreaves as director in 1919, he did much valuable work in the spectroscopy of the stars with apparatus which, compared with that at the great observatories, might have been thought inadequate.

He was made a member of the Committee on Solar Atmosphere at the Astronomical Union in 1922, and in the same year the University of Padua gave him a doctorate in all its faculties. Last year he was made a Fellow of the Royal Meteorological Society and went to Toronto for the British Association on behalf of the Royal Astronomical Society.

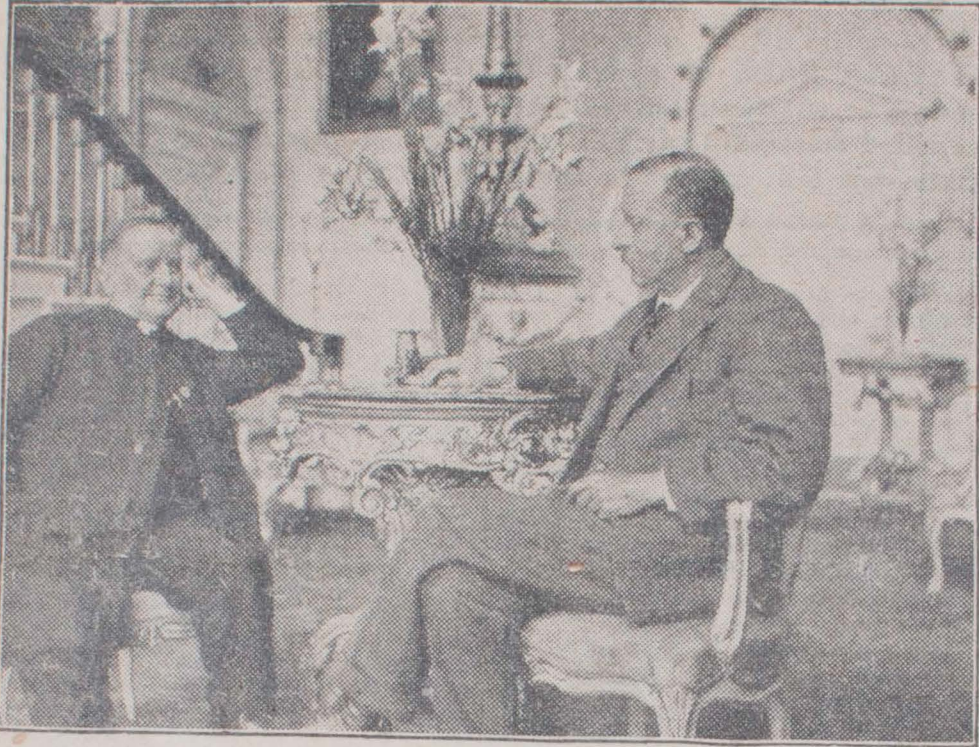
DEVOTION TO MUSIC.

It might be thought that such a pre-occupation with scientific research, added to the responsibilities of the priesthood, would have left little opportunity for other interests, and still less taste for their pursuit. Yet Fr. Cortie was no mean musician, and for nineteen years he filled the post of director of music at Stonyhurst with conspicuous ability. He was also a member of the Salford Diocesan Commission on Church Music. A delightful story is told of him when the International Union for Solar Research met at Bonn in 1913. A garden party was failing signally to inspire the assembled savants with that spirit which is indispensable to such functions. Then one of Fr. Cortie's songs came float-

(Continued at bottom of next column.)

from one of the windows and the desired spirit was promptly with them all.

FR. CORTIE, FAMOUS ASTRONOMER, DEAD.



A happy snap shot of the late Fr. CORTIE, S.J., chatting with Colonel Chichester-Constable (Lord Paramount of Holderness) in the staircase hall at Burton-Constable.

G.I.G. Designed the
Electrical Installation
for Burton Constable Hall

This apartment
← is the Staircase Hall.

to receive any criticism
the heavier families
Will all your
yo

PARCELS: WHALLEY.
TELEGRAMS: STONYHURST.
TELEPHONE: 23 WHALLEY.
STATIONS: WHALLEY & CLITHEROE.

STONYHURST COLLEGE,
BLACKBURN.

17/5/25

My dear Gibbs

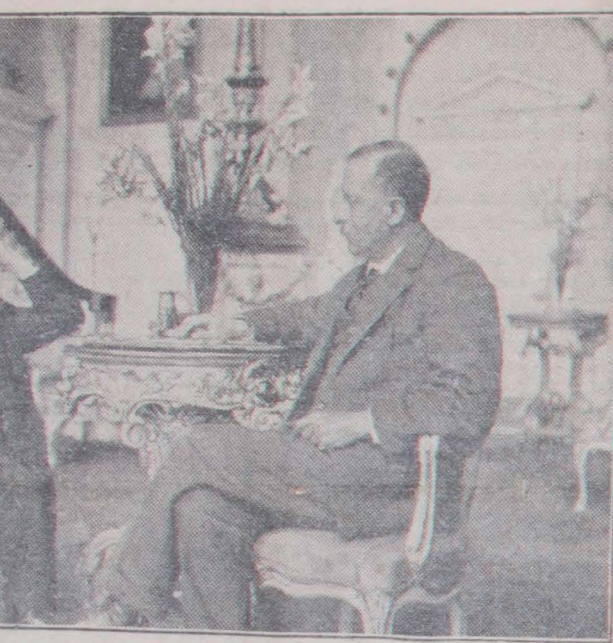
Father Rowland told
me you knew of Father Cortie's
serious illness.

I now have to tell you the
sad news that he passed
away at 7.25 p.m. yesterday.

The Bronchitis rendered his
breathing more and more
laboured; but he was conscious
to the end, and died very

Father Cortie's last letter
to myself Apr. 18/1925
Will be found in
Book No 5

CORTIE, FAMOUS ASTRONOMER, DEAD.



of the late Fr. CORTIE, S.J., chatting with Colonel Chichester-Paramount of Holderness) in the staircase hall at Burton-Constable.

peacefully. May he rest in peace!
The Requiem and funeral
will be at 11.0 a.m. on Wednesday.

Yours very sincerely
E. J. O'Connor S.J.

Nov. 8. 1905
E.J.O. first visited
Stamford and met
Fr. Cortie - introduced
by Mr. John Abbott

Father Cortie's last letter
to myself, Sept. 18/1925
Will be found in
Book No 5

PARCELS: WHALLEY.
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TELEPHONE: STONYHURST 20.
STATIONS: WHALLEY & CLITHEROE.

STONYHURST COLLEGE OBSERVATORY,
NR. BLACKBURN,
ENGLAND.

Nov. 3rd 1928

Dear Gibbs

I was interested to see in the Paper the other day that you had been lecturing on Meteorology - and it brought to my mind that it was ages since I had written to you or had heard from you.

How are you keeping?

I thought you might be interested in my latest little brain wave. The matter is still in the experimental stage. The idea is to publish each month, or rather each solar revolution, a "synoptic" chart showing the spots and "faculae regions" during the revolution. The spots are drawn usually for the day on which they were central, or occasionally on the day on which they showed the greatest area. The little vertical lines on the second line from the bottom indicate the midnights at which the corresponding longitudes of the Sun were central, the numbers below denoting the days of the month. Thus the preceding spot of group 187 was central at midnight between Aug. 25th & 26th. And at the same time there was a "sudden commencement" of a Magnetic storm. Cf. the last line, which gives a miniature reproduction of the Horizontal Force Trace. The letters above the dates of the month are the magnetic character for the day:-

c = calm, s = small disturbance, m = moderate, g = great.

I have just prepared the next revolution - and have added two other lines at the bottom - so that other phenomena may be correlated with the solar surface phenomena.

I shall be glad to know what you think of it - and very pleased to receive any criticisms or ideas

The heavier faculae outline indicate well marked ^{+ bright} faculae.

With all good wishes,

Yours very sincerely

Edwin S. J.

FR. CORTIE, FAMOUS ASTRONOMER, DEAD.

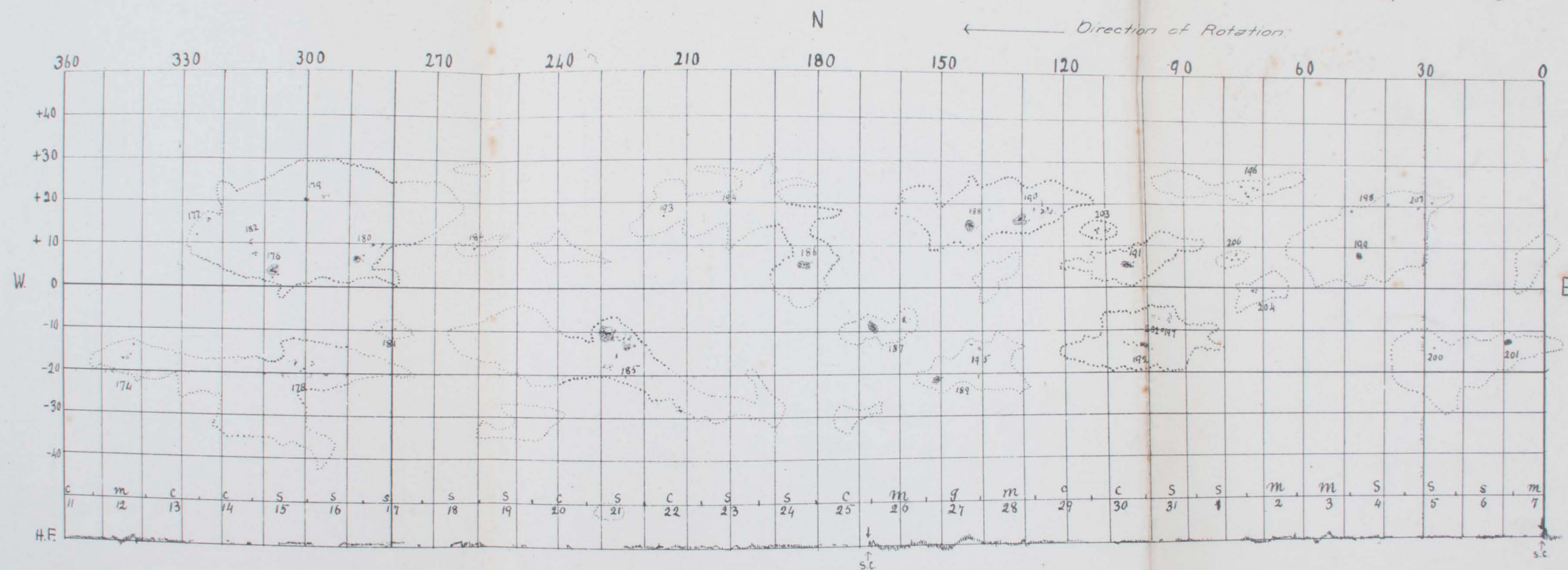
G.J.G. designed the
Electric ...L.S. WHALLEY,
STONYHURST,
"WALLEY."
"HERE."

STONYHURST COLLEGE

In C. Cortie's last letter

Revolution 1002. August 11.41 to September 7.66.

D. +6.5 to +7.3



PARCELS: WHALLEY.
TELEGRAMS: STONYHURST.
TELEPHONE: 23 WHALLEY.
STATIONS: WHALLEY & CLITHEROE.

STONYHURST COLLEGE,
BLACKBURN.

17/5/25

*Father Corrie's last letter
to myself Apr. 18/1925
Will be found in
Book No 5*



UTLÄNDSKA VETENSKAPSMÄN HIT ATT STUDERA SOLFÖRMÖRKELSEN

T. v. engelska expeditionens deltagare, t. h. två holländska astronomer. Båda expeditionerna ha etablerat sig vid Härnösand.

several subjects with distinction.
MANCHESTER EVENING CHRONICLE
Mr. Gibbs, of Preston, 8th, 1926

One of the most versatile men in Lancashire is Mr. G. J. Gibbs, of Preston.

Where to start in justifying this assertion it is difficult to say, for anything between designing a town's water supply and discoursing on Chopin's nocturnes comes within his orbit.

Many parts of Great Britain know him in his professional capacity as a civil engineer, and as such he belongs to both the Mechanical and Electrical Engineers' Institutes. Away from his actual business, he is equally well known as an astronomer and scientist. Preston Corporation call their new observatory after Jeremiah Horrocks, the illustrious Hooke parson, but it could as fittingly have been named after Mr. Gibbs, for he designed it and is its honorary curator.

"OUR MR. GIBBS."

When a "Preston Guardian" representative called at the Moor Park Observatory one evening this week, he found the Hon. Curator, Mr. G. J. Gibbs, F.R.S., in his shirt sleeves, busily examining an image of the sun projected on a piece of drawing paper through the long telescope. It appears there is a great deal of activity on the sun's surface at present, and the recent spell of bright weather has afforded him a splendid opportunity of studying a number of enormous sun-spots, which represent disturbances in the sun's atmosphere, and provide useful scientific data. Mr. Gibbs is a wonderful worker. His devotion to astronomy, his great knowledge and patience, are not only an asset to the new observatory, in which he worked so long, and where he now spends so much of his time, but are also at the service of the general public. There is nothing of the scientist full of technical jargon about him; he has the rare gift of being able to explain and illustrate all sorts of chemical and astronomical phenomena to the veriest layman, which is one of the reasons why he is such a success as a lecturer. "When I am working in the observatory," he told our representative, "and notice anyone hanging about who seems really interested in the building and what is going on, I often invite them in and briefly explain the instruments to them, and indicate the value of the records kept and the observations made. In this way many hundreds of people become interested in the observatory, and the number of names in my visitors' book is growing rapidly." Mr. Gibbs is doing good work in thus bringing home to the public the fact that the observatory is a municipal enterprise, and enabling them to participate personally in its work.

Date of Eclipse:

A Week To-day, June 29

Time of Totality ... 6-24 a.m.

Duration ... 23 seconds

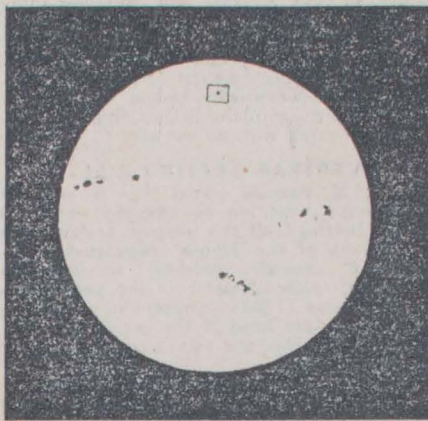
First Phase ... 5-20 a.m.

Sun Clear Again ... 7-15 a.m.

WATCHING THE SUNSPOTS.

A VISIT TO MOOR PARK OBSERVATORY, PRESTON.

The continued kindliness of the sun, about which so much has been said and written during the past week, has brought to many a business man a disinclination to work, and filled many minds with thoughts of summer games and holidays by the seaside. But there is one man in Preston who finds in the uninterrupted sunshine an opportunity for patient observation and research, altogether unsuspected by the general public.



Mr. G. J. Gibbs, the hon. curator of the Moor Park Observatory, has found in the present spell of good weather an opportunity of observing and recording the remarkable activity on the sun's surface at the present time and the continually changing sun-spots. When a "Lancashire Daily Post" representative visited the observatory last evening, Mr. Gibbs willingly explained the methods by which sun-spot positions and magnitudes are recorded. The large telescope is fitted with a frame and small drawing-board near the eye-piece, and on to an ordinary piece of drawing-paper carried on the drawing-board is focussed an image of the sun on which numerous spots, representing disturbances in the sun's atmosphere, can be clearly seen. To secure a drawing of these the astronomer has only to mark with his pencil the position and size of the spots, which usually have a very dark area in the centre, which he calls the umbra, surrounded by a less dark area which he calls the penumbra.

The sun-spots vary in size, and from the fact that they appear to travel across the face of the sun the astronomer knows that the sun turns on an axis.

A reproduction of a drawing made by Mr. Gibbs for our representative in a few minutes at the observatory last evening shows a number of sun-spots, and for the sake of comparison a dot drawn in the rectangle at the top of the picture gives a good idea of the comparative size of the earth. If care be taken, the sun-spots can be seen with the aid of binoculars and a dense-coloured screen. When the image of the sun is passed through the lenses of the telescope the heat of the rays, condensed and focussed into a small circle, is so great that a piece of paper placed close to the eye-piece is set on fire immediately.

The question naturally arises as to whether and to what extent these evidences of great activity in the sun's atmosphere affects the atmospheric conditions of the earth. A formal answer to this question is not yet forthcoming. But it is known that apart from heat and light, the radiations and emanations from the sun have other effects, such as the aurora borealis and disturbances in the magnetic conditions of the earth, which in turn react on telegraphs and wireless distribution.

In his first article, published in "The Lancashire Daily Post" yesterday, Mr. G. J. Gibbs, F.R.S., gave some valuable information to amateurs who hope to make observations of the total eclipse of the sun, on June 29th, without spoiling their chances of seeing the full grandeur of the spectacle. He strongly urged the use of eye shields, preferably those made of mica, which stop the heat rays, as well as the ultra-violet. Any attempt to gaze at the sun, until absolute totality had been reached, would, he pointed out, entail grave risk of damage to the eyesight.

Three diagrams were reproduced in the article, two illustrating the various phases of contact, and the third showing how to rig up a telescope to project a magnified image of the sun on a piece of cardboard so that a number of onlookers could watch the progress of the eclipse at the same time.

Mr. Gibbs' second article is given below.

WONDERS OF THE CORONA.

IMPRESSIVE SPECTACLE THAT IS NEVER FORGOTTEN.

HINTS TO AMATEUR PHOTOGRAPHERS.

(By Mr. G. J. GIBBS, F.R.S.)

The corona, which is never seen unless the sun is totally eclipsed, consists of extensions of the sun's atmosphere. It shines with a pearly greenish light on the dark background of the sky, for the sky is dark during totality. This darkness, with the glorious corona surrounding the jet black moon, provides that spectacle which everyone hopes to see, and which, once seen, is never forgotten.

Not only is the phenomenon itself most impressive, but the sudden change which takes place at the moment when the last vestige of the sun disappears adds to the effect. Not until this moment arrives does the round body of the moon show itself. Then, in the place of the brilliant sun, we see what appears to be a round and perfectly black hole in the sky. This is really the dark side of the moon turned towards us, and surrounding that black patch, stretching millions of miles into space, lies the corona—still, calm, and lovely to behold beyond all words of description.

All nature seems to be sensible to the effect. The sky is dark, it becomes cold, all is hushed. Birds retire to their nests, and beasts seek their lairs. The onlooker gazes at the spectacle in silent awe, while the astronomers devote their attention to their instruments, cameras, and spectroscopes, trying to discover what is the meaning of this corona and of what does it consist.

They know that it shines partly by reflected sunlight, that it is partly composed of dust, but they do not know what substance provides the dust. They also know that the corona contains some gaseous matter of a quality unknown to us on the earth. This gaseous matter is called "coronium," but what it is and what are its properties, physical and chemical, we do not yet know. Some day, perhaps, scientists may discover the secret of this gas, as they did in the case of helium, which was first found in the sun, and years afterwards found by Sir William Ramsay in a mineral from Norway called Cleveite.

TO PHOTOGRAPHERS.

Many a time and oft has the writer been asked by amateur photographers and astronomers: "What can we do by way of photography or observation?" After careful consideration the proper answer to that question is: "First of all make sure that you see all that is to be seen during totality." It is the unique sight of a lifetime, and one may leave the scientific work to the professional astronomers who, sacrificing their own pleasure and interest in the spectacle, devote their prime attention to the manipulation of their instruments.

Nevertheless, the amateur may attempt something. Photographs of the corona may perhaps be obtained, and are worth attempting. The longer the focal length of the lens and the larger the aperture the better. Fast plates should be used, and exposures of one to five seconds given—longer exposures should not be attempted with fixed cameras because the sun and moon are continuously moving.

Whatever the diameter of the sun or moon image may be in the camera, that image will move through one-tenth of its own diameter in 12 seconds. Consequently, the exposure for a fixed camera should be much less than 12 seconds. A fleecy cloud, lighted by a half-moon, is approximately as bright as the corona, and may thus serve as some guide to the time of exposure.

SKETCHING THE CORONA.

The form of the corona is always changing, and depends in some way on the number and activity of the sun spots. Without sacrificing anything of interest, the amateur may attempt a rapid outline sketch of the shape and extent of the corona. For this purpose a small circle, say about 1 in. or 1 1/2 in. in diameter, should be drawn on a piece of card, with marks on the card for future identification of top and bottom. This circle would represent the black moon, and round it may be rapidly sketched the shape of the corona.

The card with the circle should be made ready beforehand, so that no time may be lost during those few critical seconds.

If the sky be clear some stars may be looked for. Castor and Pollux to the left of the sun, Aldebaran and Betelgeuse to the right, and Capella above. Moreover, it is by no means impossible that some unknown comet may be seen in the neighbourhood of the sun.

But what if the weather be bad and the sky clouded over? Even then we may see something of interest in the gathering and passing away of the unwonted gloom, and the sudden darkening of the clouds may be seen as the shadow of the moon races across them.

Should it unfortunately be overcast, we may console ourselves by remembering that astronomers have not infrequently travelled thousands of miles and spent months in preparations, only to be balked in the end by clouds and bad weather. It is certainly right to be prepared, as nothing could be more disappointing than to omit all preparation, and when it is

seasons comes about, but we are utterly ignorant as to the reasons for "good" or "bad" seasons for our crops, travels, and pleasures. Were it possible to predict even the general quality of the seasons beforehand an immense advance in useful knowledge would have been made.

Every increase in our knowledge of the sun's activities is a step nearer to our being able to predict the weather for long periods in advance. The form of the sun's corona has some relationship to the number of positions of the sun spots. What is the precise relationship is not known. The corona takes different shapes

at different times, and those shapes are in some fashion determined by the activities of the sun's various radiations, which control many of our vital conditions on this earth by their actions on its atmosphere, perhaps mainly in its higher regions.

THE PROBLEM OF MATTER.

The problem of the ultimate constitution of matter is being attacked by scientists from one side by means of their observations of the corona. The great question at present is—What are the atoms of matter made of? Are the atoms of the various elements all built

up of some one and the same primary "stuff"? If so, what are the particular structures which bring about the different chemical and physical characters of the elements?

Why, for instance, does iron differ from lead or from gold, if they are all made of the same primary "stuff"? Are they all made up of those particles of electricity which have been given the name "electrons," and why, and how do their glowing gases give out light, and how is light transmitted to us from the sun?

We say, glibly enough, that the ether of space transmits light from the sun and stars to us, but how does it transmit light? Does

any medium even exist to carry the name "ether"? That is certainly doubtful, or, at any rate, unproved.

All those questions have connection with the study of the corona, and the instrument which, in the hands of astronomers and physicists, is the most powerful is the spectroscope. With the aid of this instrument astronomers can tell us that the stars are suns constituted like our sun, that they are of widely different temperatures, that they are moving towards or from us with great and varying velocities. Hence some of the reasons for keen study of that glorious spectacle, the total eclipse of the sun.

late learn that the eclipse has been well after all.

LESSONS OF THE ECLIPSE.

Let us consider what makes a total eclipse to be of such great interest. There are two reasons, the first being the spectacle itself, and the second the scientific aspect, which latter has many branches. It is very certain that what are known as the vagaries of the weather are by some means or other determined by the radiations from the sun.

How that comes about we do not know. It is well known how the general sequence of the

Where and How to View the Total Eclipse

CONCLUDING ARTICLE BY MR. G. J. GIBBS, F.R.A.S.



and the most suitable place locality for viewing the eclipse. dotted arrows running across to right give the line of vision the sun. The numbers near each the map indicate the periods of tality in that particular locality is. It will be noted that the se of totality starts at Southport through the neighbourhoods of n, Woodplumpton, Barton and

The circle diagrams in the N.W. and S.E. corners show that the moon will fall short of covering the whole of the sun, and that the remaining uncovered narrow crescent will be at the upper part of the sun for places beyond the line "O" "O" to the north and at the lower part of the sun for places such as Bolton, Bury, &c., beyond the line "O" "O" to the south. It will be preferable to choose positions which lie on the higher grounds, particu-

journey has to be made to a more suitable site it should be in the direction of the larger numbers on the map, i.e., towards the centre line. For instance, one might travel from Poulton to Kirkham, from Lancaster to Scorton or Brock, from Blackburn to Mellor, from Colne to Waddington or Gisburn, or from Burnley to Whalley. Lancaster on one side of the track and Burnley on the other illustrate the utility of the map. From Lancaster it will only

get right into the heart of the shadow, say, to Dolphinholme, where the period of totality is 19 seconds, or Garstang, where it is 21 seconds, as against five at Lancaster. In the same way at Burnley, a journey to Whalley will give a view of the corona for 17½ seconds. All points between the two extreme lines on the map marked "O" "O" will be passed over by the moon's shadow, but as the shadow is not of equal width at every

those places which are near the centre of the space between those lines than it will over places near the edge of its track. It is quite unnecessary to get right on to or even very close to the centre line sites. As much as five or six miles away from the line are, for all practical purposes, as suitable as those on the line. Beyond this distance the number of seconds of totality falls off rapidly, as will be seen by reference to the figures written into the map.

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Penwortham Garden Village.
Over Twenty Freehold Villas; prices from £500 to £1,500. Also Land for Building Purposes, from 100 to 200 acres. Apply, R. Moon, Broughton, Lancs. Phone 808.

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OXFORD, 15-9-h.p., 1924 Model Saloon; recently coach-painted and in very nice condition; numerous extras, balloon tyres; absolutely sound. £135

COWLEY, 11-9-h.p., 1926, 2/5-Seater; painted maroon; small mileage; front wheel brakes, balloon tyres; numerous extras. £115

COWLEY, 11-9-h.p., 1926, 4/5-Seater; cannot be told from new; negligible mileage; front wheel brakes, full equipment. £120

AUSTIN, 12-h.p., 1924, 4/5-Seater; in very good order throughout; one owner; carefully handled since new; mechanically sound; all-weather equipment. £145

VULCAN, 12-h.p., 4/5-Seater, 1927 model; car having covered 400 miles only; painted Saxe Blue, with similar colour genuine leather upholstery; guaranteed appearance as new. £165

SWIFT, 10-h.p., 1924, 4/5-Seater; in very nice order; balloon tyres; recently coach-painted; leather upholstery, all-weather equipment. £110

OXFORD, 1923, 4/5-Seater; in very good order; recently repainted; tyres good; mechanically sound. £90

ROVER, 8-h.p.; the choice of three 2/5-Seaters. Prices £20, £25, and £30

CITROEN, 1925, 7-h.p., 2/5-Seater; balloon tyres; in very nice order throughout; mechanically sound. £65

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MOTORS.

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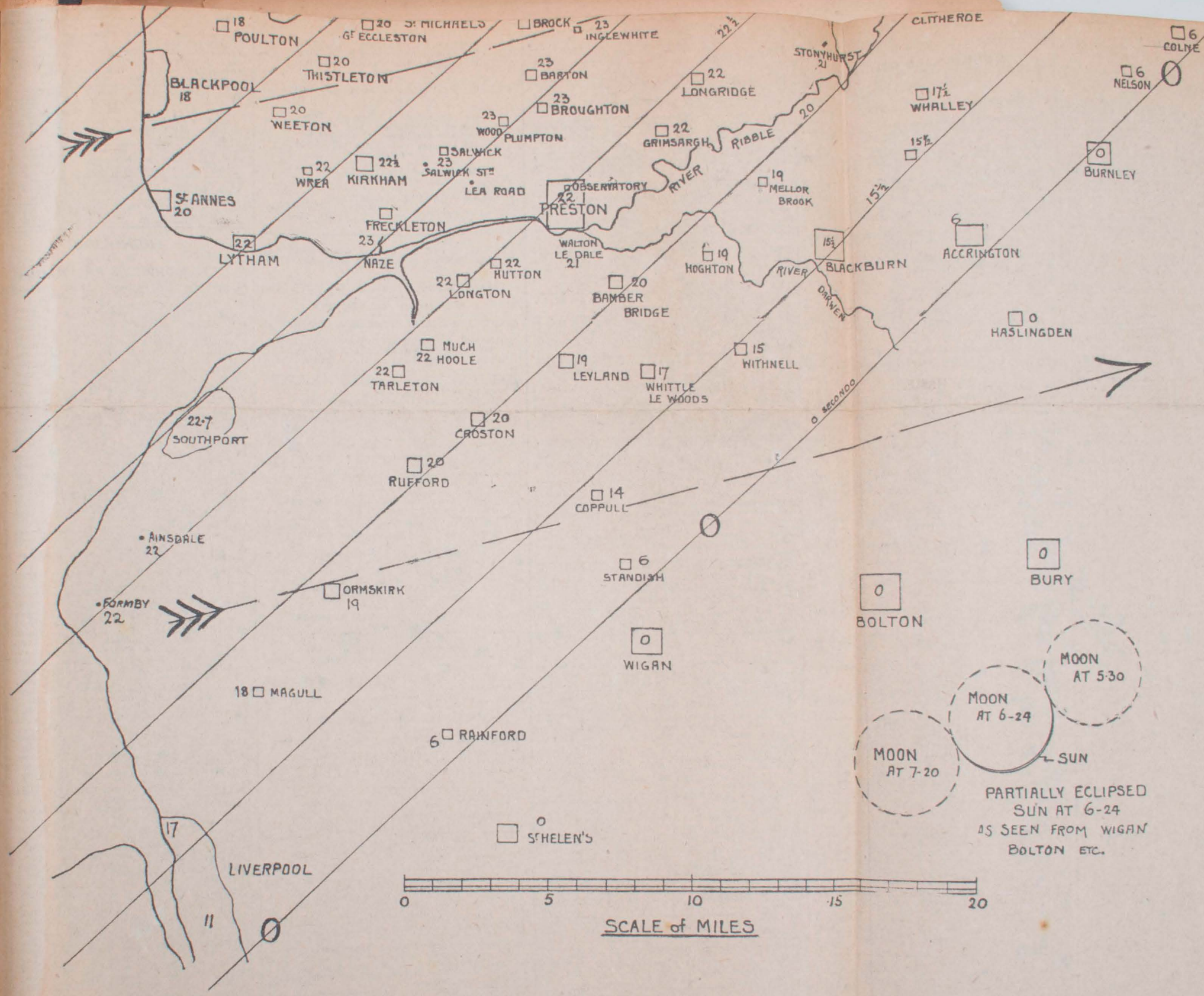
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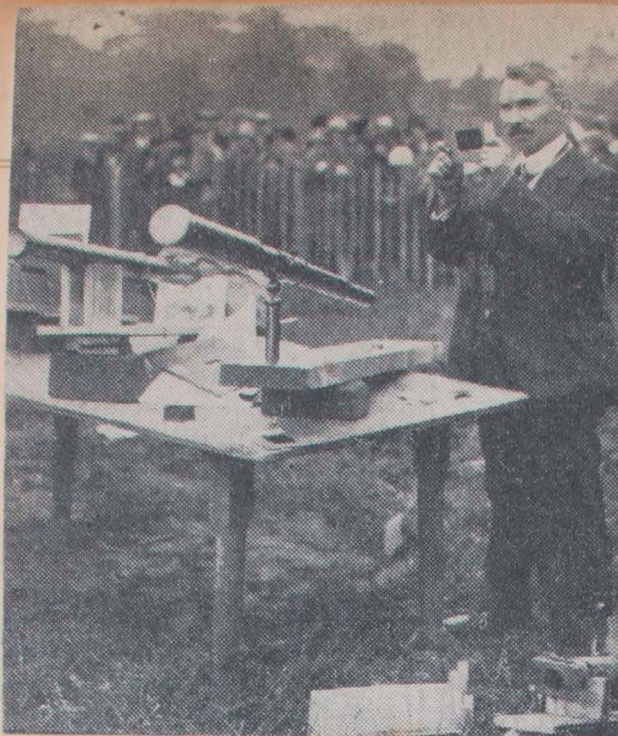
The above map will help intending observers to find the most suitable place in their locality for viewing the eclipse. The long dotted arrows running across from left to right give the line of vision towards the sun. The numbers near each place on the map indicate the periods of actual totality in that particular locality in seconds. It will be noted that the centre line of totality starts at Southport and runs through the neighbourhoods of Freckleton, Woodplumpton, Barton and

Broughton, and on to Giggleswick. The circle diagrams in the N.W. and S.E. corners show that the moon will fall short of covering the whole of the sun, and that the remaining uncovered narrow crescent will be at the upper part of the sun for places beyond the line "O" "O" to the north and at the lower part of the sun for places such as Bolton, Bury, &c., beyond the line "O" "O" to the south. It will be preferable to choose positions which lie on the higher grounds, particu-

larly in the Fylde district, and if any journey has to be made to a more suitable site it should be in the direction of the larger numbers on the map, i.e., towards the centre line. For instance, one might travel from Poulton to Kirkham, from Lancaster to Scorton or Brock, from Blackburn to Mellor, from Colne to Waddington or Gisburn, or from Burnley to Whalley. Lancaster on one side of the track and Burnley on the other illustrate the utility of the map. From Lancaster it will only

be necessary to travel a few miles south to get right into the heart of the shadow, say, to Dolphinholme, where the period of totality is 19 seconds, or Garstang, where it is 21 seconds, as against five at Lancaster. In the same way at Burnley, a journey to Whalley will give a view of the corona for 17 1/2 seconds. All points between the two extreme lines on the map marked "O" "O" will be passed over by the moon's shadow, but as the shadow is not of equal width at every

part it will take a longer time to pass over those places which are near the centre of the space between those lines than it will over places near the edge of its track. It is quite unnecessary to get right on to or even very close to the centre line sites. As much as five or six miles away from the line are, for all practical purposes, as suitable as those on the line. Beyond this distance the number of seconds of totality falls off rapidly, as will be seen by reference to the figures written into the map.



G.J.G.



THOMAS

INGLIS & BLACKBURN

*Invited from London in the evening
Stayed at the Observatory all night
after the eclipse*



A section of the huge Crowd, estimated at about 30,000 people, who assembled on Moor Park, Preston, to witness the Eclipse.
Photo: "The Preston Guardian."

PRESTON FAVOURED.

SIGHTSEERS ON MOOR PARK ESTIMATED AT 30,000.

Preston and the surrounding district, in spite of the gloomiest of forecasts, were granted a magnificent view of Wednesday's eclipse, although in some instances the actual period of totality was marred by a cloudy haze. One of

the pleasantest surprises of the morning was the multiplicity of points in Preston from which a clear view of the phenomenon was obtainable. People just opened their front doors or stepped out in the garden, and there was the eclipse all ready at hand.

Most people, however, pinned their faith to the parks, open spaces, and high ground, with Moor Park and Longridge firm favourites. As early as four o'clock the main roads were as congested with traffic as on a Sunday or Bank Holiday, while crowds of people were making

their way on foot to various vantage points. By the time the first contact became perceptible—at 5.20—it was estimated that, including the many hundreds of school children, there were fully 30,000 to 40,000 persons watching the spectacle from Moor Park.

Mr. G. J. Gibbs, the hon. curator of Preston Observatory, was quite satisfied with the observations made at the new observatory, and said those who had stayed up with him all night were repaid for their trouble.

Describing the eclipse, Mr. Gibbs said: "The hazy sky and clouds which drifted over the sun just before totality prevented the past view which makes the total eclipse so impressive, because it was practically impossible to see anything of the corona. Up to that point, whilst the sun was seen in a somewhat hazy sky, yet very clear views of the partially eclipsed sun could be seen."

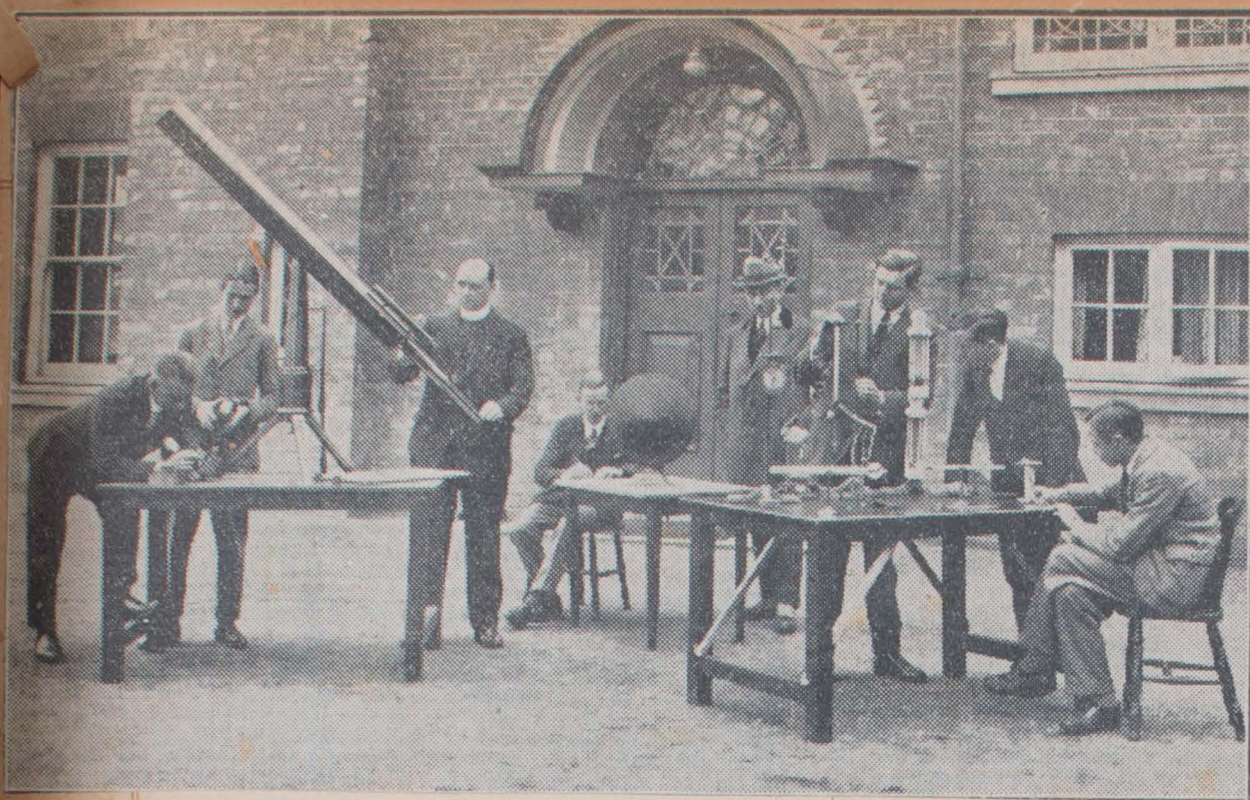
Mr. Gibbs said the quantity of light and the haze obscured the form of the corona, but sketches had been made by his assistants.

Asked about the period of totality, Mr. Gibbs said it was not timed, but it appeared to be considerably less than the time predicted. "It is not unusual," he said, "for it to be a little different from the predicted time."

Mr. Gibbs added that the wind was in the South and a cloud was blown across the sun just about the time of totality. "I watched the race between the cloud and time for totality all along, and the cloud just won," said Mr. Gibbs.

OBSERVATIONS FROM BALLOON.

For the purpose of photographing the eclipse a balloon carrying an aeronaut, a photographer, and a journalist left the Preston Gas Company's yard off Geoffrey-street at 5.50 on Wednesday morning, and as it soared it passed to the north-east. Capt. Boothby, of the Airship Club of Great Britain, was in charge of the trip. The balloon eventually came to earth at Flookborough, on the north of Morecambe Bay.



MR. THOMAS

FROM TOOTAL HEIGHT

The 5,000 enthusiasts who made Tootal Height, Longridge, their objective, had a magnificent reward for their labours, for although the prospects remained very uncertain till after six o'clock, when totality arrived the sun presented a never-to-be-forgotten spectacle.

Just as everyone had begun to despair of seeing actual totality, the wreaths of misty cloud separated and darkness rushed suddenly over the valleys below. From the crowd's elevated position the sight was both awesome and magnificent. Only a minute before Preston and the surrounding countryside could be easily distinguished through the eerie half-light. Then arose a wind, biting cold, and simultaneously came the "black-out," and we were perched between heaven and earth with nothing beneath us except a sea of inky darkness. As the moon's shadow rushed across us the clouds suddenly parted and there was no further need of eye-protectors, for totality had been reached. The 20-odd seconds' experience, the like of which no one on the hill-top would ever know again, seemed to pass in a flash, but all the phenomena which we had been told to expect were there—the corona, the hydrogen flames, and Bailey's Beads.

DISAPPOINTMENT AT STONYHURST.

The Stonyhurst contingent, who made elaborate preparations for recording the eclipse, met with a disappointing experience, for a bank of cloud obscured the sun up to five minutes before totality, when the crescent appeared momentarily, only to be obscured again almost immediately, and the sun remained obscured until the last second of totality, the crescent then reappearing free from cloud and restoring the normal light with astonishing rapidity. If the slow-moving cloud had passed over the sun a few seconds earlier the astronomers would have got a glimpse of the corona.

At Hurst Green and in the nearby fields fine views were obtained.

Giggleswick, where the Astronomer Royal's expedition was encamped, had the best view of Wednesday morning's total eclipse. Watchers at the various points on the totality belt had strange variations of fortune, a mile or two sometimes making the difference between a good view and no view at all. The Welsh end of the totality belt had almost unrelieved bad luck, Southport was moderately fortunate, and at the Hartlepool end of the belt only Sunderland on the fringe was not disappointed.

At Giggleswick Sir Frank Dyson and his colleagues of the Greenwich Observatory were able to take entirely satisfactory records which will be specially invaluable under the circumstances.

Even, however, to those who were denied a sight of the moonlight-like corona and the rose-red flaming chromosphere, the gloom which accompanied the obscuration of the sun was vastly impressive. Dr. Lockyer, who had bitter experiences near Richmond, spoke of the "wondrous gloom" of the total phase, and the play of light and shade which accompanied the development of the eclipse, and the removal of the moon's shadow was remarked in many parts of the line.

Scarcely any observations were possible outside the totality belt. Manchester's sky was beclouded till the shadow had passed. In London and the South the eclipse was attended by rain.

On the centre-line at Southport visibility varied with the difference of a few degrees between observation points, so that the reports of eye-witnesses a mile apart were not unanimous on the success of the spectacle.

A crowd of 50,000 had a good view of the

eclipse from Waddington Fell, an all-night invasion by motorists starting at 6 p.m. on Tuesday. During the exodus the traffic "jam" was so great that hundreds of motorists had to spend 1½ hours in covering 2½ miles. Following their long vigil a number of persons fainted.

Over 250,000, it is estimated, flocked to Southport, but thousands had a great disappointment at Colwyn Bay, where long preparations for observation had been made by astronomers.

"It is the end of the world," screamed a woman on New Brighton front when darkness descended. She rushed back from the front, and many fell back with her.

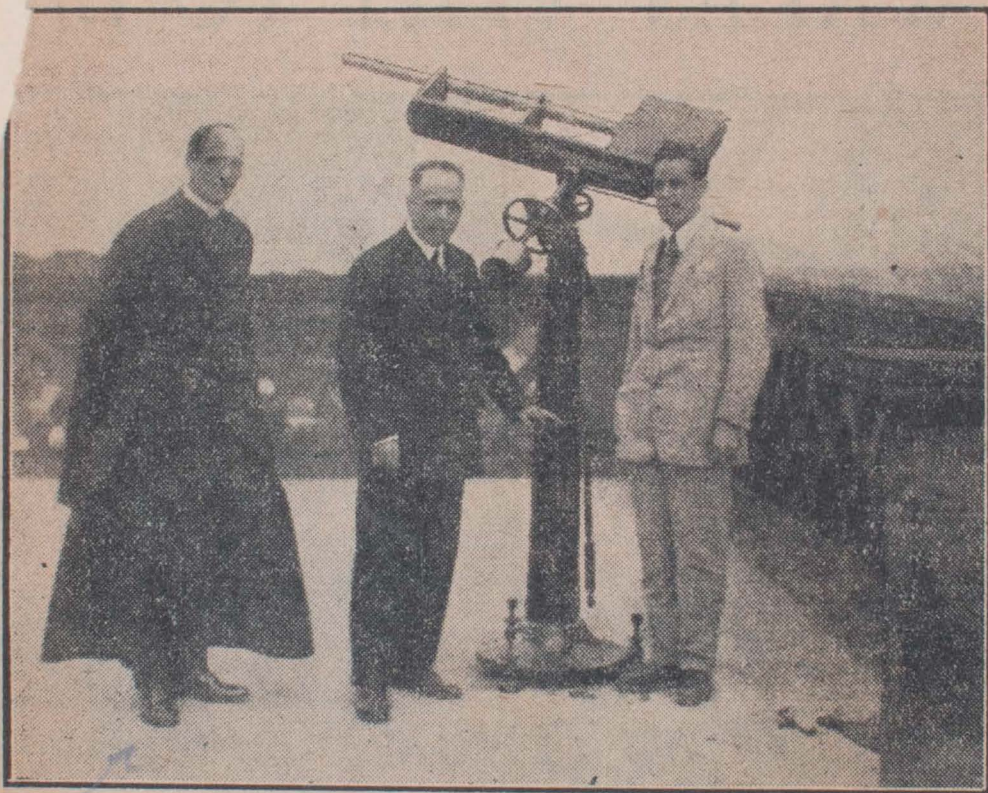
Two elephants belonging to Sanger's Circus, which had been performing at Barmouth, were on the road at the darkest hour. When the sun's face was covered they stopped and refused to move until it became light again.

Splendid views of the eclipse were obtained from the steamer Bickerstaffe, which carried many passengers at Blackpool on an eclipse sea cruise at 4.30 a.m.

Mr. Ramsay MacDonald, who saw the eclipse from Giggleswick, said: "It was the most moving sight I have ever seen."

65
70

KINEMA RECORD OF ECLIPSE.



Father O'Connor, director of Stonyhurst College Observatory, Prof. F. M. Da Sousa Lobo, director of Coimbra University, Portugal, and the latter's assistant, Mr. Madeira, photographed on the roof of Stonyhurst College, from which, with the apparatus shown, it was arranged to make a kinematograph record of the corona.

TELEPHONE: GERRARD 1587.
MESSAGES: REGENT 0291.

2, RYDER STREET,
ST JAMES'S, S.W. 1.

1. VII. 27.

My Dear Mr. Gibbs,

I do want to thank
you for your hospital-
ity & for your kindness in
having me at Preston for
the eclipse. Both Inglis
& I enjoyed our visit very
much indeed. I suppose
any eclipse must be a mem-
orable experience, but this
one would be specially so,
as we seem to have the

been so very fortunate in
comparison with many other
people. You must have
arranged it very well.

I do hope you will regard
the set of thermometers as
a small contribution towards
the expenses of the observation
& to the permanent equipment
of the observatory if they should
be useful.

Everyone was most kind to
us & we feel very indebted
to you & the Society.

With kind regards
Yours very sincerely Charles L. Blackman

