Les travaux sont poursuivis en collaboration avec les laboratoires de physique et de chimie de l'Université. Les étudiants peuvent y préparer leurs thèses.

Sur la proposition de M. Gregory, la Commission est unanimement d'avis d'intensifier son action et de maintenir son activité permanente—entre les Congrès. A cette fin, il est décidé, dès maintenant, que la Commission aura un centre permanent à Paris (à l'Institut d'Optique Théorique et Appliquée) et des centres de correspondance: en Angleterre, M. Gregory; en Europe centrale, M. Nušl; en France, M. Henri Chrétien; en Pays-Bas, M. Van Heel; en Amérique, à désigner (M. Pease (?)).

Le lendemain, mardi 10 juillet, les membres de la Commission ont visité les laboratoires d'optique de la Marine néerlandaise, sous la conduite du Directeur, M. J. F. Sirks.

Résumant les travaux de la Commission des Instruments devant l'Assemblée générale de clôture, M. Fabry a dit, en substance:

La Commission 9 ne présente à l'Assemblée aucune proposition à adopter: son rôle est surtout celui d'information réciproque. Elle émet le vœu de recevoir de ses membres tous renseignements relatifs à l'activité instrumentale de leurs pays et se propose éventuellement de les publier.

Commission 12. (Physique Solaire.)

The President, Dr C. E. St John, opened the first meeting of the Commission, and expressed the wish that the communications and discussions would be as interesting and fruitful as those held at Cambridge in 1925.

He asked Messrs Abetti, Butler and Minnaert to act as Secretaries of the meeting. At his proposal, an Advisory Committee, composed of Messrs Newall, Mitchell and Minnaert, was entrusted with the task of discussing with the President the working programme for the different meetings of the Solar Commission. Professor Brunner, Rev. Father O'Connor and Dr d'Azambuja were added as new members of the Commission. A centre for determining the index of solar activity was formed, composed of Messrs Abetti, d'Azambuja, Butler, Chapman, Evershed, and Rodés. Dr St John stated that this index had been desired by the Solar-Terrestrial Relationships Committee of the International Research Council, in order that geophysicists and others might have the means of investigating any possible correlations between various phenomena. The scheme formulated provided for a preliminary estimate by all observers of the various solar features, spots, faculae, bright calcium flocculi, bright and dark Hα flocculi.

The President then addressed the visitors present, bade them welcome, and expressed the hope that they would freely take part in all the discussions. At the request of the President, the directors of the different centres for solar investigations gave a short account of the work done at their Institutes during the last three years. The following gentlemen successively gave such an account: Rev. Father Rowland and Rev. Father O'Connor (Stonyhurst Obs.), Mr Butler (for Greenwich), Dr St John (Mt Wilson Obs.), Professor Brunner (Zurich), Rev. L. Rodés (Madrid), Professor Abetti (Arcetri), Mr Evershed (Ewhurst), Professor Newall (Cambridge), Professor Deslandres and Dr d'Azambuja (Meudon), Professor Da Costa Lobo (Coïmbra) and Dr Freundlich (Potsdam).

Beautiful spectroheliograms of the sun's disc in the light of an infra-red calcium

line were shown by Mr d'Azambuja and gave rise to an interesting discussion between him and Mr J. Evershed.

At the second meeting, held jointly with the Committee of the International Research Council on Terrestrial and Solar Relationships, Dr C. E. St John called the attention of the meeting to the question of the determination of a daily index of solar activity, to be available for solar as well as terrestrial observers, and called upon Professor S. Chapman to open the discussion.

Professor Chapman explained that geophysicists were especially interested in the possible influence of the corpuscular streams which were believed to be emitted by the sun. As the emission of these streams depended on an excess of radiation pressure, the bright portions of the solar surface were of particular importance. Moreover, it seemed that the corpuscular streams were ejected almost normally, and therefore the Index of Activity must refer especially to the central parts of the disc; for this reason it might therefore be best to consider only the circle of radius $R/2$. The determination of an Index number must be made for every Greenwich Day from midnight to midnight, and the results published as soon as possible.

Different observers emphasized the importance of faculae, flocculi, eruptive prominences, etc. Dr Minnaert reported that the H and K lines of calcium in integrated sunlight had been found to vary in width, and that the variations seemed to be correlated to the flocculi.

Professor Simpson thought that it would not be possible to give one single number representing the solar activity as a whole. The phenomena investigated on the earth were very different, and might be influenced by different solar phenomena. He hoped that during the first trials the index numbers would be published for all the separate solar phenomena.

At the third meeting, Dr C. E. St John, President, asked Professor Abetti to read the report of the Sub-Committee on the Determination of an Index for the Solar Activity. (See p. 235 below.) After this had been done, he opened the discussion on the separate points of the Report.

Some members objected to the recommendation that the solar activity numbers should only refer to the "central fuseau", or lune; M. Rodés would rather consider the whole solar disc; M. Minnaert would prefer the central circle.

Another question arose: Should the data of terrestrial magnetism be published also in our solar *Bulletin*? Or would it be best that geophysicists should have their own *Bulletin*? Dr Simpson thought that it was best to avoid delay in the publication, and to separate entirely the solar and the terrestrial phenomena.

The Report of the Sub-Committee was then carried.

The following two subventions were asked for from the Union:

(1) For Professor H. Deslandres, for the Meudon Observatory, £100 per year, for three years, for the publication of charts of solar phenomena, and £25 per year for three years, for the publication of deferred records.

(2) For Professor G. Abetti, for the Arcetri Observatory, £40 per year, for three years, for the continuation of the *Immagini*, and £20 per year, for three years, for the publication of deferred records from 1911–1922. (Particulars on p. 76.)

It was also agreed that all synoptic maps of the sun should agree on the zero point, assuming the prime meridian and rotation period of Carrington, and not according to Spörer. Professor Brunner promised that the Observatory at Zurich

would do so from the beginning of next year (1929). This proposition of Professor Deslandres was adopted.

At the fourth meeting, Dr St John, President, opened the discussion on the Report concerning the observation of solar eclipses.

Professor Slocum (Van Vleck Observatory, Middletown, Conn., U.S.A.), from meteorological observations made at about 100 stations along the path of totality of the eclipse of August 31, 1932, reported the results for 1925, 1926, 1927.

The mean percentage of clear sky for the hour of totality for the last two weeks of August and first two weeks of September comes out as follows: for Canada, 41 per cent.; northern New Hampshire, 40 per cent.; Coast of Maine, New Hampshire and Massachusetts, 42 per cent.; Cape Cod, Mass., 49 per cent. Full details of all results will be published as soon as possible after September 1931.

Dr Lockyer had received photographs of an island in the Pacific, suited for the observation of the eclipse of 1930. He would transmit them to Lt-Col. Stratton, who would communicate them to other parties interested in the observation of that eclipse.

Professor Brown insisted upon the importance, for the theory of the moon, of determining the exact path of the eclipse-shadow. It is more important to have a great number on different spots than a few very exact observers.

Dr Minnaert wished that measures of the total solar radiation should be made, not during the whole partial phase, but especially during the last minute before, and the first minute after totality. Such observations were very important, as they gave the best determination for the brightness at the extreme limb of the sun. A motion on this question was carried.

Mr Butler mentions that for the next eclipse, the wireless time signals of Rugby could be heard all over the world with a three-valve apparatus.

Dr St John proposed that the spectroheliographic data, obtained shortly before the eclipse, on the positions of prominences, should be sent out by wireless.

The following resolutions were carried:

(1) That bodies responsible for organizing eclipse expeditions be urged to co-operate by circulating freely early information as to proposed plans, and after the eclipse as to experiments that have not been carried out successfully.

If such information is sent to the Director of the eclipse centre he will circulate it to all the observing parties.

(2) That with a view to spectrophotometry of eclipse spectra in the ultra-violet, steps be taken to ascertain the distribution of the sun's continuous radiation as far as possible towards the ultra-violet.

(3) It is desirable that every eclipse plate have impressed upon it standard squares for photometric purposes, made by a source of light of known absolute intensity.

A proposal concerning the photography of the corona with a standard lens was referred back to the eclipse centre.

Dr St John emphasized the importance of determining the wave-lengths in the spectra of rare earths, and the condition of excitation of their lines. The investigation of these spectra was recommended to Commissions 14 and 29.

At the fifth meeting, Dr St John, President, called on several members to give a short account of their theoretical work and its bearing on the introduction of new observations.

Professor E. A. Milne said that the theoretical investigation of solar problems required spectrophotometric observation of (1) the sun's continuous spectrum; (2) the sun's absorption line spectrum; (3) the bright line flash spectrum. In regard to (1) and (2) the fundamental desideratum was a complete spectrophotometric map, made with the same instrument with large dispersion, from the infra-red to the ultra-violet, for the centre of the disc and for a number of places between the centre and limb. Absorption line contours would furnish the total absorption in the line and the central residual intensity. The former, added for all lines, permitted the determination of true temperature. The latter, or rather its variation from limb to limb, permitted the ascertainment of how far monochromatic radiative equilibrium held, as pointed out by Schwarzschild. This drawing in of an undisturbed continuous background in the neighbourhood of an absorption line or group of lines was partly a matter of convention; it should be carried out in relation to a particular model of the solar atmosphere, any particular background corresponding to the selection of a particular depth in each wave-length. Whether these depths correspond to some physical feature could only be ascertained by comparing results for different points between centre and limb. The transition at the limb from a dark line to a bright line spectrum was of great interest. This required data which would permit the construction in principle of a three-dimensional model in which the co-ordinates were (1) wavelength; (2) distance from limb (positive or negative); (3) intensity.

Study of the resulting surface would permit progress in the problem of the fit of the chromosphere on to the underlying layers.

Dr Minnaert stated that our knowledge on the intensities of Fraunhofer lines was progressing in three consecutive stages; (1) from laboratory measurements and from theoretical physics the emission and absorption of the different lines of an element must be deduced for a small element of volume of the gas; (2) by theoretical considerations, the influence must be calculated of the very thick layer of gas through which we were observing the sun, and the extent to which the intensities and contours of the lines were modified thereby; (3) the results found by (2) must be compared with the observed line contours. As to (1) we had the well-known multiplet rules giving the intensities of the lines in a multiplet; moreover the theory of Schrödinger gave the intensities of the lines in a series for hydrogen, and with some modification for the alkali metals. But the relative intensities were not known in multiplets where the azimuthal quantum number changed by 2, nor in inter-combinations; the intensities in the different series compared with each other were unknown, and so were the relative intensities of singlets and triplets in *He*, *Ca*, etc. Moreover, even the simple multiplet rules did not seem to be generally valid; at Utrecht exceptions were found in spectra of complicated atoms (*Fe*, *Ni*, *Co*), and in the higher terms of the principal series of alkali elements. Much work of direct astrophysical interest was to be done in that respect by theoretical and experimental physicists. As to (3) the observational methods were steadily progressing. They must endeavour to determine not only the residual intensity, or the half-width, but the whole contour of the Fraunhofer lines; for the faint lines, however, the determination of the total energy absorbed was the only possible point, and this was important. In selecting the lines to be measured, they must take first the lines connected by the theory of spectra, *e.g.* components of the same multiplets, term series, triplets, singlets, etc. The true residual intensity in the H and K lines must be determined between the reversals H_2 and K_2 with a high dispersion. For progress in this field

of research the photometric methods must be studied further, and especially an investigation should be made into photographic developing effects.

Dr E. F. Freundlich pointed out that photometric work on the Fraunhofer lines at the Einstein Observatory was developing in the direction wished. Especially a paper by Unsöld, that would be published in the course of the following month, dealt with the problem of the residual intensity at the centre of the lines, working out a theory based on the combined influence of resonance, scattering and influence of collisions. The observations, comparing the residual intensity at the centre of the sun and the limb, were in good agreement with the theoretical results, although the residual intensity led to much higher pressures in the chromosphere, than was to be expected on Milne's theory. It was to be presumed that lines emitted by atoms of high atomic volume and having a high transition probability, would be more affected by collisions than other lines originating at low levels; the observations pointed in this direction.

Dr Freundlich mentioned further that Dr v. Klüber had been checking his results on the intensity of the Fraunhofer lines, formerly obtained with the large plane-grating, by using a prism-spectrograph of high resolving power. The results of this comparison obtained with grating and prisms would be printed soon.

A resolution was passed urging on the Dutch and Australian Governments the importance of observing the total solar eclipse of May 9, 1929. It was pointed out that in the case of Australia Mr Merfield was already in possession of the necessary instruments.

Professor G. Abetti reported that Mr Bosler had installed a spectroheliograph at the Marseilles Observatory, and that he would join the solar observation centre in co-operation with Kodaikanal for prominence areas at the limb.

Professor G. Abetti also reported his agreement with the observations of Dr Jimenez, indicating that determinations of the height of the chromosphere with radial slit on the Hα line showed evidence of change with the solar cycle, and suggested the continuance of the observations.

Report of the Sub-Committee appointed by Commission 12 to prepare a scheme for the assignment of solar character figures to each Greenwich day

(*a*) It is desired to have a simple character figure for various solar phenomena referring to each Greenwich day from midnight to midnight for the purpose of examining the relationship between terrestrial phenomena which appear to depend upon corpuscular emissions projected from the sun in limited streams.

Hence the figures should refer to the state of the sun's surface which at, or about noon, on each Greenwich day is situated between meridians lying 30° on either side of the central meridian of the sun.

(*b*) It is recommended that character figures be assigned for each of the following solar characteristics:

(1) Relative sun-spot numbers, assigned on the same lines as for the Wolf numbers, except for the limitation to the central sector of the sun's disc. (Zurich centre, Stonyhurst, Greenwich.)

(2) The Calcium Flocculi. (Cambridge, Meudon, Mt Wilson, Ewhurst, Kodaikanal, Ebro, Coïmbra, Madrid.)

(3) The bright Hα Flocculi. (Arcetri, Meudon, Mt Wilson, Ewhurst, Kodaikanal, Coïmbra, Madrid, Cambridge.)

(4) The dark Hα Flocculi. (Arcetri, Meudon, Mt Wilson, Ewhurst, Kodaikanal, Coïmbra, Madrid, Cambridge.)

The character figures for phenomena (2, 3, 4) should be assigned on a scale of numbers 0, 1, 2, 3, 4, 5. The numbers should refer to the *area* and *intensity* of the flocculi, 0 representing absence or rarity of flocculi, and 5 extreme abundance and intensity.

(*c*) On days when any of the phenomena (2, 3, 4) show unusual features, such as great activity of change or unusual brilliancy, this should be indicated by a special footnote.

(*d*) It is recommended that character figures should be published quarterly or bimonthly for a period beginning from January, 1928, by the Observatoire Fédéral, Zurich (Director, Professor W. Brunner) in a special *Bulletin*.

(*e*) It is recommended, as a matter of convenience, that this *Bulletin* should give for each Greenwich day, in addition to the above character figures referring to a limited sector of the sun's disc, the following solar numbers referring to the whole solar disc:

(5) The Wolf relative sun-spot numbers.

(6) The intensity of the ultra-violet radiation as measured at Mt Wilson.

(7) The solar constant as measured by the Astrophysical Observatory of the Smithsonian Institution.

G. ABETTI, *Chairman*
W. BRUNNER
C. P. BUTLER
S. CHAPMAN
L. D'AZAMBUJA
J. EVERSHED
M. MINNAERT
L. RODÉS.

Commission 14. (LONGUEURS D'ONDE.)

In the absence of Mr Babcock, President, Professor Fowler acted as Chairman and requested Dr Meggers to act as Secretary.

The Commission held two meetings and discussed the Draft Report. Various corrections and additions were made, and the provisional recommendations were voted upon.

On the proposal of Professor Fabry and M. Buisson, the third line of the Report, p. 77, was amended by substituting for "defined the metre in terms of this standard", the statement, "adopted a relation between this standard and the metre".

Professor Fowler explained the present position with respect to the primary standard and suggested that no action be taken until the International Committee on Weights and Measures has had an opportunity to reconsider the specifications adopted provisionally in September 1927. These specifications appear to have been inadvertently based upon the Draft Report of Commission 14 in 1925 (*Trans. I.A.U.* **2**, 47) and not upon the final recommendation of the Commission (pp. 188, 232). It was accordingly decided to omit recommendation No. 1 (p. 84) of the Draft Report.