10. COMMISSION DES TACHES SOLAIRES ET DES FIGURES CARACTÉRISTIQUES SOLAIRES

PRÉSIDENT: M. W. BRUNNER, *Observatoire Astronomique Fédéral, Zürich, Switzerland.*

MEMBRES: MM. Abetti, Butler, Chapman, d'Azambuja, Dufay, Evershed, Favaro, Newall, Newton, Nicholson, Perepelkin, Pettit, Rodés, Rowland, Royds, Sekiguti, Sotome, Yamamoto.

SUGGESTED AGENDA

I. IMPROVEMENT OF THE SCALE FOR THE CHARACTER FIGURES OF BRIGHT AND DARK HYDROGEN FLOCCULI AND CALCIUM FLOCCULI

(*a*) *Subdivision of the Scale*

Mr Royds writes: "The original scheme for daily character figures called for integers ranging from 0–5 to characterise the solar activity for bright and dark flocculi. Since then it has appeared to some observatories to be desirable, particularly as the spot cycle has approached its minimum, to quote character figures intermediate between whole integers. Many observatories have introduced 0·5, 1·5, 2·5, etc., in addition to whole integers, whilst others have also used 0·2, 0·7, 1·2, etc. It seems to me that sufficient experience has now been gained to decide how far this subdivision between whole integers is to be carried. Kodaikanal would be willing to revert to the original proposal of whole integers on the scale 0–5. If it is considered desirable to interpolate half integers, I suggest that whole integers on the scale 0–10 would be easier to print and to read."

(*b*) *Comparison of the spectroheliogram-scale of the different observatories*

Mr d'Azambuja writes: "Sur la proposition faite 1932 à Cambridge (Mass.) l'Observatoire de Meudon a envoyé en octobre 1932 à tous les Observatoires coopérants à la détermination des nombres caractéristiques, des positifs sur papier de la série de spectrohéliogrammes-types formant son échelle pour l'estimation des nombres. Le but de l'envoi était de provoquer des remarques, voire des critiques qui permettraient peut-être, après discussion, de formuler des propositions précises pour l'amélioration des échelles actuellement en usage.

"En fait, autant qu'en témoigne la correspondance échangée, il n'y a pas eu grand'chose à tirer des réponses reçues, en petit nombre d'ailleurs. Le moment est peut-être venu de demander à tous les Observatoires participants d'apporter au Congrès à Paris ou d'envoyer à Zürich des copies de leur spectrohéliogrammes-échelle, de manière qu'une séance pût être consacrée à leur confrontation.

"Il est incontestable que les écarts dans la détermination des nombres caractéristiques sont devenus plus faibles depuis quelque temps entre les différents observateurs. Mais cela ne tient-il pas, au moins en partie, à ce que l'activité demeure toujours voisine de zéro, et des divergences notables ne se manifesteront-elles pas à nouveau quand les plages faculaires et les filaments seront redevenus nombreux? Dès lors, il y aurait, semble-t-il, quelque intérêt à rechercher encore une amélioration des méthodes susceptibles de conduire à un meilleur accord."

The President reminds the members of our Commission that in March 1933 the scale plates of the Mount Wilson Observatory were also sent to all the collaborators of the

bulletin through our Observatory. They have therefore two series of scale plates on hand for comparison with their own.

II. Proposition of Mr Rodès

Mr Rodés writes: "En vue des résultats auxquels ont abouti divers investigateurs en étudiant l'influence de la terre sur l'atmosphère solaire et avec le but de faciliter la vérification de la réalité d'une telle influence, le soussigné a l'honneur de proposer à la commission d'attirer l'attention des centres de Physique Solaire et tout particulièrement de l'Observatoire de Zürich sur l'importance de publier séparément dans les statistiques de taches les données qui se rapportent à chaque hémisphère et aux régions est et ouest du méridien central."

III. Consideration of the Report on the Bulletin

IV. Suggestions and Miscellaneous

REPORTS

1. *Del Ebro* (Rodés):

L'observatoire de l'Ebre a continué à enregistrer photographiquement les taches solaires, à déterminer leurs coordonnées, leur surface individuelle et la surface totale tachée du disque solaire.

Dans les *Resumen Anual* les valeurs moyennes mensuelles et annuelles des surfaces tachées de l'hémisphère nord et sud ont été publiées séparément. Nous nous sommes servis de ces nombres pour étudier la réalité d'une influence de la terre sur les phénomènes de l'atmosphère solaire. Les résultats déduits de ces recherches statistiques feront l'objet d'une communication à la prochaine assemblée de Paris.

Nous avons poursuivi à notre observatoire l'étude des relations entre l'activité solaire et les phénomènes électromagnétiques de notre globe. Nous sommes arrivés à confirmer l'influence exercée par les taches solaires sur la valeur du gradient du potentiel atmosphérique que Bauer avait déjà annoncée.

L'étendue des plages faculaires du calcium qui coïncident avec des taches continue à fournir un nombre indice de l'activité solaire équivalent au nombre relatif de Wolf et qui suit très bien la marche des perturbations du magnétisme terrestre.

De nos observations des taches solaires qui forment dans leur ensemble une série très homogène de 25 années nous n'avions pas pu trouver la moindre corrélation entre les taches, la fréquence des tremblements de terre et la variation des conditions météorologiques locales.

2. *Greenwich* (Newton):

The measurement of positions and areas of sunspots and faculae has been carried out in the usual manner at Greenwich, the series of daily photographs having been completely made up from those taken at Greenwich, the Cape of Good Hope, and Kodaikanal. The *Greenwich Photoheliographic Results* have been published for the years 1931 to 1933. The Naval Observatory, Washington, in co-operation with Harvard, Mount Wilson, Perkins, and Yerkes, has published current measures of positions and areas of sunspots in the *Monthly Weather Review*. The monthly bulletins from the Ebro observatory containing positions and areas of sunspots and bright calcium flocculi, in addition to geophysical data, have been received to March 1934.

At the conclusion of another solar cycle, the recurrent sunspots for the epoch 1924–1933 have been used to determine the period of the Sun's rotation. The value

of the daily sidereal motion so derived is $\xi = 14°{\cdot}37 - 3°{\cdot}0 \sin^2\phi$, where ϕ is the solar latitude. It is of interest to compare the value for this epoch with those derived in the same manner for the four preceding cycles, 1878–1923 (*Greenwich Photoheliographic Results*, 1924, and *Monthly Notices*, **95**, 60, 1934): (i) $14°{\cdot}36 - 2°{\cdot}5 \sin^2\phi$, (ii) $14°{\cdot}39 - 3°{\cdot}0 \sin^2\phi$, (iii) $14°{\cdot}39 - 2°{\cdot}8 \sin^2\phi$, (iv) $14°{\cdot}39 - 2°{\cdot}6 \sin^2\phi$.

The lists of magnetic storms and comparative sunspot data, published in *Greenwich Photoheliographic Results*, 1927, for the epoch 1874 to 1927, have been kept up to date by yearly summaries published in *The Observatory*.

The positions and areas published in the *Greenwich Photoheliographic Results* for 1931–33 have been supplemented by tables giving the measures of radial velocities associated with dark $H\alpha$ flocculi observed near sunspots with the spectrohelioscope at Greenwich.

3. *Mount Wilson* (Nicholson):

There is little to report concerning the work here on character figures of solar phenomena except to say that it was done and reported regularly. My only suggestion would be that a character figure based on very bright $H\alpha$ alone might be useful. This subject may be covered by the observations with the spectrohelioscope which will be reported in the bulletin through Mr d'Azambuja. I think that the publication of character figures should be continued, at least through another solar cycle.

4. *Poulkovo* (Perepelkin):

Since the summer of 1932 systematic photographic observations of solar surface have been carried out at Simeiz and Kharkov Observatories (U.S.S.R.). These observatories give the areas of sunspots and faculae expressed in millionths of the solar hemisphere. Similar observations though visual have been made at Tashkent Observatory. The area of prominences in the $H\alpha$ line was also determined there by visual observations with a spectroscope. Using this material, as well as Simeiz sunplates, the Pulkovo Observatory started to determine the sunspot area for the whole disc and for the central zone, faculae and prominences areas, approximate coordinates and the course of the development of spot groups. Data on magnetic disturbances and the strength of wireless signals are given every month by the Institute of Atmospheric Electricity and Terrestrial Magnetism at Slutsk (Pavlovsk). The Pulkovo Observatory is presently preparing a synoptic map of sunspot groups and faculae for every month on which the geophysical data mentioned are also plotted. All this material will be published in a special bulletin of the Central Geophysical Observatory. At the present time this material is widely used by various Geophysical Institutions.

The study of the spectrograms obtained since 1928 with the three prism spectrograph attached to the 30-inch refractor of the Pulkovo Observatory enabled me to establish the variability of the intensity ratio of the $H\epsilon$ to the [H] line of the prominence spectra*. It was intimated that this variability is due to the change of the extreme ultra-violet radiation, which can probably be referred to small regions in the photosphere. For the period 1928–34 this relative intensity changes from 0·58 to 0·27, which data can serve as a good new index of solar activity having a definite physical sense. These relative intensities give a high correlation coefficient (0·98) with the range of the diurnal change of the magnetic declination†. Un-

* E. J. Perepelkin, *Poulkovo Observatory Circular*, Nos. 9 and 10.
† P. J. Gussev, *Poulkovo Observatory Circular*, No. 10.

fortunately this index can be of use only for the extreme parts of the Sun's disc. Systematic observations of the relative intensities of the $H\epsilon$ and the [H] lines of prominence spectra by some favourably situated observatories, possessing solar spectrographs, would be of value.

5. *Stonyhurst* (Rowland):

The routine work of visual observation of the Sun has been carried out as formerly. Drawings of spots and faculae have been made on all possible occasions, and these have been supplemented by copies of drawings made at Zürich, kindly supplied by Prof. Brunner, for most of the days on which we failed to get an observation. Counts of the numbers of groups and nuclei in the whole visible disc, and in the central zone area of half the disc radius, have been made for each day of observation, and the numbers sent to Zürich for use in the evaluation of the Character Index. The results of measurements of the position and area of all spots have been published in the *Annual Reports* of the observatory.

Regular determinations have been made of the Terrestrial Magnetic Elements, and the continuous photographic records of Declination and Horizontal Force have been maintained. The results have been incorporated in the *Annual Reports*, and magnetic character figures for each day have been supplied quarterly to the International Organisation at De Bilt. Charts showing the excess of magnetic disturbance for each day over the mean for the five quietest days of each month, arranged in 27-day intervals, have been printed in the *Observatory Reports* since 1930, and show numerous sequences of disturbance at approximately 27-day intervals, some of these sequences being of very long duration—up to a year or more. It is noteworthy that in many instances these disturbances are not associated with the presence of spots in the central area of the Sun, whilst, on the other hand, on several occasions notable spot groups have passed the central meridian in circumstances which might lead to the expectation of a disturbance, but none has followed for intervals up to as much as 14 days, when a notable disturbance has occurred with no spots on the visible hemisphere of the Sun. An investigation is in progress with a view to ascertaining whether there is sufficient evidence to establish a definite association between individual spot groups and long-deferred magnetic activity, which would point to the possibility that particles emitted from the Sun with much lower velocities than those hitherto considered may be responsible for terrestrial magnetic disturbances.

6. *Zürich* (Brunner):

The sunspot relative numbers deduced from the observations at Zürich and its station at Arosa have been regularly published as hitherto at the end of each quarter in the *Meteorologische Zeitschrift*, in the *Journal of Terrestrial Magnetism* and in the *Monthly Weather Review*. These numbers are the so-called provisional sunspot numbers. These series are not quite complete as there are gaps here and there in the observations at Zürich and Arosa. The combined results of the Zürich and Arosa observations secured, nevertheless, the sunspot relative numbers of our own for 344, 343 and 343 days respectively for the years 1932–34.

The final sunspot numbers are the result of the Zürich/Arosa observations supplemented by a large number of foreign series, by which all the gaps in the former series are filled and the list made complete. The following observatories have regularly sent us their series: Batavia, Catania, Greenwich/Cape Town, Kiev, Lyon, Roma-Campidoglio, South Hadley, Stonyhurst, Tokyo and Wellington. The

final sunspot numbers for the whole disc and for the central circle zone for the years 1932–34 have been published in our *Astronomische Mitteilungen*, Nos. 129–132, and in the *Bulletin for Character Figures of Solar Phenomena*, Nos. 17–28. Brief remarks as to time and position of new formations of centres of activity, entrances of spot groups and passages of groups through the central meridian are added to these numbers. The series of Zürich daily sunspot numbers are complete, i.e. without gaps, since 1849, the year when Wolf started with his own observations.

In the *Astronomische Mitteilungen* of our observatory synoptic heliographic maps are given again illustrating all the observed spot and faculae centres of activity for the periods of solar rotation in the years 1932–34. From these maps one can see for any moment which centres of activity were on the visible solar hemisphere and what position they had. Further there is attached to these maps a list of coordinates for the spot groups, as well as a short description of the character and of the development of each group.

7. *Report on* Bulletin for Character Figures of Solar Phenomena (Brunner):

The bulletin with daily character figures for spot activity, for calcium flocculi, bright and dark hydrogen flocculi, and for the intensity of ultra-violet radiation has been issued regularly each quarter. Co-operating observatories were: Arcetri-Firenze, Cambridge (England), Catania, Coimbra, del Ebro, Ewhurst (Mr Evershed), Greenwich, Kiev, Kodaikanal, Kyoto-Kwasan, Lyon, Meudon-Paris, Mount Wilson, Roma-Campidoglio, South Hadley, Stonyhurst, Tokyo, Wellington and Zürich. The bulletin has been published from 1928 onwards. Two special volumes, issued 1932 and 1933 respectively, contain the character figures prior to 1928, i.e. for the periods 1917–22 and 1923–28. There are now on hand complete series from 1917–34 with two maxima and two minima. Tables, giving for the years 1917–33 the monthly, quarterly, half-yearly and yearly means of the character figures for the various solar phenomena, for the whole Sun disc as well as for the central circle zone, are added to bulletin No. 24.

The bulletins have been forwarded to a large number of observatories, institutions, laboratories and individual investigators according to a list drawn up in co-operation with the International Unions of Astronomy, Geodesy and Geophysics and Radiotelegraphy.

In the last report presented to the Cambridge meeting the causes of the discrepancies in the figures from the different observatories for the same day were thoroughly discussed. For the period 1931–34 the daily indices for the same day agree much better. This is partly due to more experience in estimating the values, partly also, of course, to the smaller solar activity in years near a minimum. Greater deviations may however be anticipated with the increasing activity. With a view to eliminate them as far as possible and to obtain homogeneous estimates all the co-operating observatories have been asked to bring copies of their spectro-heliogram scales to the Paris meeting for comparison, or to forward them to Zürich (proposal of Mr d'Azambuja, Meudon). I may remind the members that Meudon and Mount Wilson sent their standard scales to all other co-operating stations in November 1932 and February 1933 respectively.

Most of the observatories have introduced half-values 0·5, 1·5, etc., for character figures in addition to whole integers and del Ebro uses even 0·2, 0·7, etc. It will be necessary to decide if and how far this subdivision is to be carried (proposal of Mr Royds). Should it be considered desirable to interpolate half-degrees, Mr Royds suggests whole integers on the scale 0–10. They would be easier to write and to read.

Personally I should prefer to keep the old scale 0–5 and use half-values too. By this method there will be no material break in the continuity of the old scale and character figures for the coming years can be compared with those for 1917–35 without more ado.

The chief purpose of the bulletin is prompt publication of simple and handy indices for the various solar phenomena. As there are now on hand figures for a series of years, the question arises whether they serve their purpose and whether they are of use for solar research, particularly for the relationship between solar and terrestrial phenomena. The fact is that the bulletin is much in demand and that the indices are widely used. From a first investigation made by J. Bartels it resulted, however, that the new solar indices give practically no better correlation with magnetic character figures than the old sunspot numbers and the sunspot areas. Especially the bright $H\alpha$ flocculi indices are so highly correlated with the sunspot numbers, that the former can hardly be expected to give better results in comparison with geophysical phenomena than the latter. In particular, Bartels' M-regions of the Sun, which are so strongly indicated by the twenty-seven day recurrences in magnetic activity and which in many cases cannot be identified with sunspot groups, cannot be associated either with regions showing bright $H\alpha$ flocculi. In appreciating these results one has to consider that Bartels' investigation refers to the period 1928–31 only, and that character figures for the central zone have been taken.

These first results are not very promising, but the work done was certainly not useless. It was simply indispensable to try once with indices of other solar phenomena to get nearer to a solution of the question of the relationship between solar and terrestrial phenomena. It would not be advisable to abandon this attempt too soon. Such series of observations attain their real value only if they are carried on long enough. It is also to be assumed that the character figures of the last few years were and in future will be better and more reliable. The series can also be used for other research work, if they are on hand for sufficiently long periods (comparison of the course of the various solar phenomena during the 11-year cycle, deviations of maxima and minima epochs, etc.).

Since April 1934 the bulletin has also been giving a list of bright hydrogen eruptions observed at the different stations with the spectrohelioscope. Mr d'Azambuja, Meudon-Paris (President of the Commission for Chromospheric Phenomena), is collecting the returns and is sending them to Zürich for publication in the bulletin. This including of the results of the spectrohelioscopic observations will certainly improve the value of the bulletin. It would gain further in value if the daily solar constant figures could also be published in our bulletin in addition to the other character figures of solar phenomena.

W. BRUNNER
President of the Commission